PCX*i*

# Water-Cooled Chillers

## with Rotary Screw Compressors
## 280 to 485 Tons — 60 HZ
## 250 to 440 Tons — 50 HZ


### Features

- Uses HCFC-22 & compatible with HFC refrigerants
- Advanced microcomputer with open protocol
- Most reliable screw compressor on market
- Smaller footprint than centrifugals

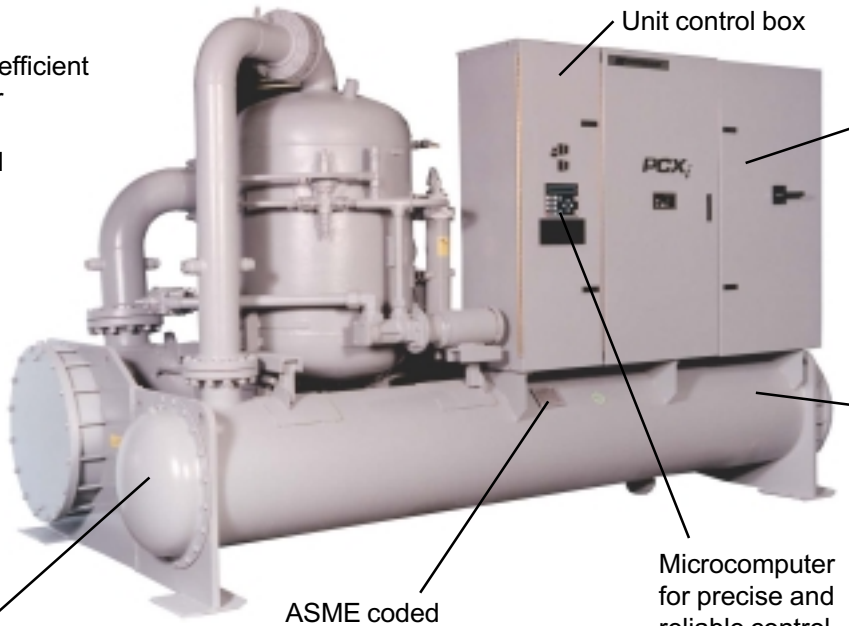
MANUFACTURER CERTIFIED TO ARI AS COMPLYING WITH CERTIFICATION SECTIONS OF ARI STANDARD 550/590 WATER CHILLING PACKAGES USING THE VAPOR COMPRESSION CYCLE ®

DUNHAM-BUSH®

Form No. 6068

# INTRODUCTION

Dunham-Bush's ***PCX$_i$*** water cooled water chiller is the newest addition to a large family of rotary screw chillers follows on the heels of thirty-five years of experience and dedication to rotary screw technological advancements. Dunham-Bush, the world's largest manufacturer of screw compressorized air conditioning, has over 20,000 screw compressor installations worldwide.




# ARI CERTIFICATION

## ARI Certification Program

The performance of Dunham-Bush Water-Cooled R-22 Rotary Screw Water Chillers has been certified by the Air Conditioning and Refrigeration Institute (ARI) in accordance with ARI Standard 550/590-98.

Full load ratings, part load ratings, and water pressure drop data are regularly tested under this certification program. This provides an independent, third party verification of water chiller performance with a laboratory-rated performance test utilizing instrumentation which has calibration traced to the National Bureau of Standards.

The ARI Seal of Certification shows the commitment to quality and to our customer's peace of mind. You will get the industry's standard for efficiency and reliability when you purchase a Dunham-Bush water chiller.

This certification program does not include low temperature applications (Ice Bank) or units utilizing glycol or 50 Hz applications.

## Computer Performance Ratings

Dunham-Bush ***PCX$_i$*** Water-Cooled Rotary Screw Water Chillers are available from 280 to 480 tons. The many combinations of heat exchangers, compressors and motors make it impractical to publish tabular ratings for each combination. A chiller may be custom matched to certain building requirements by your Dunham-Bush Sales Representative utilizing the **electronic catalog** which has ratings certified in accordance with ARI Standard 550/590-98. Data which can be provided to you will include:

- Chiller capacity
- KW Input
- Evaporator and Condenser Water Pressure Drop
- Evaporator and Condenser Tube Water Velocities
- IPLV / NPLV
- Part-Load Performance

Contact your local Dunham-Bush Sales Representative to discuss what Real Solutions Dunham-Bush can offer to solve your chiller selection questions.

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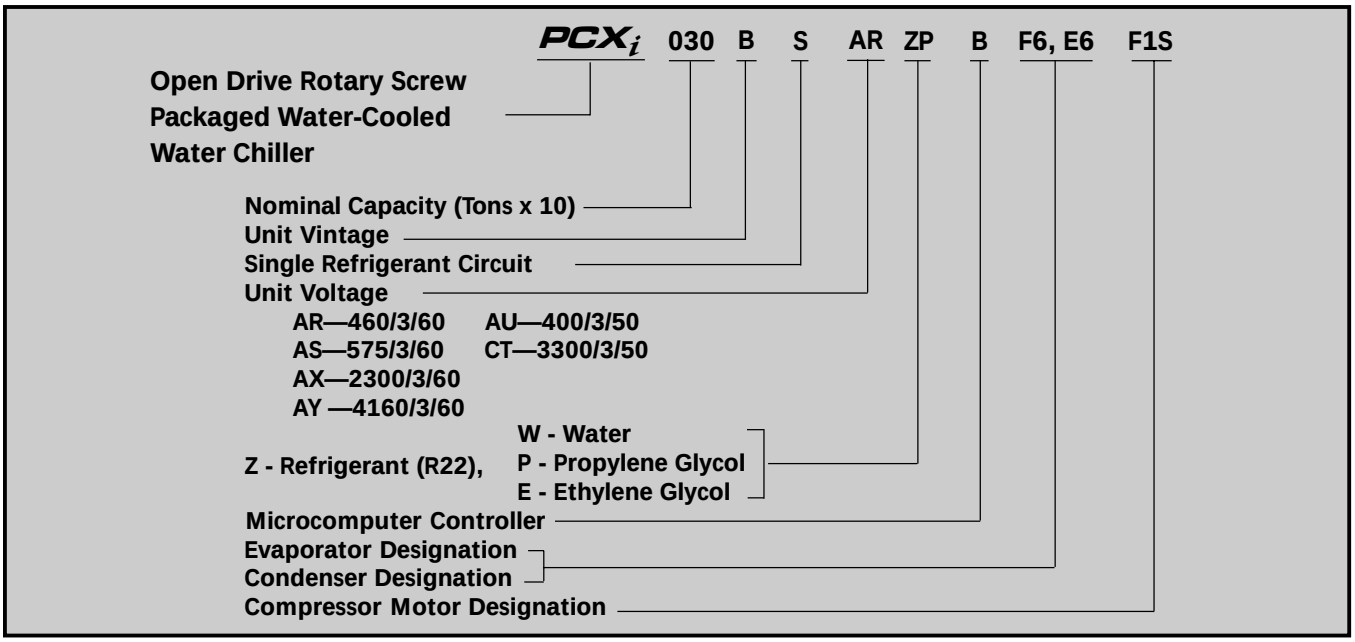
# NOMENCLATURE



# Design Features and Owner Benefits

## Compressor Experience

- Over thirty-five years of rotary screw compressor design technological advancements and field operating experience.
- Innovative design for high reliability has only two rotating parts.
- Industrial grade Dunham-Bush dual-rotor rotary screw compressor with double-acting slide valve for infinite capacity control to match load requirements, down to 20% of full load.
- Many of these compressors have operated 100,000 hours and never been opened, let alone overhauled.
- Insured continuous oil flow to the compressor through an external positive displacement oil pump and high efficiency oil separator.

## Direct Drive Motor

- Open drip-proof squirrel cage motor 3550 RPM - 60 Hz (2950 RPM - 50 Hz) with 115% service factor, factory mounted and aligned.

## Cooler and Condenser Vessels

- Shell and tube vessel construction with individually replaceable tubes.
- Standard vessel tubes are copper; copper-nickel tubes available as an option.
- Standard vessel water connections are victaulic; flanged connections available as an option.
- Marine water boxes are available as an option.
- The cooler has a single spring-loaded relief valve.
- The condenser has dual spring-loaded relief valves mounted on a three-way selector valve.
- One, two, or three-pass coolers and two-pass condensers for flexibility in design.
- Condenser sized to hold a full refrigerant charge; pumpout is not required.

## Refrigerant Piping

- The compressor is equipped with a discharge line check valve. The refrigerant charge can be isolated by closing the liquid line ball valve and pumping the entire charge into the condenser.
- The cooler liquid level is maintained by the microcomputer controller.
- Replaceable core liquid line filter-drier and sight glass/moisture indicator are standard.

## Refrigerant Compatibility

- Designed to operate with environmentally safe and economically smart HCFC-22 with proven efficiency and reliability.
- Consult factory for use with new HFC refrigerants.

## Energy Efficiency

- Designed to provide the greatest amount of cooling for the least kilowatt input over the entire operating range of your building, with excellent kW per ton and IPLV/NPLV ratings.
- Delivers outstanding efficiency and considerable energy savings through the use of microcomputer controlled, infinite dual-acting slide valve unloading of the Dunham-Bush screw compressor, leaving chilled water control, coupled with the building load profile, provides for superior operating system efficiency.

# DESIGN FEATURES AND OWNER BENEFITS (CONT.)

## Energy Efficiency (cont.)

- High efficiency oil separator insures removal of oil carry over in the discharge gas flow which maintains the heat exchangers at their maximum efficiency at both full and part load.
- Rating certified by ARI Standard 550/590-98 “Water Chilling Packages Using the Vapor Compression Cycle”.
- Meets or exceeds ASHRAE Standard 90.1 Energy Efficiency Code.

## Installation Ease

- The ***PCX$_i$*** has a smaller footprint than comparable centrifugal chillers and takes up less equipment room space.
- Small size makes the ***PCX$_i$*** ideal for retrofit when it comes time to change out obsolete CFC chillers or absorption units.
- Units shipped completely factory tested, charged and adjusted for ease of installation with minimal field start-up adjustments.

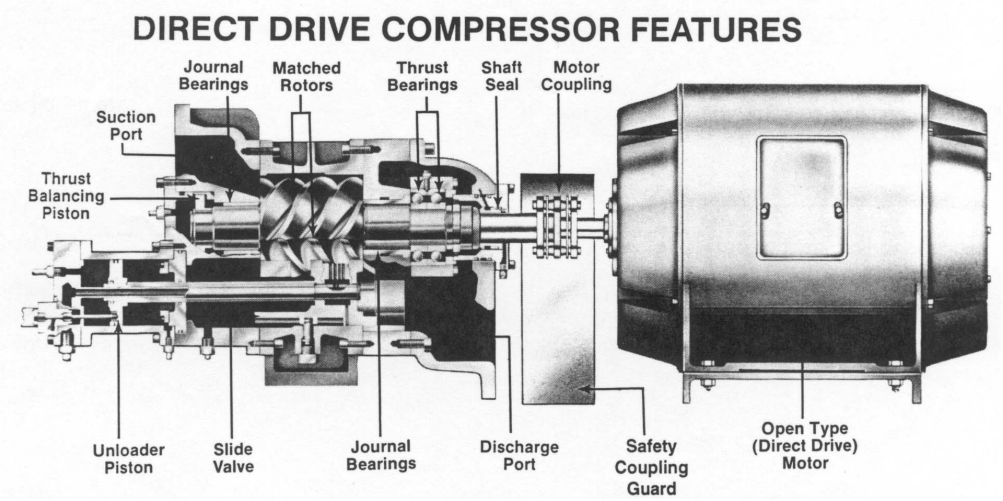
## Safety Code Compliance

- ASME Boiler and Pressure Vessel Code, Section VIII Division 1 “Unfired Pressure Vessels”.
- ASME Standard B31.5 Refrigerant Piping.
- ASHRAE Standard 15 Safety Code for Mechanical Refrigeration.
- Underwriters Laboratories Standard UL508 Industrial Control Panels.
- ETL/CSA and MEA unit listing pending.

## Control Flexibility

- Microcomputer-based with DDC (direct digital control) features precise push button control over every aspect of operation with built-in standard features that allow extra energy savings on start-up and throughout the life of the equipment.
- Insured optimum energy efficiency through microcomputer controls which utilize pressure transducers to measure evaporator and condenser pressure.
- Microcomputer control of cooler leaving water temperature to ±1/2 to 3/4°F (.28 to .42°C) via special control logic that monitors temperature derivative.
- Microcomputer monitors discharge pressure, discharge temperature and cooler refrigerant level to optimize unit performance.
- Lower energy costs resulting from automatic load monitoring.
- Monitoring your chiller’s key functions from a remote location with a phone modem.
- Proactive control by the microcomputer anticipates problems and takes corrective action before they occur. Controls will unload compressor if discharge or suction pressure, and/or compressor motor amps, approach limits. This allows the unit to stay on line. When operating in the proactive caution mode, the microcomputer will provide an output via contact closure for field use as required.
- Chilled water reset and demand limiting from the unit control panel, or by external signal from the building automation system.
- High oil temperature, high oil sump temperature, low oil pressure, freeze potential, low suction pressure, high discharge pressure, and solid state motor overload protection are all standard features.
- Condenser water pump control for low water temperature starting.

# UNIT FEATURES: COMPRESSOR




**Compressor Assembly**
The Dunham-Bush rotary Compressor is a positive displacement helical-axial design for use with high pressure refrigerants.

- The compressor consists of two intermeshing helical grooved rotors in a stationary housing with suction and discharge gas ports.
- Uniform gas flow, even torque and positive displacement, all provided by pure rotary motion, contribute to vibration-free operation over a wide range of operating conditions. Intake and discharge cycles overlap effectively, producing a smooth, continuous flow of gas.

**Simplified Capacity Control**
The slide valve mechanism for capacity modulation and part load operation is an outstanding feature:

- Slide valve unloading provides the most efficient part load unloading of any type of screw compressor unloading.
- Moving parts are simple, rugged and trouble free. The slide mechanism is hydrostatically supported with aid from a pressurized oil supply.
- Package capacity reduction can be as low as 20% without HGBP by progressive movement of the slide valve away from is stop.
- Capacity reduction is programmed by an exclusive electronically initiated, hydraulically actuated control arrangement.
- Any degree of part-load capacity at any head condition can be accepted without duress for any period of time. The screw compressor actually operates cooler at partload conditions.

**Thrust Bearings**
Each rotor is fitted with a pair of preloaded, duplex mounted angular contact thrust bearings.

These bearings are designed to safely carry thrust in either direction at or near zero thrust loads. Additionally the bearing races are mechanically locked to assure that outer race rotation does not occur.

Through the use of hydraulic counterbalance arrangements, the thrust bearings carry only a small portion of the total thrust generated. This combined system for carrying the thrust load is not affected by emergencies such as power outage, low oil pressure trip-out or similar incidents.

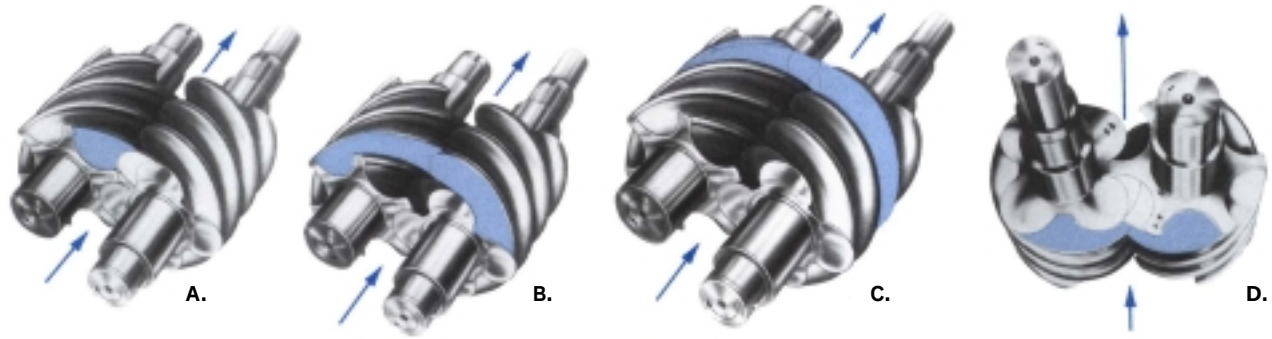
**Main Journal Bearings**
Heavy duty, steel backed, field replaceable/serviceable bearings are conservatively loaded even at maximum operating conditions. These bearings are center fed and supplied with lubricant by an independently driven oil pump. Start-up lubrication is provided and "coast down" lubrication is not required as the screw compressor stops within a matter of seconds.

**Rotors**
The latest Dunham-Bush patented asymmetrical design rotor profiles assure operation at highest efficiencies. Rotors are precision machined from AISI 1141 bar stock and dynamically balanced.

**Castings**
Castings are manufactured with high grade, high density cast iron, externally ribbed for structural stability and efficient heat dissipation. Also, the cast iron provides a high degree of noise reduction.

**Shaft Seal**
A bellows type balanced shaft seal effectively seals the drive rotor and provides a long operating life.

# UNIT FEATURES: COMPRESSOR (CONT.)




**Compressor Operation**

Note: For clarity reasons, the following account of the compressor operation will be limited to one lobe on the male rotor and one interlobe space on the female rotor. In actual operation, as the rotors revolve, all of the male lobes and female interlobe spaces interact similarly with resulting uniform, non-pulsating gas flow.

**Suction Phase**

As a lobe of the male rotor begins to unmesh from an interlobe space in the female rotor, a void is created and gas is drawn in tangentially through the inlet port - Fig. A. As the rotors continue to turn, the interlobe space increases in size - Fig. B, and gas flows continuously into the compressor. Before the point at which the interlobe space leaves the inlet port, the entire length of the interlobe space is completely filled with drawn-in gas - Fig. C.

**Compression Phase**

As rotation continues, the gas in the interlobe space is carried circumferentially around the compressor housing. Further rotation meshes a male lobe with the interlobe space on the suction end and squeezes (compresses) the gas in the direction of the discharge port. Thus the occupied volume of the trapped gas within the interlobe space is decreased and the gas pressure consequently increased.

**Discharge Phase**

At a point determined by the designed "built-in" volume ratio, the discharge port is uncovered and the compressed gas is discharged by further meshing of the lobe and interlobe space - Fig. D. While the meshing point of a pair of lobes is moving axially, the next charge is being drawn into the unmeshed portion and the working phases of the compressor cycle are repeated.

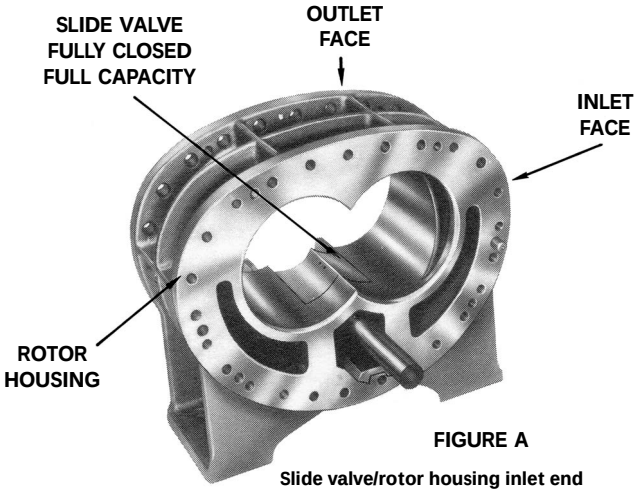



FIGURE A

Slide valve/rotor housing inlet end

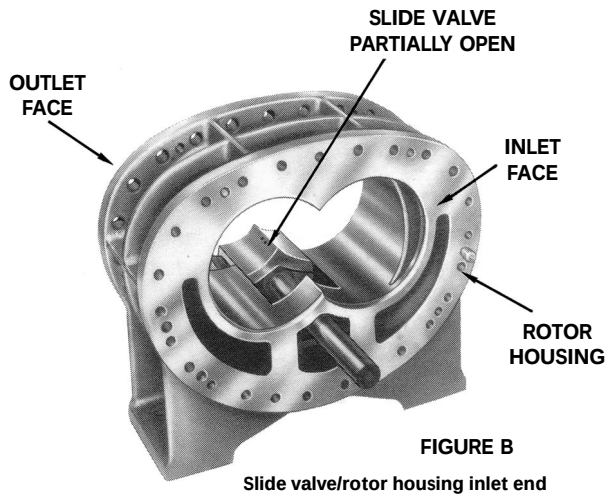



FIGURE B

Slide valve/rotor housing inlet end

## Capacity Control System

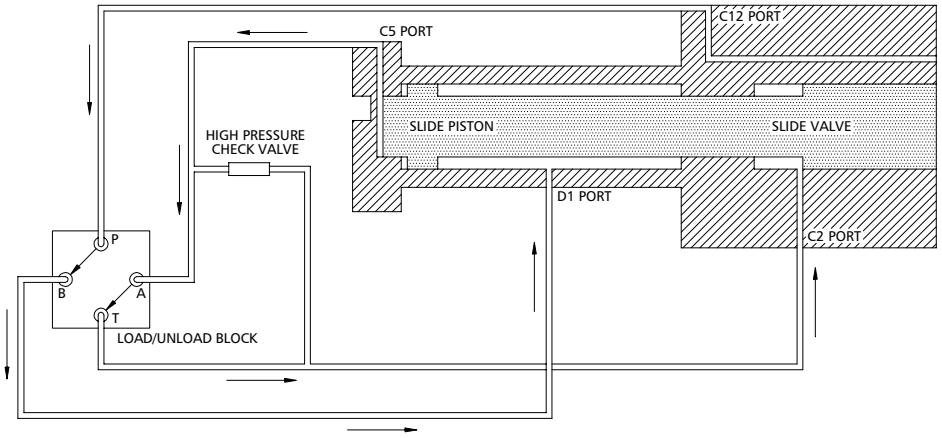
Figures A & B show the capacity control slide valve within the rotor housing. Axial movement of this valve is programmed by an exclusive Dunham-Bush electrically initiated (by variations in leaving chilled water temperature) hydraulically actuated control arrangement. When the compressor is fully loaded, the slide valve is in the closed position (Figure A). Unloading starts when the valve is moved back away from the valve stop (Figure B). Movement of the valve creates an opening in the bottom of the rotor housing. Suction gas can then pass back from the rotor housing to the inlet port area before it has been compressed. Since no significant amount of work has been done on this return gas, no appreciable power use is incurred. Reduced compressor capacity is obtained from the gas remaining in the rotors which is compressed in the ordinary manner. Capacity reduction down to 20% of full load is possible by progressive movement of the slide valve away from the valve stop.

# UNIT FEATURES: COMPRESSOR (CONT.)

## Capacity Control

The advanced microprocessor supplies power to the load solenoid valve (B) and unload solenoid valve (A) to control the position of the compressor slide valve piston. Control is achieved by monitoring leaving chilled fluid temperature. The sophisticated microprocessor will always meet a specific load demand and stabilize unit operation.

## Compressor Loading

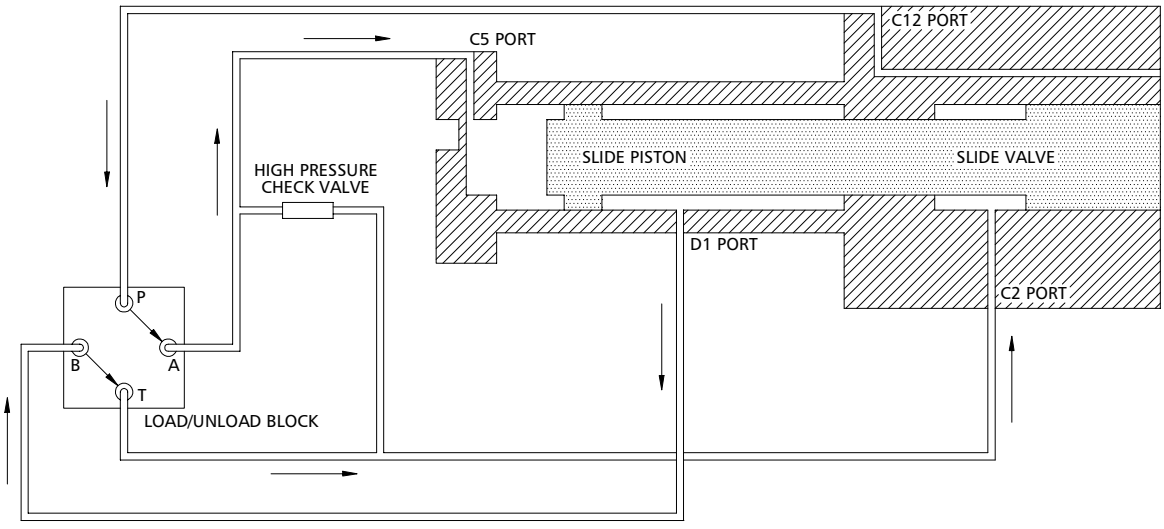



C2: Suction Pressure Port
C5: Unload Oil Port
C12: Oil Supply Port
D1: Load Oil Port

Notes:
1) Solenoid Valves A & B are part of Load/Unload block.
2) The Load/Unload block has a flow control valve to regulate load/unload rates at each connection point.

**Loading** - When the load solenoid valve (B) is energized, oil pressure is applied to Port D1, pushing the slide valve towards load, forcing oil out of the cylinder (Port C5) into the suction housing (Port C2).

## Compressor Unloading




**Unloading** - When the unload solenoid valve (A) is energized, oil pressure is applied to Port C5 pushing the slide valve towards unload, forcing oil out of the cylinder (Port D1) into the suction housing (Port C2).

**Part-Load** - The unit will remain in the part-load position as long as the leaving chilled fluid temperature remains at the desired temperature. Both load and unload solenoid valves will not be energized and the piston will be stationary at the part-load position.

# UNIT FEATURES: MOTORS (60 HZ)

Dunham-Bush supplies three basic styles of compressor motors and two efficiency ranges for ***PCXi*** Packaged Chillers, for Standard and Premium efficiency applications.

Low voltage motors (460/575/3/60) are supplied in low noise 84 dba open drip proof squirrel cage configuration only, and offered for Standard and Premium efficiency applications.

Medium voltage motors (2300/4160/3/60) are supplied with standard 87 dba open drip-proof squirrel cage frames, or optional low noise 84 dba frames and offered for Standard or Premium efficiency applications. These quiet version motors are considerably larger than the standard frame motors, and the motor and junction box will extend over the unit base width as noted in the Unit Dimensional Data.

Medium Voltage Premium Efficiency Motors provide approximately 1% better motor efficiency than standard efficiency motors.

Motor Efficiencies and Power Factors are both shown under each voltage listed.

**Table 9**

| 60 Hz Compressor Motor | | | | ***PCXi*** Unit Models | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | ***PCXi*** 030S | | | ***PCXi*** 040S | | | ***PCXi*** 050S | | |
| | | | | | % Eff. & (Power Factor) | | | % Eff. & (Power Factor) | | | % Eff. & (Power Factor) | |
| Code | Size | Sound | Eff. | S/O | 460/575 | 2300/4160 | S/O | 460/575 | 2300/4160 | S/O | 460/575 | 2300/4160 |
| E1S | 200 HP | 87 dba | Std. | O | | 94.0 (89.0/88.8) | | | | | | |
| E1P | 200 HP | 87 dba | Prem. | O | | 94.6 (88.5/88.3) | | | | | | |
| E2S | 200 HP | 84 dba | Std. | O | 94.7 (89.4/89.0) | 94.0 (89.0/88.8) | | | | | | |
| E2P | 200 HP | 84 dba | Prem. | O | 95.7 (88.6/88.5) | 94.6 (88.5/88.3) | | | | | | |
| F1S | 250 HP | 87 dba | Std. | **S** | | **94.0 (89.5/89.2)** | | | | | | |
| F1P | 250 HP | 87 dba | Prem. | **S** | | **94.6 (89.1/88.9)** | | | | | | |
| F2S | 250 HP | 84 dba | Std. | **S** | **94.0 (88.0/88.4)** | **94.0 (89.5/89.2)** | | | | | | |
| F2P | 250 HP | 84 dba | Prem. | **S** | **95.8 (87.9/88.1)** | **94.6 (89.1/88.9)** | | | | | | |
| G1S | 300 HP | 87 dba | Std. | O | | 94.1 (89.5/89.2) | O | | 94.1 (89.5/89.2) | | | |
| G1P | 300 HP | 87 dba | Prem. | O | | 94.8 (89.0/88.7) | O | | 94.8 - 00.0 (89.0/88.7) | | | |
| G2S | 300 HP | 84 dba | Std. | O | 94.1 (88.7/88.6) | 94.1 (89.5/89.2) | O | 94.1 (88.7/88.6) | 94.1 (89.5/89.2) | | | |
| G2P | 300 HP | 84 dba | Prem. | O | 96.1 (88.5/88.5) | 94.8 (89.0/88.7) | O | 96.1 (88.5/88.5) | 94.8 (89.0/88.7) | | | |
| H1S | 350 HP | 87 dba | Std. | | | | **S** | | **94.2 (89.5/89.2)** | O | | 94.2 (89.5/89.2) |
| H1P | 350 HP | 87 dba | Prem. | | | | **S** | | **95.2 (89.3/89.0)** | O | | 95.2 (89.3/89.0) |
| H2S | 350 HP | 84 dba | Std. | | | | **S** | **95.3 (89.0/88.8)** | **94.2 (89.5/89.2)** | O | 95.3 (89.0/88.8) | 94.2 (89.5/89.2) |
| H2P | 350 HP | 84 dba | Prem. | | | | **S** | **96.2 (88.8/88.5)** | **95.2 (89.3/89.0)** | O | 96.2 (88.8/88.5) | 95.2 (89.3/89.0) |
| J1S | 400 HP | 87 dba | Std. | | | | O | | 94.5 (89.6/89.3) | **S** | | **94.5 (89.6/89.3)** |
| J1P | 400 HP | 87 dba | Prem. | | | | O | | 95.2 (89.4/89.0) | **S** | | **95.2 (89.4/89.0)** |
| J2S | 400 HP | 84 dba. | Std. | | | | O | 94.9 (89.7/89.5) | 94.5 (89.6/89.3) | **S** | **94.9 (89.7/89.5)** | **94.5 (89.6/89.3)** |
| J2P | 400 HP | 84 dba | Prem. | | | | O | 96.1 (89.1/89.0) | 95.2 (89.4/89.0) | **S** | **96.1 (89.1/89.0)** | **95.2 (89.4/89.0)** |
| K1S | 450 HP | 87 dba | Std. | | | | O | | 94.8 (89.4/89.1) | O | | 94.8 (89.4/89.1) |
| K1P | 450 HP | 87 dba | Prem. | | | | O | | 95.2 (89.3/89.0) | O | | 95.2 (89.3/89.0) |
| K2S | 450 HP | 84 dba | Std. | | | | O | 95.0 (89.8/89.6) | 94.8 (89.4/89.1) | O | 95.0 (89.8/89.6) | 94.8 (89.4/89.1) |
| K2P | 450 HP | 84 dba | Prem. | | | | O | 96.2 (89.2/89.1) | 95.2 (89.3/89.0) | O | 96.2 (89.2/89.1) | 95.2 (89.3/89.0) |
| L1S | 500 HP | 87 dba | Std. | | | | | | | O | | 95.3 (89.6/89.3) |
| L1P | 500 HP | 87 dba | Prem. | | | | | | | O | | 95.6 (89.5/89.3) |
| L2S | 500 HP | 84 dba | Std. | | | | | | | O | 95.3 (90.0/89.6) | 95.3 (89.6/89.3) |
| L2P | 500 HP | 84 dba | Prem. | | | | | | | O | 96.5 (89.0/89.5) | 95.6 (89.5/89.3) |

**Notes:**

**Motor efficiency is the same for voltages stated in each column.**
**Power factor varies by motor voltage and is stated in order per voltage per column.**

AR - 460/3/60 Voltage Motors are available in 84 dba ONLY.
AS - 575/3/60 Voltage Motors are available in 84 dba ONLY.

When selecting medium voltage motors (AX, AY) the motor efficiency and sound must be considered.
AX - 2300/3/60 Voltage Motors are available in 84 dba or 87 dba.
AY - 4160/3/60 Voltage Motors are available in 84 dba or 87 dba.

**S** = Std. Motor Horsepower
**O** = Optional Motor Horsepower

# UNIT FEATURES: MOTORS (50 HZ)

Dunham-Bush supplies three basic styles of compressor motors and two efficiency ranges for ***PCXi*** Packaged Chillers, for Standard and Premium efficiency applications.

Low voltage motors (400/3/50) are supplied in low noise 84 dba open drip-proof squirrel cage configuration only, and offered for Standard and Premium efficiency applications.

Medium voltage motors (3300/3/50) are supplied with standard 87 dba open drip-proof squirrel cage frames, or optional low noise 84 dba frames and offered for Standard or Premium efficiency applications. These quiet version motors are considerably larger than the standard frame motors, and the motor and junction box will extend over the unit base width as noted in the Unit Dimensional Data.

Medium Voltage Premium Efficiency Motors provide approximately 1% better motor efficiency than standard efficiency motors.

Motor Efficiencies and Power Factors are both shown under each voltage listed.

**Table 10**

| 50 Hz Compressor Motor | | | | ***PCXi*** Unit Models | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | ***PCXi*** 030S | | | ***PCXi*** 040S | | | ***PCXi*** 050S | | |
| | | | | | % Eff. & (Power Factor) | | | % Eff. & (Power Factor) | | | % Eff. & (Power Factor) | |
| Code | Size | Sound | Eff. | S/O | 400/3/50 | 3300/3/50 | S/O | 400/3/50 | 3300/3/50 | S/O | 400/3/50 | 3300/3/50 |
| E1S | 200 HP | 87 dba | Std. | O | | 93.0 (88.0) | | | | | | |
| E1P | 200 HP | 87 dba | Prem. | O | | 93.6 (87.5) | | | | | | |
| E2S | 200 HP | 84 dba. | Std. | O | 94.6 (88.5) | 93.0 (88.0) | | | | | | |
| E2P | 200 HP | 84 dba. | Prem. | O | 94.7 (88.2) | 93.6 (87.5) | | | | | | |
| F1S | 250 HP | 87 dba | Std. | **S** | | **93.0 (88.2)** | | | | | | |
| F1P | 250 HP | 87 dba | Prem. | **S** | | **93.6 (88.0)** | | | | | | |
| F2S | 250 HP | 84 dba. | Std. | **S** | **94.0 (87.8)** | **93.0 (88.2)** | | | | | | |
| F2P | 250 HP | 84 dba. | Prem. | **S** | **94.8 (87.6)** | **93.6 (88.0)** | | | | | | |
| G1S | 300 HP | 87 dba | Std. | O | | 93.1 (88.3) | O | | 93.1 (88.3) | | | |
| G1P | 300 HP | 87 dba | Prem. | O | | 93.8 (88.1) | O | | 93.8 (88.1) | | | |
| G2S | 300 HP | 84 dba. | Std. | O | 94.2 (88.1) | 93.1 (88.3) | O | 94.2 (88.1) | 93.1 (88.3) | | | |
| G2P | 300 HP | 84 dba. | Prem. | O | 95.1 (88.0) | 93.8 (88.1) | O | 95.1 (88.0) | 93.8 (88.1) | | | |
| H1S | 350 HP | 87 dba | Std. | | | | **S** | | **93.2 (88.4)** | O | | 93.2 (88.4) |
| H1P | 350 HP | 87 dba | Prem. | | | | **S** | | **94.1 (88.3)** | O | | 94.1 (88.3) |
| H2S | 350 HP | 84 dba. | Std. | | | | **S** | **94.3 (88.2)** | **93.2 (88.4)** | O | 94.3 (88.2) | 93.2 (88.4) |
| H2P | 350 HP | 84 dba. | Prem. | | | | **S** | **95.2 (88.4)** | **94.1 (88.3)** | O | 95.2 (88.4) | 94.1 (88.3) |
| J1S | 400 HP | 87 dba | Std. | | | | O | | 93.8 (88.5) | **S** | | **93.8 (88.5)** |
| J1P | 400 HP | 87 dba | Prem. | | | | O | | 94.4 (88.4) | **S** | | **94.4 (88.4)** |
| J2S | 400 HP | 84 dba. | Std. | | | | O | 94.3 (88.8) | 93.8 (88.5) | **S** | **94.3 (88.8)** | **93.8 (88.5)** |
| J2P | 400 HP | 84 dba. | Prem. | | | | O | 95.1 (88.7) | 94.4 (88.4) | **S** | **95.1 (88.7)** | **94.4 (88.4)** |
| K1S | 450 HP | 87 dba | Std. | | | | O | | 94.0 (88.4) | O | | 94.0 (88.4) |
| K1P | 450 HP | 87 dba | Prem. | | | | O | | 94.4 (88.3) | O | | 94.4 (88.3) |
| K2S | 450 HP | 84 dba. | Std. | | | | O | 94.6 (89.0) | 94.0 (88.4) | O | 94.6 (89.0) | 94.0 (88.4) |
| K2P | 450 HP | 84 dba. | Prem. | | | | O | 95.2 (88.6) | 94.4 (88.3) | O | 95.2 (88.6) | 94.4 (88.3) |

Notes:
AU - 400/3/50 Voltage Motors are available in 84 dba ONLY
When selecting medium voltage motors (CT) the motor efficiency and sound must be considered.
CT - 3300/3/50 Voltage Motors are available in 84 dba or 87 dba

**S** = Std. Motor Horsepower
**O** = Optional Motor Horsepower

The ***PCXi*** is available with several types of compressor motor starting methods, depending on voltage, for Unit Mounted and Remote Mounted applications. All models are supplied in NEMA 1 enclosures. The unit controller and all other options are in a separate section of the electrical enclosure with the exception of the remote mounted starter.

**Unit mounted** *Solid State reduced voltage* and *WYE-Delta Starters* are available for 460/3/60, 575/3/60 and 400/3/50 voltage applications and are supplied fully installed and wired with all starter options ordered. All unit mounted starters include control transformer with primary and secondary fuses, oil pump starter, oil pump overloads, undervoltage relay, and current transformer for compressor motor load control.

**Remote mounted** *WYE-Delta Starters* are supplied for 460/3/60, 575/3/60 and 400/3/50. *Across-The-Line Starters* are supplied for medium voltage 2300/4160/3/60 and 3300/3/50 applications.

## Solid State Reduced Voltage Starters

### Unit Mounted

Solid State Starters are unit mounted and wired in a NEMA 1 enclosure, and offer many standard features:

- Microprocessor controller
- Bypass contactor for eliminating SCR heat generation
- Programmable starting profiles
- Controlled inrush current and torque
- Stepless acceleration to full speed
- Adjustable acceleration rate
- Programmable motor protection
- Under/over voltage and phase monitoring
- Electronic overloads
- Motor short circuit protection
- Instant over current protection
- Current imbalance
- Ground fault interrupt
- Embedded diagnostics
- Integral display
- Digital metering
- Built-in self testing
- Pending fault indicator

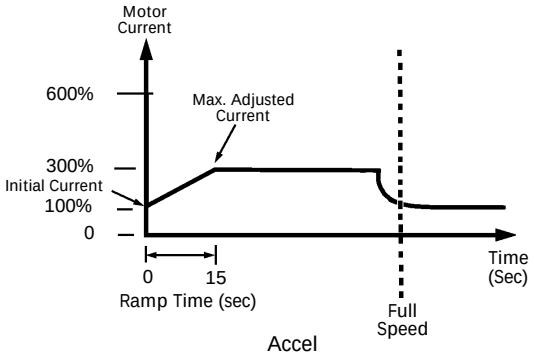
### Options

- **Unit Mounted Circuit Breaker—**with disconnect handle extended through the door
- **Unit Mounted Fused Disconnect—**handle extends through the door
- **Door Latch Solenoid**—for power and control panels

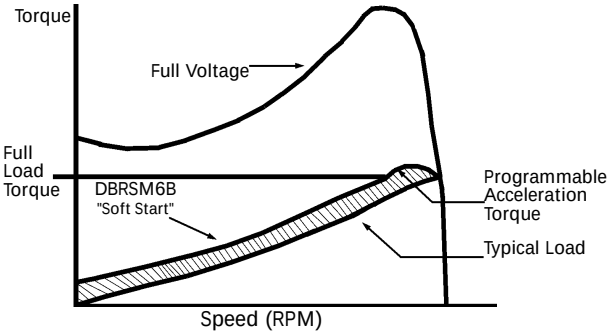
**Solid State Starters DBRSM6B a**re microprocessor-controlled solid state reduced voltage with easy-to-use keypad interface. They operate on a user-programmed closed-loop current ramp for optimum motor control and protection.

Solid State Starters are an excellent method of soft motor starting, through solid state ramp control of voltage, current, speed and torque. The effect/benefit of the soft start is a reduction of both electrical and mechanical system stress. This special solid state ramp control is shown in the following diagrams.

**Programmable Ramp Profiles**

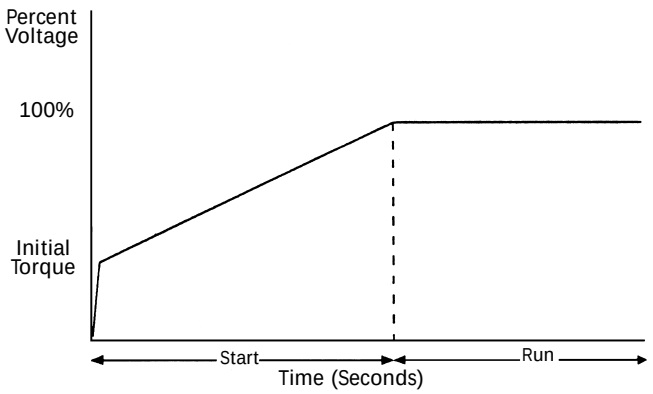



**Programmable Speed / Torque Curves**



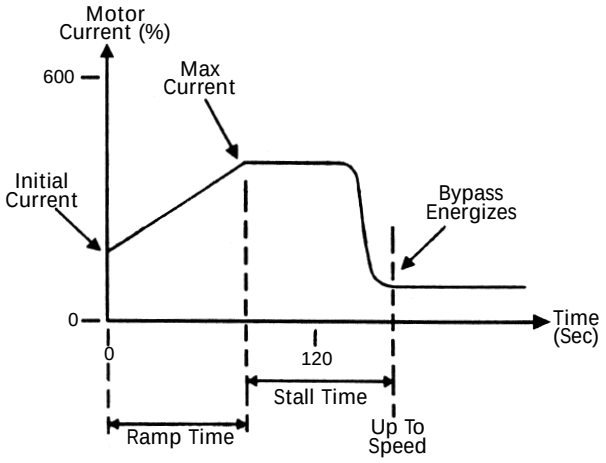

**Standard Features of the DBRSM6B Starter**

- **Electronic Motor Overloads** are Class 10, with 115% overload service factor for the DBRSM starters.
- **Initial Current** is the starting point for the current ramp. It can be set between 50-400% of the motor FLA. This must be set so the motor starts turning when a start command is given.
- **Current Limit** is the maximum motor current limit with an adjustable current range from 200-600% of the full load current. This reduces the starting current to limit brownout conditions during starting.



# UNIT FEATURES: STARTER & CONTROL PANELS

- **Latched Fault Relay Output**, switches and is latched, if any fault occurs that will not allow the motor to start or operate properly.
- **Programmable Relay Outputs** are supplied to indicate overload trip, overload lock, overload warning, starter operating, motor up-to-speed, shorted SCR, ground fault, or under current trip.
- **Programmable Metering** for each of two display meters may be set to measure amps(A), volts(V), frequency(Hz), motor overload content(OL), power factor(pf), elapsed time meter(etm), kilowatts(KW), kilowatt-hours(KWH), kilovolt-amps reactive(Kvar). When measuring current or voltage, "avg" indicates an average of all three lines, "scr" will give a scrolling meter, and 1, 2, or 3 indicates a specific line measurement. For example, selecting "Vavg" will display the average voltage of all three lines.
- **Starts Per Hour Limiter** sets the number of starts allowed per hour.
- **Start Interval Limiter** sets the minimum allowed time between starts. The motors used on this equipment should not be started more than three times per hour.
- **Adjustable Acceleration Ramp Profiles** are the profiles of the motor starting current. The starting point of each current ramp is the initial current setting, which is adjustable from 50 to 400%. The maximum current is adjustable from 200 to 600% and sets the endpoint for the current ramp. The ramp time is adjustable form 0 to 120 seconds. This sets the amount of time the starter spends smoothly ramping from the initial current to the maximum current value. Typical values are 150% for initial current; 250% for maximum current, and 15 seconds for ramp time.
- **Closed Loop Current Ramp** function of the starter operates on a user-programmed current ramp for optimal motor control and protection. The motor is accelerated from the initial current setting to the maximum current setting during the defined ramp time.




- **Single Phase Protection,** protects against one of the three phases being lost, the starter will shut down the motor, if running, and refuse to start until the phase is restored. The starter will report the condition and register a fault.
- **Phase Rotation Protection** for the starter can be selected to be ABC sensitive. If the incoming line phasing is detected to be out of sequence, a fault is registered.
- **Line to Line Current Imbalance** is monitored and if the current in any phase differs from the average by a programmable setting (10 to 40%), the starter will shut down, and report the condition and register a fault.
- **Over / Under Voltage Protection** monitors the line voltage and if any phase varies above or below the base line voltage by more than a programmable percentage (10 to 30%), a fault is recorded and the motor is shut down.
- **Adjustable Stalled Motor Protection** monitors the current of the motor for an up-to-speed condition. If the motor does not reach up-to-speed before the ramp time plus the set stall time expires, the starter will consider the motor stalled. An Up-To-Speed fault will be registered.
- **Ground Fault Detection** monitors the motor and wiring for ground faults. The starter performs the Ground Fault Protection by monitoring the instantaneous sum of the three phase currents. The user can set a predetermined trip point or alarm for when a ground fault is detected.
- **Instantaneous Electronic Over-Current Trip** for situations where the current level suddenly increases to > 8 x FLA due to a power system or motor fault. The starter registers a fault and shuts the motor down immediately.
- **Under Current Protection** allows the user to select a low current trip level (10 to 100% of FLA) and delay time (0.1 to 90.0 seconds). This allows the user to set a predetermined trip point that can indicate an under current condition or cause a starter trip to detect loss of motor load.
- **Low / High Frequency Trips** protect against any of the phases going above or below the programmed range, and the starter will register a fault. The Maximum range of the Frequency Trips is 23 to 72 HZ.
- **Shorted SCR Detection** detects shorted SCRs during acceleration. The starter will then shut down, report the condition and register a fault.
- **Protection Modules** are Metal Sintered-Oxide Varistors (SIOVs) that protect electronic components against external voltage spikes.
- **Passcode Protection** provides protection against unauthorized changes and when enabled, most programmable menu parameters may only be viewed and not changed. A three digit passcode between 001 and 999 may be chosen.
- **Battery Back-Up Menu Parameters** are protected by an 10 year life battery.
- **Full Fault Annunciation** when a motor fault occurs, the fault code and description are displayed on the LCD display and recorded in the event recorder.
- **The LCD and LED Status and Diagnostics** comes standard with programmable keypad, plain English LCD display and status LEDs. The keypad is door-mounted for viewing and programming from outside the enclosure.
- **Accumulated Event Recorder** provides information for each time an event occurs, the code, condition, and time of the event will be recorded in the revolving

99-event recorder. An event is considered anything that changes the present state which the starter is in, including faults, starts, stops, overload warnings, and overload trips.
- **Programmable Service Factor** is set to the service factor of the motor.
- **Real Time Clock** with battery backup is included in the starter. This allows the starter to track motor thermal overload content, enforce starter lockout times, and time stamp faults in the event recorder. It will track lockouts even when the power is removed.
- **Emergency Restart Provision** has the ability to override the starter lockouts if it is necessary to start the motor. This feature should only be used in the event of an emergency.

## Wye-Delta Starters

### Unit Mounted

Wye Delta Starters are unit mounted for 460/3/60, 575/3/60 and 400/3/50 applications and offer many standard features mounted and wired in a NEMA 1 enclosure:

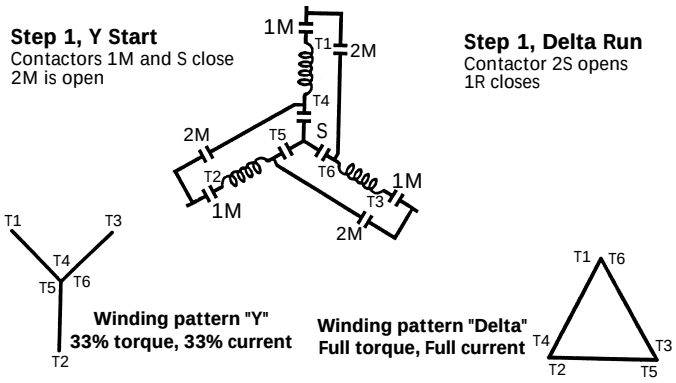
- Closed Transition controller in a NEMA 1 enclosure
- Controlled inrush current and torque to 33%
- Two Step acceleration speed control
- Ambient compensated overload relay
- Under voltage, phase monitoring relay

### Options

- **Unit Mounted Circuit Breakers**—with disconnect handles extended through the door
- **Unit Mounted Fused Disconnect—**handles extended through the door
- **Ground Fault Interrupt Relay**
- **Under and Over Voltage, Phase Loss, and Phase Imbalance Relay**
- **Volt and Amp Meters**—with selector switches for three phase meter reading
- **Door Latch Solenoid**—for power and control panels

WYE Delta Closed Transition Starters (also called Star Delta Starters) - offer a reduced voltage/reduce inrush current method of starting motors. WYE Delta starters utilize special wound motors that can be connected to the "Y" pattern for reduced starting torque. In the "Y" configuration, each set of phase windings is brought together at a common point. This increases the impedance of the motor itself, reducing the current and torque to 33% of normal. Three contactors and a timer are used to switch the six leads brought out of the motor into the Y-then-Delta configuration in a two-step starting process. "Closed Transition" WYE Delta starters utilize shunt resisters in the circuit during the transition phase of starting to prevent motor stalls or current spikes. This scheme uses four contactors in three steps and large starting resisters.

**WYE Delta Wiring Configuration**




This method is superior to Across-The-Line motor starting due to the reduced electrical demand, in areas with high electrical rates and utility demand charges.

### Remote Mounted

Remote Mounted WYE Delta Starters offer the same standard features and options as the Unit Mounted Starters, and are supplied in a stand alone NEMA 1 enclosure, for contractor mounting and wiring. Terminals are marked for interconnecting wiring, from the remote starter to the **PCX** chiller, for ease of wiring.

## Across-The-Line Starters

### Remote Mounted

Remote Mounted Starters are available for medium voltage 2300/4160/3/60 and 3300/3/50 voltage applications. Other voltages are available by contacting our Sales Representative or Application Engineering Department.

Across-The-Line Starters are supplied in NEMA 1 enclosures and have the many standard features:

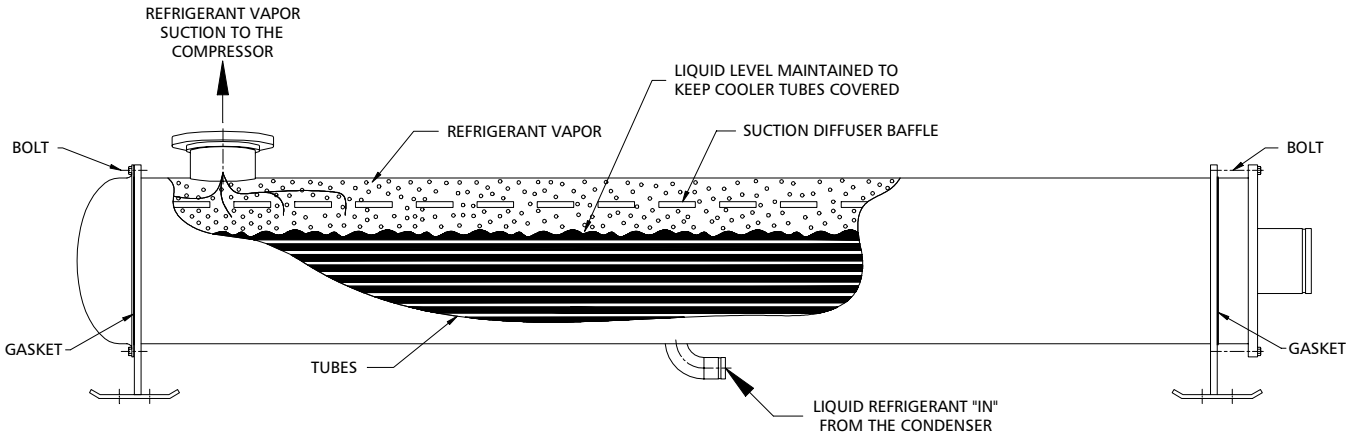
- Control Power Transformer with primary and secondary fusing
- Ambient compensated overloads
- Current transformers
- 4-20mA load signal
- Oil Pump Starter with overload protection
- Under voltage and phase monitoring relay
- Draw out contactor with fused isolation switch

### Options

- **Ground Fault Interrupt Relay**
- **Under and Over Voltage, Phase Loss, and Phase Imbalance Relay**
- **Volt and Amp Meters**—with selector switches for three phase meter reading
- **Door Latch Solenoid**—for power and control panels

# UNIT FEATURES: FLOODED COOLERS

## *PCXi* - Flooded Cooler Control




## *PCXi* - Shell and Tube Flooded Coolers

Flooded Coolers operate considerably different than Direct Expansion Coolers. They have the refrigerant in the shell side with the fluid to be cooled in the tubes. The liquid level of refrigerant in the shell covers the tubes with refrigerant. This direct contact enables the cooler to operate more efficiently than a direct expansion cooler by having a closer total temperature difference (TTD). This closer TTD between the refrigerant and the fluid to be cooled allows for lower leaving water temperatures without the risk of freezing. These Dunham-Bush Flooded Coolers employ the most advanced vessel technology available today. Special internal and external enhanced tubing provides excellent unit efficiency. These coolers are designed and constructed to meet the requirements of the ASME Code, Section VIII, Division 1 for unfired pressure vessels and are stamped accordingly. The 3/4 inch tubing is roll expanded into the tubesheets and the heads are removable and interchangeable from end-to-end for ease of tube maintenance. Vent and drain plugs are provided in each head. Two-pass coolers are supplied standard with one and three-pass optional. Victaulic connections are supplied standard with flanges optional.

See the Unit Physical Specifications for other details.

**Table 14A**

| *PCXi* - Shell and Tube Flooded Cooler | | | | | | | |
|---|---|---|---|---|---|---|---|
| Water Side Design Pressure | | R22 Refrigerant Side | | | | | |
| | | Design Pressure | | Test Pressure | | Relief Valve | |
| (psig) | (kPa) | (psig) | (kPa) | (psig) | (kPa) | (psig) | (kPa) |
| 150 | 1034 | 300 | 2068 | 330 | 2275 | 300 | 2068 |

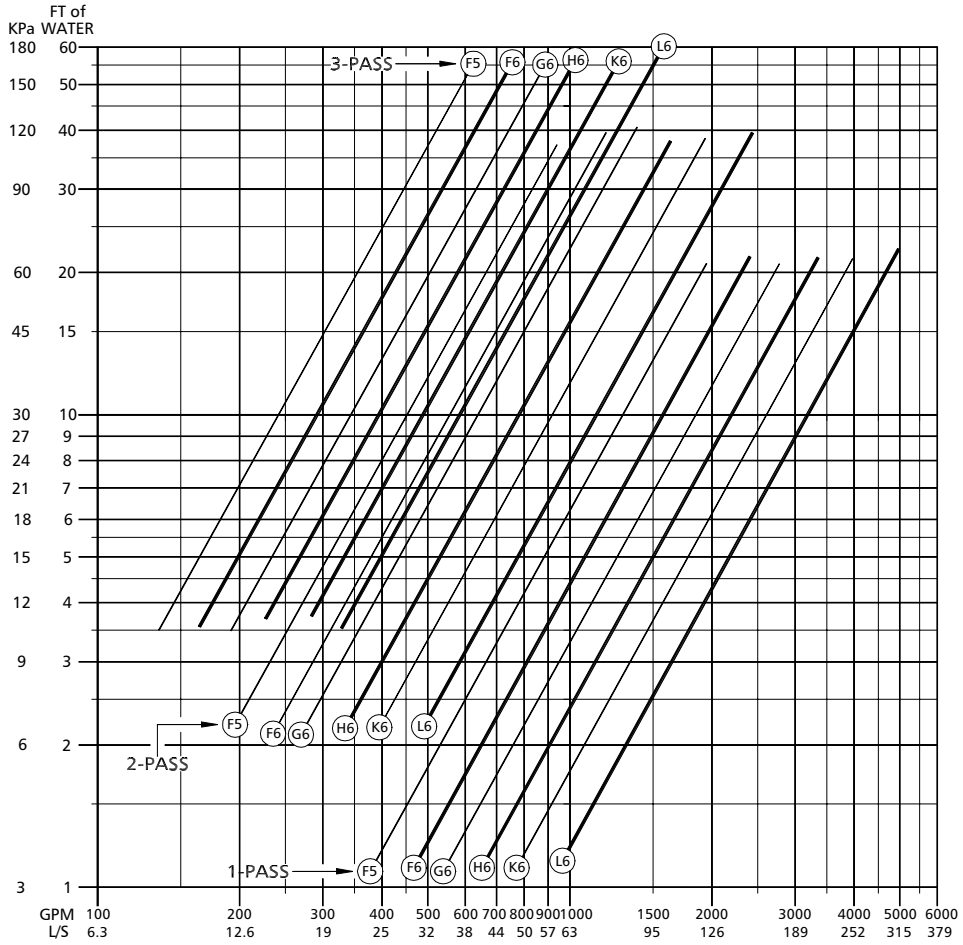
**Table 14B**

| Cooler Fouling Factor | | | |
|---|---|---|---|
| English I.P. Units ($h \cdot ft^2 \cdot °F/BTU$) | Metric S.I. Units ($m^2 \cdot °C/kW$) | Capacity Factor | kW Factor |
| 0.0001 | 0.018 | 1.000 | 1.000 |
| 0.00025 | 0.044 | 0.992 | 0.997 |
| 0.0005 | 0.088 | 0.978 | 0.990 |
| 0.0010 | 0.176 | 0.951 | 0.978 |

# UNIT FEATURES: FLOODED COOLER WATER SIDE PRESSURE DROP

**Figure 15**

## ENGLISH I.P. UNITS AND S. I. UNITS

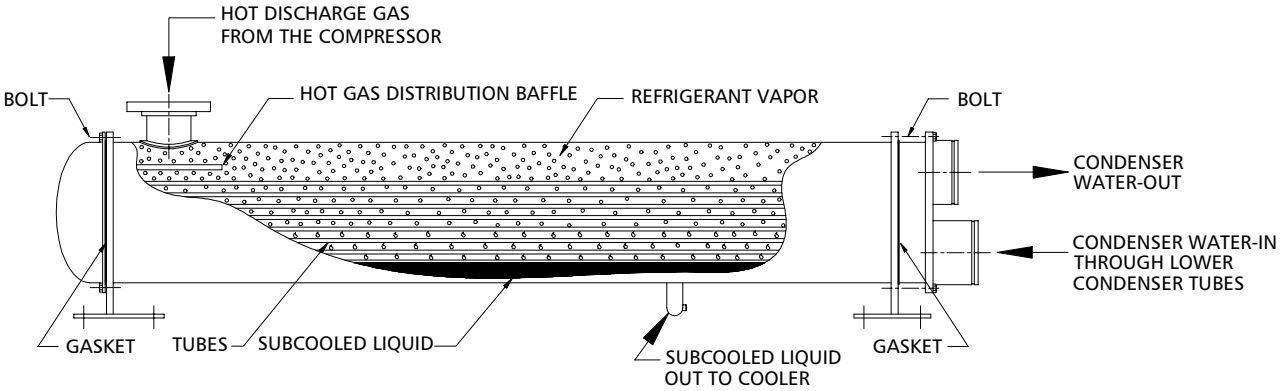



| Vessel Code | Water Connection Size (*) | Minimum GPM | Maximum GPM | Minimum L/s | Maximum L/s |
|---|---|---|---|---|---|
| **Single Pass - Flooded Cooler** | | | | | |
| F5 | 10" VIC | 389 | 1946 | 24.6 | 122.8 |
| F6 | 10" VIC | 481 | 2406 | 30.4 | 151.7 |
| G6 | 12" VIC | 555 | 2777 | 35.0 | 175.2 |
| H6 | 12" VIC | 671 | 3354 | 42.3 | 211.6 |
| K6 | 14" VIC | 794 | 3970 | 50.1 | 250.4 |
| L6 | 14" VIC | 994 | 4968 | 62.7 | 313.4 |
| **Two Pass - Flooded Cooler** | | | | | |
| F5 | 8" VIC | 201 | 939 | 12.7 | 59.2 |
| F6 | 8" VIC | 243 | 1193 | 15.3 | 75.3 |
| G6 | 8" VIC | 278 | 1389 | 17.5 | 87.6 |
| H6 | 10"VIC | 344 | 1633 | 21.7 | 103.0 |
| K6 | 10"VIC | 407 | 1936 | 25.7 | 122.1 |
| L6 | 10"VIC | 507 | 2435 | 32.0 | 153.6 |
| **Three Pass - Flooded Cooler** | | | | | |
| F5 | 6" VIC | 135 | 606 | 8.5 | 38.5 |
| F6 | 8" VIC | 164 | 733 | 10.4 | 46.3 |
| G6 | 8" VIC | 192 | 861 | 12.1 | 54.3 |
| H6 | 8" VIC | 227 | 997 | 14.3 | 62.9 |
| K6 | 8" VIC | 284 | 1232 | 17.9 | 77.7 |
| L6 | 8" VIC | 329 | 1535 | 20.7 | 96.8 |

* Non-Metric Compliant

# UNIT FEATURES: CONDENSERS

## PCXi - Condenser Function




NOTE: COOLEST CONDENSER SUPPLY WATER PASSES THROUGH THE SUBCOOLER SECTION FOR EFFICIENT UNIT OPERATION

## PCXi - Shell and Tube Condenser

The condenser is a cleanable "shell and tube" type with high efficiency external and internal enhanced copper tubes, mechanically expanded into heavy fixed steel tube sheets. Fluid connections are standard victaulic or optional flanged. The condenser is sized for full refrigerant pumpdown capacity and the shell side is equipped with dual refrigerant relief devices. Vent and drain fittings are provided in each head and the heads are removable for tube cleaning and serviceability.

These condensers are designed and constructed to meet the requirements of the ASME Code, Section VIII, Division 1 for unfired pressure vessels and are stamped accordingly.

See the Unit Physical Specifications for other details.

**Table 16A**

| PCXi - Shell and Tube Condenser | | | | | | | |
|---|---|---|---|---|---|---|---|
| Water Side Design Pressure | | R22 Refrigerant Side | | | | | |
| | | Design Pressure | | Test Pressure | | Relief Valve | |
| (psig) | (kPa) | (psig) | (kPa) | (psig) | (kPa) | (psig) | (kPa) |
| 150 | 1034 | 300 | 2068 | 330 | 2275 | 300 | 2068 |

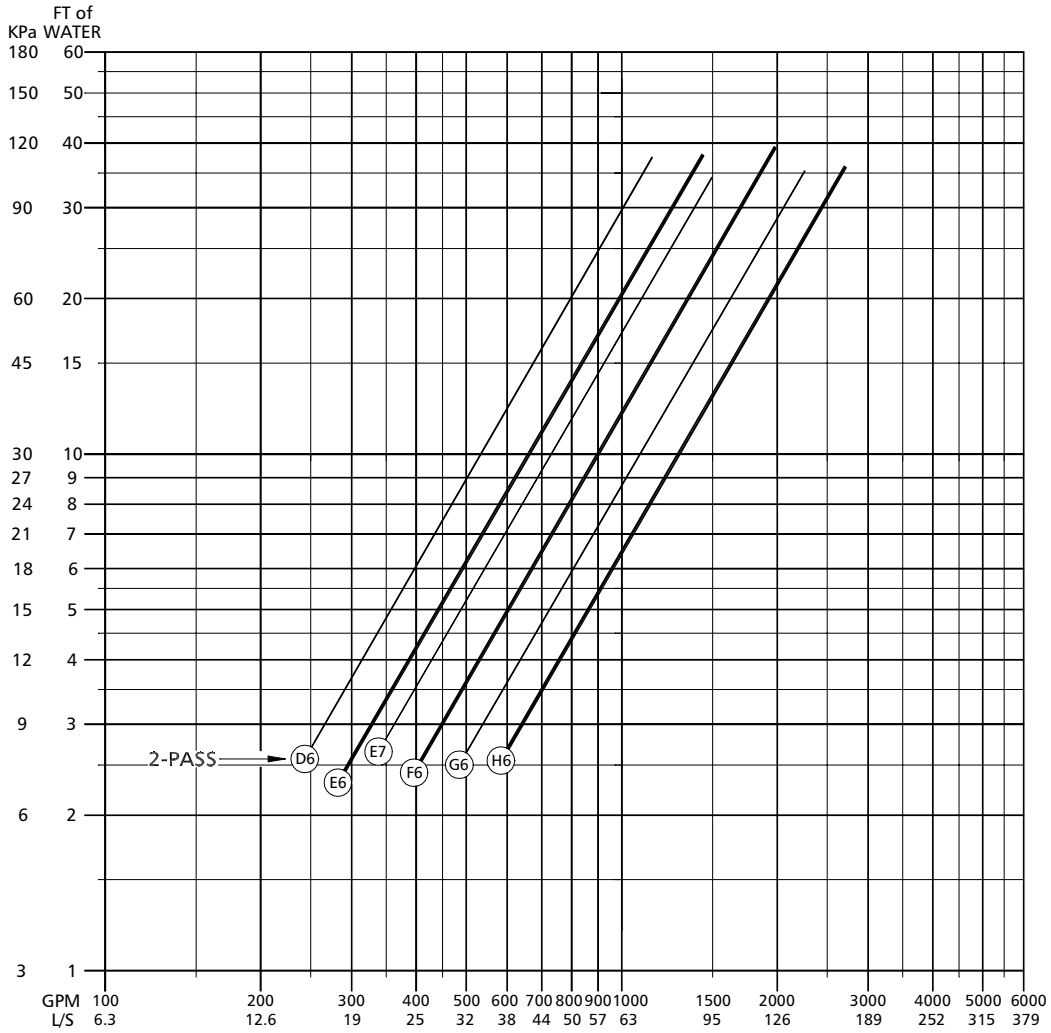
**Table 16B**

| Condenser Fouling Factor | | | |
|---|---|---|---|
| English I.P. Units ($h \cdot ft^2 \cdot °F/BTU$) | Metric S.I. Units ($m^2 \cdot °C/kW$) | Capacity Factor | kW Factor |
| 0.0001 | 0.018 | 1.000 | 1.000 |
| 0.00025 | 0.044 | 0.992 | 0.997 |
| 0.0005 | 0.088 | 0.978 | 0.990 |
| 0.0010 | 0.176 | 0.951 | 0.978 |

# UNIT FEATURES: CONDENSER WATER SIDE PRESSURE DROP

**Figure 17**

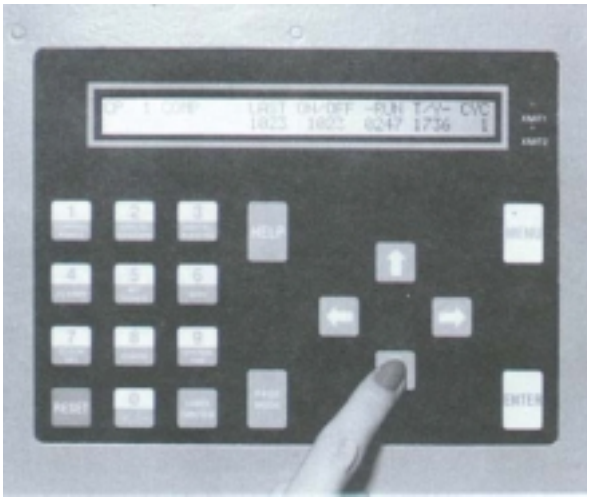
## ENGLISH I.P. UNITS AND S. I. UNITS




| Vessel Code | Water Connection Size (*) | Minimum GPM | Maximum GPM | Minimum L/s | Maximum L/s |
|---|---|---|---|---|---|
| **Two Pass - Condenser** | | | | | |
| D6 | 6" VIC | 251 | 1146 | 15.8 | 72.3 |
| E6 | 8" VIC | 291 | 1435 | 18.4 | 90.5 |
| E7 | 8" VIC | 349 | 1495 | 22.0 | 94.3 |
| F6 | 8" VIC | 409 | 1983 | 25.8 | 125.1 |
| G6 | 10" VIC | 500 | 2262 | 31.6 | 142.7 |
| H6 | 10" VIC | 602 | 2711 | 38.0 | 171.0 |

* Non-Metric Compliant

# UNIT FEATURES: MICROCOMPUTER CONTROL



Advanced Microcomputer Control is a standard feature on all Dunham-Bush Rotary Screw Chillers monitoring analog and digital inputs to achieve precise control of the major operational and protective functions of the unit.

Direct digital control (DDC) allows fingertip user interaction. Its simple-to-use push button keyboard and menu-driven software provide access to operating conditions, control setpoints and alarm history clearly displayed on a prominent multi-line 80 character alphanumeric display.

An easy-to-install, inexpensive modem option allows remote reading of operating parameter updates. The Dunham-Bush microcomputer insures its owner state-of-the-art efficiency and reliability.

## Display Information

The 80 character alphanumeric liquid crystal display utilizes easy-to-understand menu-driven software. Inexperienced operators can quickly work through these menus to obtain the information they require or to modify control parameters. More experienced operators can bypass the menu systems, if desired, and move directly to their requested control function. At all times, assistance is available to the operator by simply pressing the help key. Easily accessible measurements include:

- Leaving chilled water temperature
- Cooler pressure
- Condenser pressure
- Oil pressure
- Compressor motor amp draw
- Compressor elapsed run time
- Percent of slide valve loading
- Reservoir oil temperature
- Seal oil temperature
- Water temperature reset value
- Demand limit reset value
- Compressor starter status
- Oil pump starter status
- Water flow switch status
- External start / stop command status

Optional watering temperature monitoring (WTM) for entering chilled water temperature and entering and leaving condenser water temperature is available. With this option the operator can quickly and accurately read the water temperatures and eliminate the need for thermometers.

## Capacity Control

Leaving chilled water temperature control is accomplished by entering the entering water temperature setpoint and placing the microcomputer in automatic control. The unit will monitor all control functions and move the slide valve to the required operating position. The compressor ramp (loading) cycle is programmable and may be set for specific building requirements. Remote adjustment of the leaving chilled water setpoint is accomplished through either direct connection via terminal or modem connected to the RS232 communication port, or from an external Building Automation System supplying a simple 0 to 5 VDC signal. Remote reset of compressor current limit may be accomplished in a similar fashion.

## System Control

The unit may be started or stopped manually, or through the use of an external signal from a Building Automation System. In addition, the microcomputer may be programmed with a seven-day operating cycle or other Dunham-Bush control packages may start and stop the system through inter-connecting wiring.

## System Protection

The following system protection controls will automatically act to insure system reliability:

- Low suction pressure
- High discharge pressure
- Low oil pressure
- Freeze protection
- High oil temperature
- Compressor starter failure
- Oil pump starter failure
- Compressor run error
- Power loss
- Chilled water flow loss
- Sensor error
- Compressor overcurrent
- Anti-recycle

## Alarm History

The microcomputer retains the latest eight alarm conditions complete with time of failure in its alarm history. This tool aids service technicians in troubleshooting tasks enabling downtime and nuisance trip-outs to be minimized.

## Remote Monitoring Capability

The microcomputer is complete with an RS232 communications port and all hardware and software necessary to remotely monitor and control the packaged chiller up to 50 feet away (hard wired) or by optional phone modem for extended distances by the phone system. This valuable enhancement to the chiller system allows the ultimate in serviceability. The microcomputer is equipped with history files as standard which records a history that may be retrieved via the phone modem periodically. Now owners of multiple buildings have a simple and inexpensive method of investigating potential problems quickly and in a highly cost effective manner.

## Remote Monitoring and Operating Terminals

There are four methods of remote monitoring and operating of our package chillers.

### 1) RMDT - Remote Monitor Display Terminal

The RMDT (Remote Monitor Display Terminal) can be hard wired up to 50 feet away from the chiller or connected thru a modem for remote monitoring and operating of up to three chillers. The RMDT is supplied with a 14" monitor, two RS232 serial ports, a 6 foot 115 volt power cord and an enhanced PC keyboard.

This option allows remote start-stop, chilled water set-point changes, and reading of all microcomputer screens including operating conditions, faults and fault history.

### 2) IBM PC Compatible Computer Terminal

A customer's IBM PC Compatible computer with communication software installed (simple terminal) can interface with the chiller in the same manner as the RMDT (Remote Monitor Display Terminal). Again, this method of communication interfaces with the chiller microcomputer CPU and provides the same level of communication.

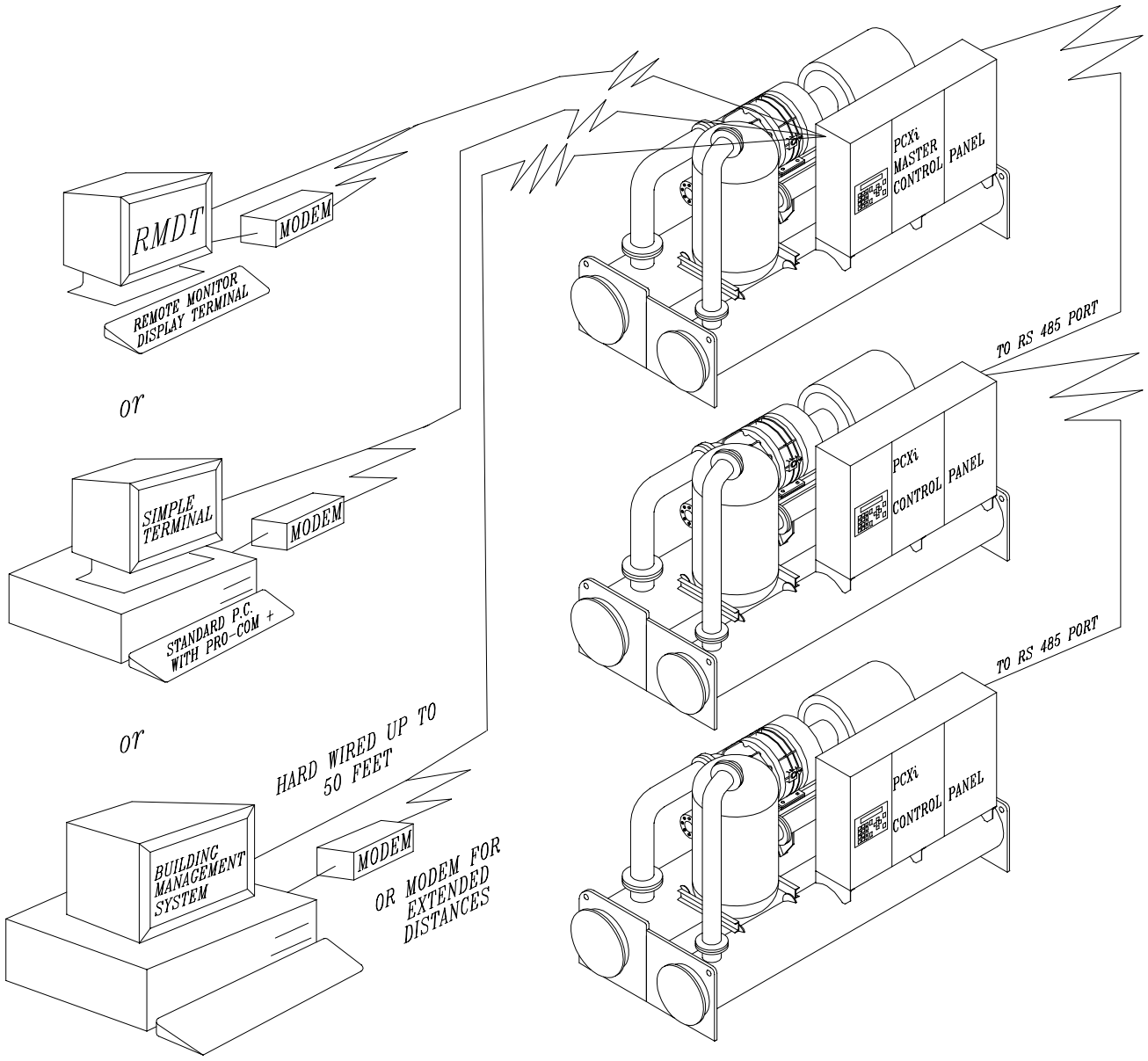
### 3) BMS - Building Management System Terminal

A BMS (Building Management Systems) may interface with the chiller microcomputer and provide the same level of monitoring and operating control as above, when the BMS company has implemented the communications protocol.

Dunham-Bush has an open communications protocol policy with most BMS companies.

## Terminal Interfacing

Using any one method shown below.




### 4) CHLK - Chiller*LINK*

Dunham-Bush has always been a strong advocate of open systems communications. This has been evident in the past with the publication of our network protocol, and now once again through our interoperability with BACnet. In addition to BACnet, the modular design of our Chiller*LINK* also supports Modbus protocol. Consult with Dunham-Bush to verify compatibility with other protocols.

Dunham-Bush's Chiller*LINK* is a microprocessor-based communication device designed to provide seamless, two-way translation between a Dunham-Bush microcomputer and a BACnet or MODBUS compliant network or work station. Chiller*LINK* devices can be set for two Data Link/Physical Layer configurations:
1. PTP (point-to-point) via EIA-232 standard
2. EIA-485 standard for 2-wire or 4-wire systems

In addition to providing seamless interoperability with BACnet or MODBUS systems, Chiller*LINK* can be specially designed for full custom programmability of the data flowing between the Dunham-Bush/BACnet/MODBUS networks.

# UNIT FEATURES: PART-LOAD PERFORMANCE

Dunham-Bush Rotary Screw Water Chillers possess superior part-load performance characteristics. This is accomplished with the infinite capacity control capability of the slide valve equipped compressor.

Actual building system loads are significantly less than full load design conditions, therefore chillers operate at full load for only a fraction of the operating time.

Dunham-Bush Rotary Screw Water Chillers combine the efficient operation of the rotary screw compressor with finite refrigerant management and microprocessor control to yield the best total energy efficiency and significant operating savings under any load.

When specifying air conditioning equipment it is important to consider the system load characteristics of the building application. In a typical city, the air conditioning load will vary according to changes in the ambient temperature. Weather data compiled over many years will predict the number of hours that equipment will operate at various load percentages. The Air Conditioning and Refrigeration Institute (ARI) has established a system, in ARI 550/590-98, for measuring total chiller performance over full and part-load conditions. The Integrated Part-Load Value (IPLV) is an excellent method of comparing diverse types of equipment on an equal basis. The IPLV is a single number estimate of a chiller's power use weighted for the number of hours the unit might spend at each part-load point. IPLV's are based on Standard ARI Rating Conditions.

For COP and EER:

$$\begin{matrix} IPLV \\ or \\ NPLV \end{matrix} = 0.01A + 0.42B + 0.45C + 0.12D \qquad (1a)$$

where: A = COP or EER at 100%
B = COP or EER at 75%
C = COP or EER at 50%
D = COP or EER at 25%

For kW/ton:

$$\begin{matrix} IPLV \\ or \\ NPLV \end{matrix} = \frac{1}{\frac{0.01}{A} + \frac{0.42}{B} + \frac{0.45}{C} + \frac{0.12}{D}} \qquad (1b)$$

where: A = kW/ton at 100%
B = kW/ton at 75%
C = kW/ton at 50%
D = kW/ton at 25%

**Non-Standard Part-Load Values** (NPLV) also give a single number estimate for the part-load performance of a chiller but at Selected Application Rating Conditions.

**Integrated Part-Load Values** and Application Part-Load Values are available from your Dunham-Bush Representative and will be calculated for your specific conditions. These points, as well as the full load selection point, are all covered under the ARI Large Tonnage Certification Program for Centrifugal and Rotary Screw Water-Chilling Packages.

# OPTIONS

Dunham-Bush offers many factory installed and tested options for "custom solutions" to everyday owner and operator special requirements:

**Solid State Starter (SS)**—is the standard starting method for 460/3/60, 575/3/60 and 400/3/50 voltage unit applications. This method provides reduced starting current transients with solid state compact starter design, and fits into the power section of the unit control panel. This state-of-the-art starting method provides soft-starting with reduced mechanical and electrical stresses. See Unit Features section of this catalog for details.

**WYE—Delta Starter (YD)**—is available for 460/3/60, 575/3/60 and 400/3/50 voltage unit applications. The Y-Delta electromechanical method of starting is supplied built into the power section of the unit starter and control panel. Y-Delta starting has a long history of starting this type of mechanical equipment. See Unit Features section of this catalog for details.

**Remote Across-the-line starter (RA)**—is available for 2300/3/60, 4160/3/60 and 3300/3/50 supply voltage unit applications. This method of starting equipment is supplied with a stand-alone remote NEMA 1 enclosure and a fused isolation switch. See details in the Unit Features of this catalog.

**Circuit Breaker (CB)**—for 460/3/60, 575/3/60 and 400/3/50 voltage units which provide short circuit protection for the unit and is supplied with a disconnect handle and hardware extended through the control box door.

**Fused Disconnect (UMFD)**—for 460/3/60, 575/3/60 and 400/3/50 voltage units which provide a unit mounted disconnect and is supplied with a disconnect handle and hardware extended through the control box door.

**Ground Fault Interrupt Relay (GFI)**—that takes the unit off the line if a ground fault is detected.

**Volt and Amp Meters (VAM)**—provide both volt and amp meters mounted in the control box door with selector switches to allow readings of each power phase.

**Over and Under Voltage and Phase Protection Relay (UVR2)**—protects against high and low incoming voltage conditions as well as single phasing, phase reversal and phase imbalance by opening the control circuit. The UVR2 is an automatic reset device, but the unit microcomputer controller can be set up for manual reset to prevent unwanted restarts.

**Alarm Bell (BEL2)**—mounted and wired to indicate a common alarm fault.

**Electric Panel Door Latch Solenoid (DLS)**—to provide the safety and security required by local codes. Main power must be disconnected to gain entry to the power and control electrical panels. The control panel can be accessed with a key-lock actuated override switch.

**Chiller*LINK* (CHLK)**—for communication with (BMS) building management systems through BacNet or Modbus. See details in unit features of this catalog.

**Systems International Display (SID)**—provides microcomputer controller information displayed in SI Units. The microcomputer controller display defaults to English Units unless the computer is set up for SI units. (Temperature in °C and pressure in BARS.)

**Remote Monitoring Modem (MOD)**—for long distance communication, allows the system to be monitored and history logs retrieved to assist with investigating potential problems quickly and in a cost effective manner from a remote source.

**R22 Refrigerant Sensor (REFS)**—is an R22 sensor that senses R22 in the equipment room between the chiller vessels and reports this information to the unit microcomputer controller.

**Water Temperature Monitoring (WTM)**—is three extra temperature sensors mounted and wired to the microcomputer controller, for monitoring of entering cooler water temperature, leaving condenser water temperature, and entering condenser water temperature. These sensors are for information only.

**Condenser Water Control (CWC)**—provides an analog output that can be used to control condenser water flow. The 0-5VDC or 0-10VDC signal increases as discharge pressure rises above a setpoint (TYP 160 psig). This should produce an increase in the condenser water flow.

**Hot Gas Bypass (HGB)**—for very low load situations when the load is less than the minimum capacity of the chiller.

## OPTIONS (CONT.)

**Shipping and Handling Skid (SKID)**—for special handling arrangements where rigging is not available.

**Shipping Less Refrigerant (SLR)**—for shipping units without the refrigerant charge. The chiller will be built and tested and the refrigerant removed after testing.

**Cooler Single Layer Insulation (CSLI)**—for factory installed single layer of 3/4 inch closed cell insulation.

**Cooler Double Layer Insulation (CDLI)**—for factory installed double layer of 3/4 inch closed cell insulation.

## ACCESSORIES (SHIPPED LOOSE FOR FIELD INSTALLATION)

**Water Flow Switch (WFS)**—field mounted and wired paddle type, field adjustable, flow switch available for use in the cooler fluid piping circuit. The water flow switch is a safety to help prevent cooler freeze ups and needs to be tied into the unit safety circuit to confirm fluid flow before the unit can operate.

**Spring Vibration Isolators (SPG)**—designed for 1" deflection, with a neoprene friction pad on the bottom to help prevent sound passing into the unit mounting structure. Spring vibration isolators are more suitable on critical sound sensitive applications than Rubber-in-Shear (RIS) isolators.

**Alarm Bell (BEL1)**—is a shipped loose bell to be mounted remote of the unit and wired to the unit ALC common alarm contacts in the unit by the contractor.

**Remote Monitor Display Terminal (RMDT)**—provides remote monitoring and enable/disabling of the unit control plus reading of all microcomputer screens.

## Chilled Water Flow

The Dunham-Bush ***PCX$_i$*** Packaged Water Chiller is designed for a constant chilled water flow rate even when the cooling load is varying. The machine will generally perform satisfactorily with steady flow rates deviating from design by as much as +10% to -50%. However, varying water flow rates can cause control instability which will result in undesirable system effects, particularly poor control of leaving chilled water temperature. If two-way valves are used to control flow through cooling coils, some means such as an automatic modulating valve should be provided in the system to maintain steady flow through the cooler.

If the chilled water system is arranged for the dual purpose of cooling and heating, the cooler must incorporate valves to prevent the flow of hot water through it. This can be done with either manual or automatic shutoff valves, but the method of control must be such that water temperature entering the cooler never exceeds 90°F (32°C).

## Ice Storage

With a positive displacement rotary screw compressor, the Dunham-Bush water chiller can easily cool low temperature glycol down to 22°F (-6°C) with entering condenser water of 85°F (29°C). The same chiller can also produce warmer (40°F (4°C) to 45°F (7°C) leaving glycol for those building systems designed for only peak shaving. This can be accomplished by an external signal to the unit microcomputer. No matter what your ice storage needs, the Dunham-Bush Rotary Screw Water-Cooled Chiller can handle the application.

When used with Dunham-Bush Ice-Cels, the microcomputer can be specially programmed to provide dual mode leaving chilled liquid set points for both air conditioning and ice freezing duty, plus start and stop of chilled liquid and condenser pumps.

In addition, the following thermal storage controls can be provided.

a. Freeze only
b. Freeze plus cooling
c. Cooling with ice only
d. Cooling with chiller plus ice
e. Cooling with chiller only
f. Off

The microcomputer can provide daily scheduling of above modes in as many different daily schedules as desired. These schedules can be assigned to days of the week and holidays.

## Multiple Unit Control

One of the most perplexing problems to system designers is control of multiple chillers on the same water loop. The first decision is whether to put the chillers in parallel or series on the chilled water side. If lower pumping cost is paramount, then putting chillers in series is often preferable. If primary/secondary pumping is utilized with normal 10°F (6°C) range, then putting chillers in parallel is normally used. In either case, the Dunham-Bush microcomputer (with special programming) can control up to three chillers. This eliminates the need for external control interface which often becomes difficult. Contact the factory if more than three chillers need to be networked.

## Condensing Water Treatment

Condensing water tends to leave silt, algae and mineral deposits in the condenser tubes. This fouling gradually decreases unit efficiency. For this reason, a program of water treatment should be employed. Also, at regular intervals depending an water quality, the unit should be shut down, condenser heads removed and tubes cleaned.

## Foundation

A flat, level concrete foundation or floor capable of supporting the weight of the unit must be provided. The unit must be levelled to within 1/16 inch per foot (1.6mm per 30.5cm) for proper operation.

## Vibration Isolation

Where structure-borne vibration may be of concern, it is recommended that the unit be mounted on vibration isolators. Spring isolators are available for this unit as optional equipment. If spring isolators are installed, it is also necessary to provide isolation in condenser water and chilled water pipes by means of flexible connectors and in main power supply conduit through use of flexible conduit. Isolation of piping and electrical conduit is desirable in any event to avoid noise transmission.

## Location and Installation Suggestions

***PCX$_i$*** **Packaged Chillers** are designed for indoor application. Proper locations and installation procedures for this equipment are very important for successful trouble free operation. It is desirable to install these units with sufficient service space on all sides of the Unit. Tube cleaning and unit servicing require considerable space at the ends of the units as shown in the dimensional outline section of this catalog. Compressor and motor servicing require space at the rear of the unit. NEC and Local Codes require a minimum of 36 to 48 inches in front of the unit depending on the application location.

## Equipment Location and Unit Security

The ***PCX$_i$*** is a quiet operating chiller but sound sensitivity should be considered when locating this equipment. Equipment and equipment rooms need to be located in areas of the building that will not disturb surrounding occupied spaces. Equipment rooms can be acoustically designed for sound sensitive installations to minimize sound transmission into occupied spaces. It is suggested that an acoustical Engineer be consulted on critical sound and vibration applications before, rather than after, the equipment is installed. Unit security and personal safety should also be considered when locating this equipment. All state and local sound and safety codes should be considered when laying out or installing mechanical equipment.

## Cooler - Freeze Protection

The leaving water sensor mounted on the Cooler will shut down the unit if a cooler freeze condition should occur. A water flow switch must be supplied and mounted in the water piping to protect the unit from low or no flow, which can cause cooler freezing.

## Electrical Connection Options

Refer to the Electrical Data Tables for specific electrical data requirements. All wiring must be done in accordance with the National Electric Code (NEC) and all local and state codes. Typical power, control and interconnection wiring diagrams are found on pages 48 through 55. A complete set of wiring diagrams for all units is available from our Dunham-Bush Sales Representative.

The unit will be shipped with wiring diagrams located in the electrical panel.

## Low Voltage Units

460/3/60, 575/3/60 & 400/3/50 voltage applications are supplied with unit-mounted, Solid State Reduced Voltage or Wye-Delta starter panel. An optional remote-mountable Wye-Delta starter panel can also be supplied. All three low voltage starter panels are for **single point power source.** Refer to the Electrical Data Tables for detailed information.

## Medium Voltage Units

2300/3/60, 4160/3/60 & 3300/3/50 applications are supplied with remote-mounted across-the-line starter panel.

## Power Sources

The term “Power Source” refers to the unit main power supply.

The Control Power includes the oil sump heater power. For unit mounted starters, control power is supplied by a unit mounted control transformer. Dunham-Bush supplied remote mounted starters also include a control circuit transformer to provide 115 VAC.

Medium voltage units require a separate 460/3/60 or 400/3/50 power source for the oil pump and control power transformer.

## Unit and Field Mounted Disconnects

“Disconnecting means” are described in Article 440 of the National Electric Code (NEC) which requires “disconnecting means capable of disconnecting air conditioning and refrigeration equipment including motor-compressors, and controllers from the circuit feeder”. If the fused disconnect option is not supplied, then the disconnects by others should be selected and located within the NEC guidelines. Location requirements per NEC, indicate that the disconnect be located in a readily accessible position within sight (50 feet) of the unit. Maximum recommended fuse or CB breaker sizes are found in the Electrical Data Tables in this catalog. Maximum wire sizes that the unit can accept, are listed in the Electrical Data Table in this catalog.

## Control Circuits

115 volt control circuit terminals are clearly marked on the electrical diagram found in the control panel for control power.

Contact our Application Engineering Department for help with other requirements.

## Cooler Design Data

1. **Maximum—LCFT** (Leaving Chilled Fluid Temperature) is 50°F (10°C). The unit can start and pull down with up to 90°F (32.2°C) entering water temperature.

2. **Minimum—LCFT** is 38°F (3.3°C) for all unit models being applied to water applications using standard coolers. Consult factory for other operating conditions below 38°F (3.3°C) or use ethylene or propylene glycol.

3. **Operating Leaving Temperature Applications** using ethylene or propylene glycol can be applied from 50 to 20°F (10.0 to -6.7°C). These are often process or thermal storage applications and may require special attention from your local Dunham-Bush Sales Representative for selections and other details.

4. **Minimum/Maximum Flow Rates Data** and vessel fluid volume is found in the Physical Data section of this catalog.

5a. **Two Pass Coolers** are considered **Standard** and are used for most Air Conditioning and Process Applications. They have a chilled fluid temperature difference range from 8° to 14°F (4.4° to 7.8°C). Consult factory for all special applications.

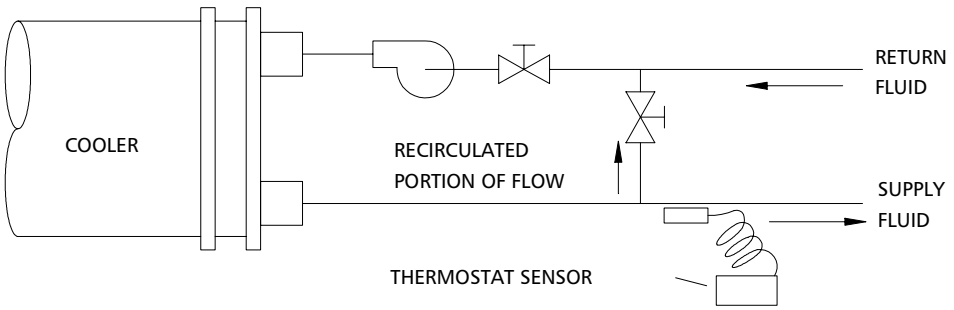
5b. **Single Pass Coolers** are used for Narrow Temperature Range Applications, and have a chilled fluid temperature difference range from 3° to 10°F (1.7° to 5.6°C). Consult factory for special applications.

5c. **Three Pass Coolers** are used for Wide Range Applications, and have an effective chiller operating chilled fluid temperature difference range from 10° to 20°F (5.6° to 11.1°C). Extra wide ranges may be applied for special applications. Consult factory for all special applications not listed above.

6. **Wide Range - Low Flow Chiller Operation** can be accomplished with a by-pass recirculation method of piping, to allow the chiller to operate with acceptable flow rates as shown in Figure 26A. This is a suggested arrangement and special engineering of piping, valving, and sensor locations is required to ensure proper operation.

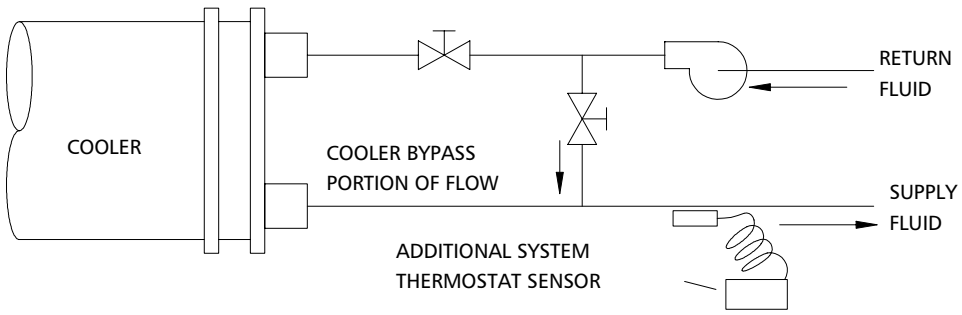
7. **For Extra Narrow and Wide Range Applications** a by-pass piping arrangement can be used similar to Figure 26B. This is a suggested arrangement and special engineering of piping, valving, and sensor locations is required to ensure proper operation.

**Figure 26A**




The mixed fluid temperature range through the cooler, for units with standard coolers, should not be less than 6°F (3.3°C).

**Figure 26B**




This fluid mixes after the cooler.

## Chilled Fluid Loop Volume (CFLV)

Careful consideration needs to be given to the "Chilled Fluid Loop Volume" (CFLV) or System / Inertia to maintain an acceptable leaving fluid temperature.

**Small Loop Volume Systems** may have temperature control problems due to the small fluid volume in the system. This "System Inertia Problem" is exaggerated at low load conditions and causes chiller to short cycle. The small fluid volume in the system will be pulled down to setpoint in a very short period of time, and the chiller will be shut down. The chiller's anti-recycle timer limits the number of starts to three per hour. The system loop temperature will warm up during this off cycle and may require cooling before the anti- recycle timer has timed out. Once the anti-recycle timer has timed out the unit will re-start and the chiller will again load up possibly to 100% and pull the loop down again repeating the short cycle pattern.

**The System Loop Volume** should be sized to limit the temperature rise that can occur during the off cycle.

**Air Conditioning Applications**
The chilled fluid loop volume must be at least 3 gallons per nominal ton of cooling (3.25 L per kW).

**Process & Special Air Conditioning Applications**
Where leaving fluid temperature is often more critical, the chilled fluid loop volume should be increased to 6 to 10 gallons per ton (6.5 to 10.8 L per KW).

**Table 27A** **Quick Reference—Minimum Chilled Fluid Loop Volume***

| PCX Model | Air Conditioning Applications | | Process Applications | | | | |
|---|---|---|---|---|---|---|---|
| | Gallons | Liters | Gallons | Liters | | Gallons | Liters |
| 030 | 900 | 3406 | 1800 | 6813 | To | 3000 | 11355 |
| 040 | 1200 | 4542 | 2400 | 9084 | To | 4000 | 15140 |
| 050 | 1500 | 5677 | 3000 | 11355 | To | 5000 | 18925 |

*Values based on nominal capacity at 10°F (5.6°C) chilled fluid temperature range.

| Type of Application | Gal/Ton | L/KW |
|---|---|---|
| Normal Air Conditioning | 3 | 3.25 |
| Process Cooling | 6 - 10 | 6.5 - 10.8 |

Gallons = Gal/Ton x ARI Capacity in Tons
Liters = L/KW x ARI capacity in KW

For applications with other than 10°F (5.6°C) range, calculate the system loop volume based on chilled water temperature range / 10 x minimum loop volume shown above. Example: PCX 040 running at 14°F range = 14° / 10°F x 1200 gallons = 1680 gallons corrected system fluid loop volume.

**Tanks for System Volume Enhancement**
It may be necessary to install a tank in the system to provide sufficient system fluid volume, as shown below.

**Figure 27A** Single Loop System with Storage Tank to Increase Loop Volume

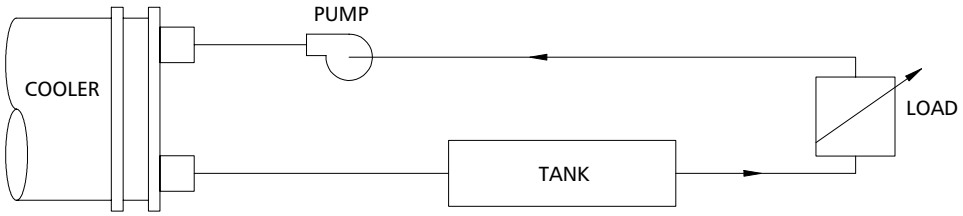
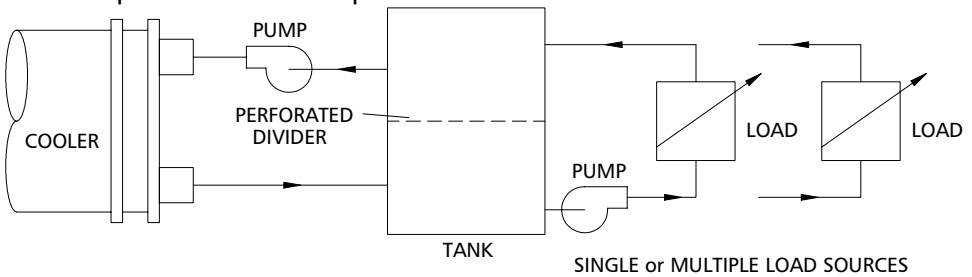



**Figure 27B** Primary and Secondary Loop Systems are normally used where the secondary system has variable flow and/or multiple loads. See example below.



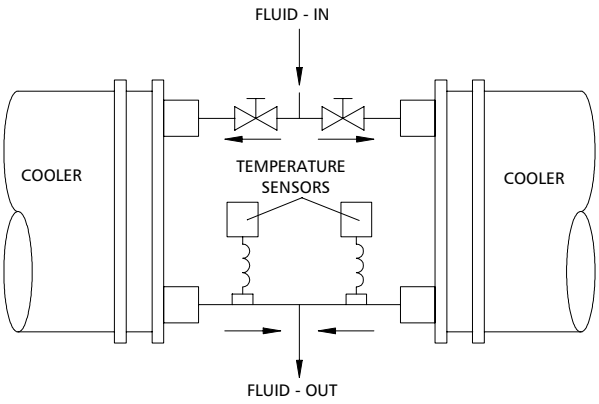
## Multiple Chillers Per Chilled Water System

1. Where the load is greater than one PCXi can supply or where standby capacity is required or the load profile dictates, multiple chillers may be piped in parallel. Units of equal size help to ensure fluid flow balance, but balancing valves ensure balanced flows even with dissimilar chillers. Temperature controller sensors may or may not need to be moved to the common fluid piping depending on the specific application.

2. Parallel Chiller Applications (Figure 28A). Both units operate simultaneously modulating with load variations. Each unit operates independently sensing its own leaving water temperature. The set point of each sensor is set to maintain the desired loading scheme.

   If unit sequencing is required, special programming and interconnecting wiring are required. Additional water control piping may also be required.

**Figure 28A**

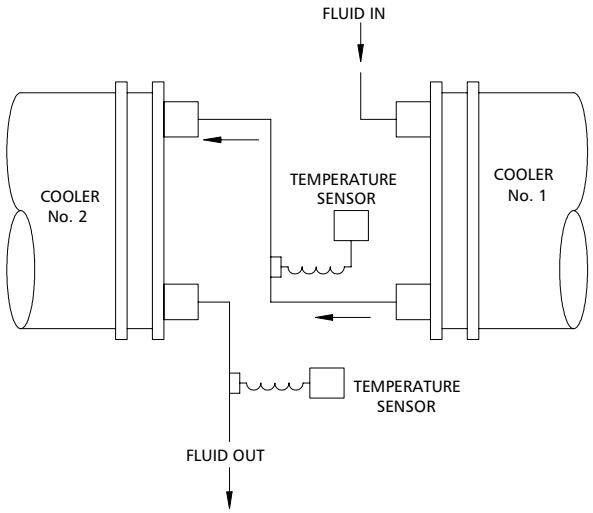



CONTACT FACTORY FOR ADDITIONAL SENSOR AND CONTROL SCHEME

3. Series Chiller Applications (Figure 28B). Where a large temperature range is required (generally over 15°F [8.4°C]), the chiller may be piped in series. If load balancing is not required, the units are controlled independently. Chiller Number 1 will operate up to full load when the system requirements are within its capability.

   If load balancing is required, special programming and interconnecting wiring are required. The load is progressive by temperature so the chiller selections are critical.

**Figure 28B**




## Oversizing Chillers

***Oversizing*** of chillers more than 10-15% is not recommended. Oversizing causes energy inefficiency and shortened compressor life due to excessive compressor cycling. Larger future load requirements may cause temporary oversizing of equipment which will require careful unit selection. It may be better to properly size for the present load and add another unit later for future expansion. It is also recommended using multiple units where operation at minimum load is critical. Fully loaded equipment operates better and more efficiently than large equipment running at or near minimum capacity.

Hot gas bypass should not be a means to allow oversizing of chillers. Hot gas bypass should only be used where the equipment is sized properly for full load but the load turn down is less than the minimum unloading capacity available.

## Water (Fluid) Strainers

It is recommended that 40-mesh strainers be installed in the fluid piping as close to unit cooler as possible to prevent plugging or damage to the tubes.

## Cooling Tower Control and Condenser Application Design Data

**Cooling Tower and Head Pressure Control** is imperative for proper trouble free chiller operation. There are several methods of tower and head pressure that we will discuss below.

**Condenser Water Temperature** should never go below 60°F (15.6°C) and its rate of change should not be rapid. Rapid is defined as not exceeding 2°F (1.1°C) per minute. If this cannot be guaranteed, then other controls such as tower dampers, tower sump heater, 3-way tower bypass valve, 2-way tower throttling valve or variable speed condenser pumping must be utilized. This is necessary because a chiller operates in a dynamic environment and is designed to maintain a precise leaving chilled water temperature under varying entering conditions. The additional dynamics of rapidly varying condenser water temperature subjects the machine to fluctuating pressure differentials across the cooler and condenser. This varies the refrigerant flow and, therefore, the capacity and efficiency of the chiller. If this occurs faster than the machine can accommodate, the head pressure or suction pressure will soon exceed their safety setpoints and the machine will shut down. Through an optional analog output board, the microcomputer can control the bypass or throttling valve directly from condenser pressure, by sending a 0 to 10 VDC signal to a direct current, valve motor actuator.

The Dunham-Bush microcomputer can provide a digital signal to enable the control circuit of the tower.

**Condenser Water Regulating Valves** are a desirable method of head pressure control, because they respond directly to changes in head pressure and provide the most stable method of head pressure control. Stable head pressure control allows the chiller to operate at the best efficiency for the load conditions.

**Cooling Tower and Head Pressure Control** can be attained via fan cycling if the tower is rated at the same capacity as the chiller, and the machine will operate at design conditions under heavy load. On multiple chiller installations, a single tower may be sized, for a multiple of the individual chillers. If this is true and only one machine is running, the tower is then oversized, relative to the individual chiller needs, and head pressure control becomes a challenge. On other installations, the tower/chiller might be oversized to the design load and the machine and tower frequently cycle under light loads. Under these conditions, fan cycling might result in very rapid temperature swings, which creates a dynamic situation that occurs faster than the chiller control system can accommodate. Variable speed fans or modulating valve control should be used to maintain system stability.

**Condenser Water Pump** must be controlled by the chiller to ensure there is no condenser water flow until start-up.

**Fan Cycling Tower Control** is one method of head pressure control, but this type of control does not work for all systems. We recommend that the condenser water pump control through the unit interlock, in the chiller control panel, be used to enable and disable the condenser water pumps. We further recommend that the designer carefully evaluate the system to determine a precise method of tower fan and water pump temperature control for the most efficient method of head pressure control.

1. **Minimum—ECWT** (Entering Condenser Water Temperature) is 60°F (15.6°C) to start the unit, and maintain head pressure control for proper unit operation. The water temperature change rate must be less than 2°F (1.1°C) per minute to assure proper chiller operating stability. This is necessary because it operates in a dynamic environment. Head pressure through water regulating control valves or bypass piping should be used where lower ECWT is expected.
2. **Maximum—ECWT** (Entering Condenser Water Temperature) is 95°F (35°C) without loss of unit capacity or potential high condensing temperature/ pressure shutdown. The water temperature change rate must be less than 2°F (1.1°C) per minute to assure proper chiller operating stability. For higher condenser entering water temperature, consult the factory.
3. **Unit Operating Efficiency** and trouble free operation is greatly influenced by the entering condenser water temperature, proper flow, and the mean temperature of the condenser water.

4. **Minimum/Maximum Flow Rates Data** and vessel fluid volume is found in the Physical Data section of this catalog.
5. **Condenser Water Pressure Drop Data** is found in the unit features section of this catalog.
6. **Wide Condenser Water Temperature Ranges** for units operating with 95° ECWT (35°C) and higher**,** and wider than 10°F (5.6°C) range, increases the unit condensing temperature and decreases the unit efficiency. This situation is usually found in applications with undersized condenser water towers.
7. **Narrow Condenser Water Temperature Ranges** are desirable for unit efficiency, because it reduces the mean condensing temperature.

## Glycol Freeze Protection

If the chiller or fluid piping may be exposed to temperatures below freezing, glycol protection is recommended if the water is not drained. The recommended protection is 10°F (5.6°C) below the minimum ambient temperature in the equipment room and around piping. Use only glycol solutions approved for heat exchanger duty. **DO NOT** use automotive anti-freeze.

If the equipment is being used for applications below 38°F (3.3°C), glycol should be used to prevent freeze damage. The freeze protection level should be 10°F (5.6°C) lower than the leaving brine temperature.

**Table 31A**

**Ethylene Glycol**

| % E.G. By Mass | FREEZE POINT | |
|---|---|---|
| | °F | °C |
| 10 | 26.2 | -3.2 |
| 15 | 22.2 | -5.3 |
| 20 | 17.9 | -7.9 |
| 25 | 12.7 | -10.8 |
| 30 | 6.7 | -14.1 |
| 35 | -0.2 | -17.8 |
| 40 | -8.1 | -25.8 |
| 45 | -17.5 | -27.5 |
| 50 | -28.9 | -33.8 |

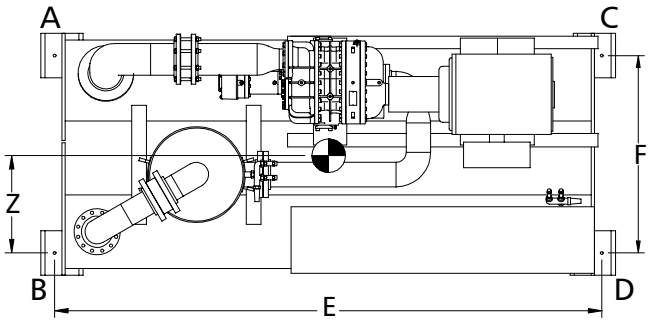
**Table 31B**

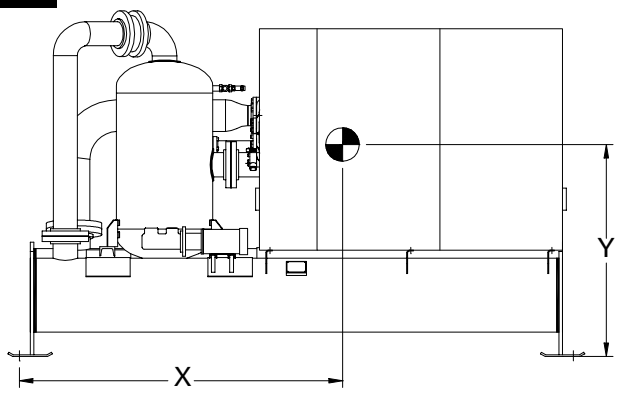
**Propylene Glycol**

| % P.G. by Mass | FREEZE POINT | |
|---|---|---|
| | °F | °C |
| 10 | 26.1 | -3.3 |
| 15 | 22.9 | -5.1 |
| 20 | 19.2 | -7.2 |
| 25 | 14.7 | -9.7 |
| 30 | 9.2 | -12.8 |
| 35 | 2.4 | -16.6 |
| 40 | -6.0 | -21.3 |
| 45 | -16.1 | -27.0 |
| 50 | -28.3 | -33.8 |

# APPLICATION DATA: POINT-LOADINGS

## ENGLISH I.P.



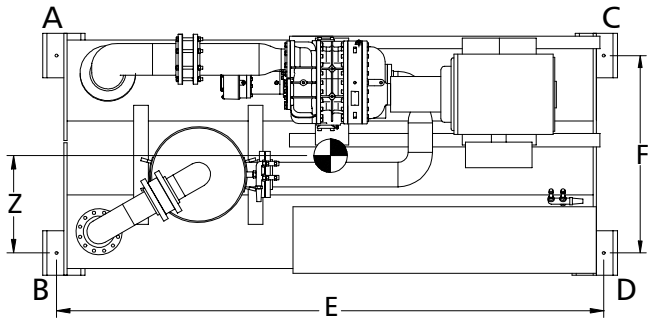



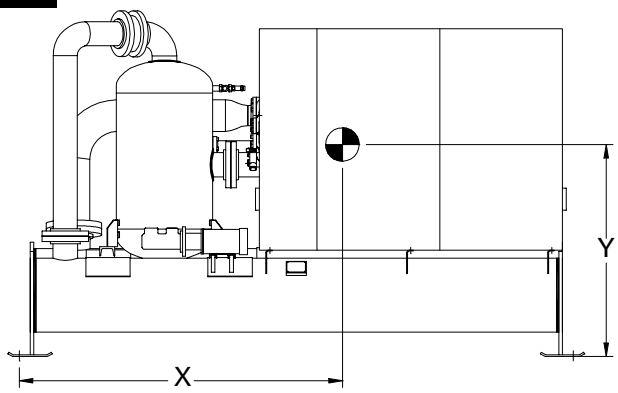

| Model | Cooler Code | Cond. Code | Comp. | Motor | Operating Weight A lbs. | B lbs. | C lbs. | D lbs. | Total lbs. | Shipping Weight lbs. | X in. | Y in. | Z in. | E in. | F in. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ***PCX$_i$* 030** | | | | | | | | | | | | | | | |
| 60Hz, STD | F6 | E6 | 2010 | Low Volt Motor | 3115 | 3710 | 3630 | 4325 | 14780 | 13720 | 80 | 25 | 36 | 148 | 53.50 |
| 60Hz, STD | F6 | E6 | 2010 | Med Volt Motor | 3040 | 3910 | 3930 | 5050 | 15930 | 14870 | 84 | 24 | 38 | 148 | 53.50 |
| 60Hz, Single O.S. Clr. | G6 | E7 | 2010 | Low Volt Motor | 3305 | 3965 | 3845 | 4610 | 15725 | 14515 | 80 | 27 | 35 | 148 | 58.00 |
| 60Hz, Single O.S. Clr. | G6 | E7 | 2010 | Med Volt Motor | 3235 | 4160 | 4150 | 5330 | 16875 | 15665 | 84 | 26 | 37 | 148 | 58.00 |
| 60Hz, DBL O.S. Clr. | H6 | F6 | 2010 | Low Volt Motor | 3715 | 4450 | 4250 | 5085 | 17500 | 15980 | 79 | 28 | 34 | 148 | 59.00 |
| 60Hz, DBL O.S. Clr. | H6 | F6 | 2010 | Med Volt Motor | 3655 | 4635 | 4565 | 5795 | 18650 | 17135 | 83 | 27 | 36 | 148 | 59.00 |
| 50Hz, STD | F5 | D6 | 2010 | Low Volt Motor | 2835 | 3450 | 3375 | 4110 | 13770 | 12885 | 81 | 24 | 36 | 148 | 52.75 |
| 50Hz, STD | F5 | D6 | 2010 | Med Volt Motor | 2770 | 3645 | 3675 | 4835 | 14925 | 14035 | 85 | 23 | 38 | 148 | 52.75 |
| 50Hz, Single O.S. Clr. | F6 | E6 | 2010 | Low Volt Motor | 3085 | 3680 | 3620 | 4320 | 14705 | 13645 | 80 | 25 | 35 | 148 | 53.50 |
| 50Hz, Single O.S. Clr. | F6 | E6 | 2010 | Med Volt Motor | 3015 | 3875 | 3920 | 5045 | 15855 | 14790 | 84 | 24 | 37 | 148 | 53.50 |
| 50Hz, DBL O.S. Clr. | G6 | E7 | 2010 | Low Volt Motor | 3280 | 3935 | 3835 | 4600 | 15650 | 14435 | 80 | 27 | 35 | 148 | 58.00 |
| 50Hz, DBL O.S. Clr. | G6 | E7 | 2010 | Med Volt Motor | 3210 | 4125 | 4140 | 5320 | 16795 | 15590 | 84 | 26 | 37 | 148 | 58.00 |
| ***PCX$_i$* 040** | | | | | | | | | | | | | | | |
| 60Hz, STD | H6 | F6 | 2015 | Low Volt Motor | 3800 | 4675 | 4510 | 5545 | 18530 | 17010 | 81 | 27 | 36 | 148 | 59.00 |
| 60Hz, STD | H6 | F6 | 2015 | Med Volt Motor | 3755 | 4780 | 4710 | 5990 | 19235 | 17710 | 83 | 27 | 37 | 148 | 59.00 |
| 60Hz, Single O.S. Clr. | K6 | G6 | 2015 | Low Volt Motor | 4430 | 5250 | 5155 | 6110 | 20945 | 19105 | 80 | 29 | 35 | 148 | 61.88 |
| 60Hz, Single O.S. Clr. | K6 | G6 | 2015 | Med Volt Motor | 4390 | 5355 | 5365 | 6540 | 21650 | 19805 | 82 | 29 | 36 | 148 | 61.88 |
| 60Hz, DBL O.S. Clr. | L6 | H6 | 2015 | Low Volt Motor | 5065 | 5660 | 5800 | 6475 | 23000 | 20755 | 80 | 31 | 35 | 148 | 63.00 |
| 60Hz, DBL O.S. Clr. | L6 | H6 | 2015 | Med Volt Motor | 5025 | 5760 | 6020 | 6900 | 23705 | 21455 | 81 | 31 | 36 | 148 | 63.00 |
| 50Hz, STD | G6 | E7 | 2015 | Low Volt Motor | 3370 | 4120 | 4000 | 4890 | 16380 | 15170 | 81 | 27 | 36 | 148 | 58.00 |
| 50Hz, STD | G6 | E7 | 2015 | Med Volt Motor | 3315 | 4280 | 4245 | 5485 | 17325 | 16115 | 84 | 26 | 37 | 148 | 58.00 |
| 50Hz, Single O.S. Clr. | H6 | F6 | 2015 | Low Volt Motor | 3785 | 4605 | 4405 | 5360 | 18155 | 16630 | 80 | 27 | 35 | 148 | 59.00 |
| 50Hz, Single O.S. Clr. | H6 | F6 | 2015 | Med Volt Motor | 3735 | 4760 | 4665 | 5945 | 19105 | 17585 | 83 | 27 | 37 | 148 | 59.00 |
| 50Hz, DBL O.S. Clr. | K6 | G6 | 2015 | Low Volt Motor | 4410 | 5180 | 5045 | 5930 | 20565 | 18730 | 79 | 30 | 34 | 148 | 61.88 |
| 50Hz, DBL O.S. Clr. | K6 | G6 | 2015 | Med Volt Motor | 4365 | 5335 | 5320 | 6500 | 21520 | 19680 | 82 | 29 | 36 | 148 | 61.88 |
| ***PCX$_i$* 050** | | | | | | | | | | | | | | | |
| 60Hz, STD | K6 | G6 | 2018 | Low Volt Motor | 4535 | 5390 | 5295 | 6295 | 21515 | 19675 | 80 | 29 | 36 | 148 | 61.88 |
| 60Hz, STD | K6 | G6 | 2018 | Med Volt Motor | 4510 | 5510 | 5480 | 6695 | 22195 | 20355 | 82 | 29 | 36 | 148 | 61.88 |
| 60Hz, Single O.S. Clr. | L6 | H6 | 2018 | Low Volt Motor | 5170 | 5795 | 5940 | 6655 | 23560 | 21330 | 80 | 31 | 36 | 148 | 63.00 |
| 60Hz, Single O.S. Clr. | L6 | H6 | 2018 | Med Volt Motor | 5150 | 5915 | 6135 | 7045 | 24245 | 22000 | 81 | 30 | 37 | 148 | 63.00 |
| 50Hz, STD | H6 | F6 | 2018 | Low Volt Motor | 3835 | 4750 | 4615 | 5715 | 18915 | 17400 | 81 | 27 | 36 | 148 | 59.00 |
| 50Hz, STD | H6 | F6 | 2018 | Med Volt Motor | 3810 | 4870 | 4790 | 6125 | 19595 | 18075 | 83 | 27 | 37 | 148 | 59.00 |
| 50Hz, Single O.S. Clr. | K6 | G6 | 2018 | Low Volt Motor | 4470 | 5330 | 5265 | 6275 | 21340 | 19500 | 81 | 29 | 35 | 148 | 61.88 |
| 50Hz, Single O.S. Clr. | K6 | G6 | 2018 | Med Volt Motor | 4445 | 5445 | 5450 | 6675 | 22015 | 20175 | 82 | 29 | 36 | 148 | 61.88 |
| 50Hz, DBL O.S. Clr. | L6 | H6 | 2018 | Low Volt Motor | 5100 | 5730 | 5910 | 6640 | 23380 | 21145 | 80 | 31 | 36 | 148 | 63.00 |
| 50Hz, DBL O.S. Clr. | L6 | H6 | 2018 | Med Volt Motor | 5080 | 5850 | 6105 | 7030 | 24065 | 21825 | 81 | 30 | 37 | 148 | 63.00 |

Notes: Low Voltage Motor - 460/3/60, 575/3/60 and 400/3/50
Medium Voltage Motor - 2300/3/60, 4160/3/60 and 3300/3/50
X, Y, and Z Designates Location for Center of Gravity

# APPLICATION DATA: POINT-LOADINGS

## METRIC S. I.

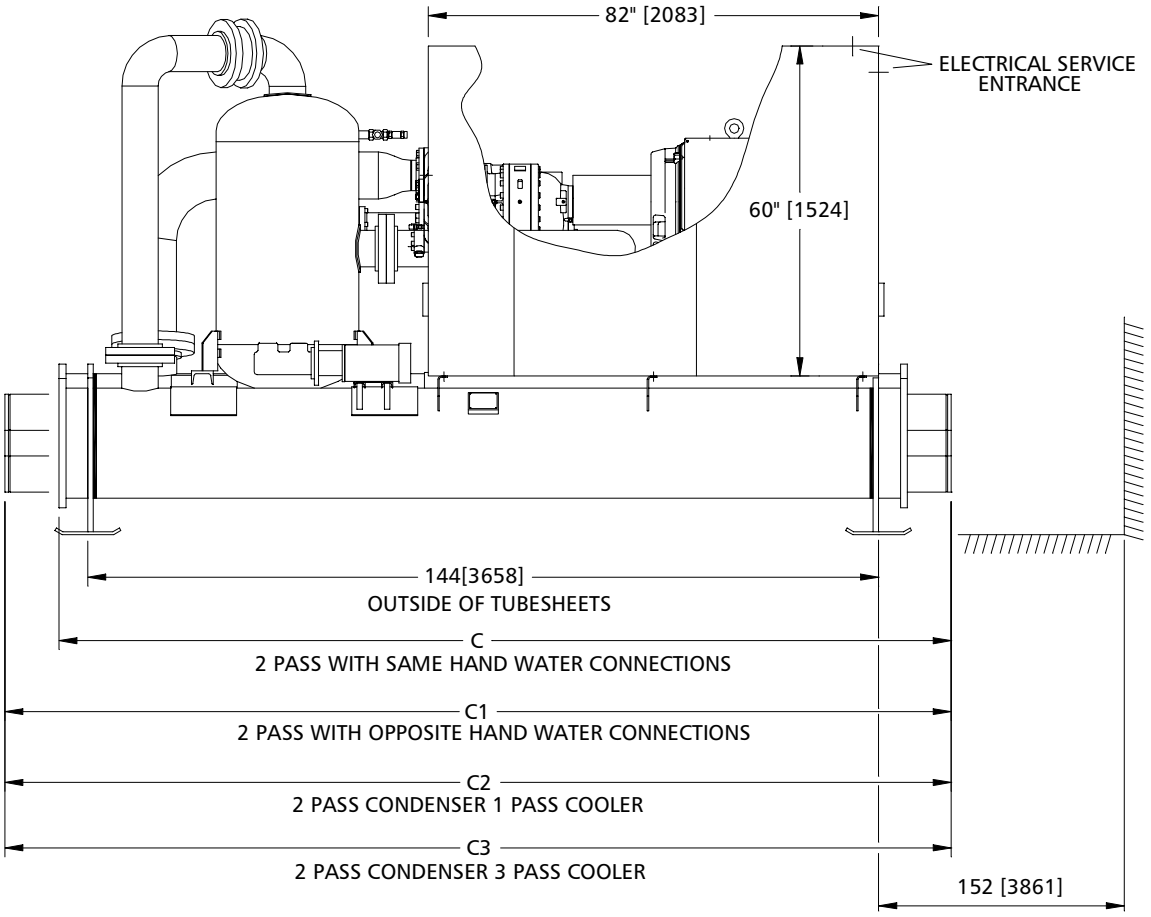


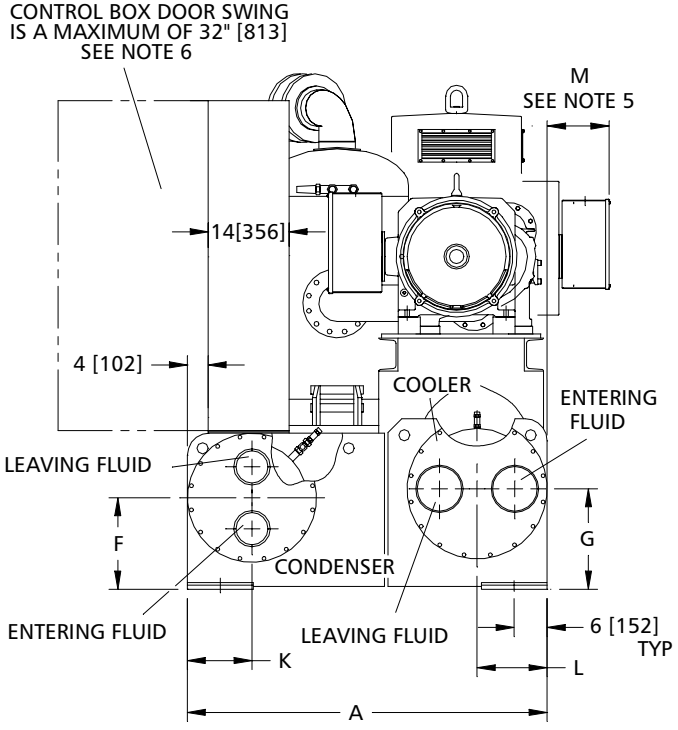




| Model | Cooler Code | Cond. Code | Comp. | Motor | Operating Weight A kgs. | B kgs. | C kgs. | D kgs. | Total kgs. | Shipping Weight kgs. | X cm. | Y cm. | Z cm. | E cm. | F cm. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ***PCXi* 030** | | | | | | | | | | | | | | | |
| 60Hz, STD | F6 | E6 | 2010 | Low Volt Motor | 1413 | 1683 | 1647 | 1962 | 6704 | 6223 | 203 | 64 | 91 | 376 | 136 |
| 60Hz, STD | F6 | E6 | 2010 | Med Volt Motor | 1379 | 1774 | 1783 | 2291 | 7226 | 6745 | 214 | 61 | 96 | 376 | 136 |
| 60Hz, Single O.S. Clr. | G6 | E7 | 2010 | Low Volt Motor | 1499 | 1799 | 1744 | 2091 | 7133 | 6584 | 203 | 69 | 89 | 376 | 147 |
| 60Hz, Single O.S. Clr. | G6 | E7 | 2010 | Med Volt Motor | 1467 | 1887 | 1882 | 2418 | 7655 | 7106 | 213 | 66 | 93 | 376 | 147 |
| 60Hz, DBL O.S. Clr. | H6 | F6 | 2010 | Low Volt Motor | 1685 | 2019 | 1928 | 2307 | 7938 | 7249 | 202 | 70 | 87 | 376 | 150 |
| 60Hz, DBL O.S. Clr. | H6 | F6 | 2010 | Med Volt Motor | 1658 | 2102 | 2071 | 2629 | 8460 | 7772 | 211 | 68 | 91 | 376 | 150 |
| 50Hz, STD | F5 | D6 | 2010 | Low Volt Motor | 1286 | 1565 | 1531 | 1864 | 6246 | 5845 | 205 | 62 | 91 | 376 | 134 |
| 50Hz, STD | F5 | D6 | 2010 | Med Volt Motor | 1256 | 1653 | 1667 | 2193 | 6770 | 6366 | 216 | 59 | 96 | 376 | 134 |
| 50Hz, Single O.S. Clr. | F6 | E6 | 2010 | Low Volt Motor | 1399 | 1669 | 1642 | 1960 | 6670 | 6189 | 204 | 64 | 90 | 376 | 136 |
| 50Hz, Single O.S. Clr. | F6 | E6 | 2010 | Med Volt Motor | 1368 | 1758 | 1778 | 2288 | 7192 | 6709 | 214 | 61 | 95 | 376 | 136 |
| 50Hz, DBL O.S. Clr. | G6 | E7 | 2010 | Low Volt Motor | 1488 | 1785 | 1740 | 2087 | 7099 | 6548 | 204 | 69 | 88 | 376 | 147 |
| 50Hz, DBL O.S. Clr. | G6 | E7 | 2010 | Med Volt Motor | 1456 | 1871 | 1878 | 2413 | 7618 | 7072 | 214 | 66 | 93 | 376 | 147 |
| ***PCXi* 040** | | | | | | | | | | | | | | | |
| 60Hz, STD | H6 | F6 | 2015 | Low Volt Motor | 1724 | 2121 | 2046 | 2515 | 8405 | 7716 | 205 | 69 | 91 | 376 | 150 |
| 60Hz, STD | H6 | F6 | 2015 | Med Volt Motor | 1703 | 2168 | 2136 | 2717 | 8725 | 8033 | 211 | 68 | 93 | 376 | 150 |
| 60Hz, Single O.S. Clr. | K6 | G6 | 2015 | Low Volt Motor | 2009 | 2381 | 2338 | 2771 | 9501 | 8666 | 204 | 75 | 89 | 376 | 157 |
| 60Hz, Single O.S. Clr. | K6 | G6 | 2015 | Med Volt Motor | 1991 | 2429 | 2434 | 2967 | 9820 | 8984 | 208 | 74 | 91 | 376 | 157 |
| 60Hz, DBL O.S. Clr. | L6 | H6 | 2015 | Low Volt Motor | 2297 | 2567 | 2631 | 2937 | 10433 | 9414 | 202 | 79 | 90 | 376 | 160 |
| 60Hz, DBL O.S. Clr. | L6 | H6 | 2015 | Med Volt Motor | 2279 | 2613 | 2731 | 3130 | 10753 | 9732 | 207 | 78 | 92 | 376 | 160 |
| 50Hz, STD | G6 | E7 | 2015 | Low Volt Motor | 1529 | 1869 | 1814 | 2218 | 7430 | 6881 | 205 | 68 | 91 | 376 | 147 |
| 50Hz, STD | G6 | E7 | 2015 | Med Volt Motor | 1504 | 1941 | 1926 | 2488 | 7859 | 7310 | 213 | 66 | 95 | 376 | 147 |
| 50Hz, Single O.S. Clr. | H6 | F6 | 2015 | Low Volt Motor | 1717 | 2089 | 1998 | 2431 | 8235 | 7543 | 204 | 70 | 89 | 376 | 150 |
| 50Hz, Single O.S. Clr. | H6 | F6 | 2015 | Med Volt Motor | 1694 | 2159 | 2116 | 2697 | 8666 | 7977 | 211 | 68 | 93 | 376 | 150 |
| 50Hz, DBL O.S. Clr. | K6 | G6 | 2015 | Low Volt Motor | 2000 | 2350 | 2288 | 2690 | 9328 | 8496 | 202 | 75 | 87 | 376 | 157 |
| 50Hz, DBL O.S. Clr. | K6 | G6 | 2015 | Med Volt Motor | 1980 | 2420 | 2413 | 2948 | 9761 | 8927 | 208 | 73 | 91 | 376 | 157 |
| ***PCXi* 050** | | | | | | | | | | | | | | | |
| 60Hz, STD | K6 | G6 | 2018 | Low Volt Motor | 2057 | 2445 | 2402 | 2855 | 9759 | 8925 | 204 | 75 | 91 | 376 | 157 |
| 60Hz, STD | K6 | G6 | 2018 | Med Volt Motor | 2046 | 2499 | 2486 | 3037 | 10068 | 9233 | 208 | 73 | 93 | 376 | 157 |
| 60Hz, Single O.S. Clr. | L6 | H6 | 2018 | Low Volt Motor | 2345 | 2629 | 2694 | 3019 | 10687 | 9675 | 202 | 79 | 91 | 376 | 160 |
| 60Hz, Single O.S. Clr. | L6 | H6 | 2018 | Med Volt Motor | 2336 | 2683 | 2783 | 3196 | 10998 | 9979 | 206 | 77 | 93 | 376 | 160 |
| 50Hz, STD | H6 | F6 | 2018 | Low Volt Motor | 1740 | 2155 | 2093 | 2592 | 8580 | 7893 | 206 | 69 | 91 | 376 | 150 |
| 50Hz, STD | H6 | F6 | 2018 | Med Volt Motor | 1728 | 2209 | 2173 | 2778 | 8888 | 8199 | 211 | 67 | 94 | 376 | 150 |
| 50Hz, Single O.S. Clr. | K6 | G6 | 2018 | Low Volt Motor | 2028 | 2418 | 2388 | 2846 | 9680 | 8845 | 205 | 75 | 90 | 376 | 157 |
| 50Hz, Single O.S. Clr. | K6 | G6 | 2018 | Med Volt Motor | 2016 | 2470 | 2472 | 3028 | 9986 | 9151 | 209 | 73 | 92 | 376 | 157 |
| 50Hz, DBL O.S. Clr. | L6 | H6 | 2018 | Low Volt Motor | 2313 | 2599 | 2681 | 3012 | 10605 | 9591 | 203 | 78 | 91 | 376 | 160 |
| 50Hz, DBL O.S. Clr. | L6 | H6 | 2018 | Med Volt Motor | 2304 | 2654 | 2769 | 3189 | 10916 | 9900 | 207 | 77 | 93 | 376 | 160 |

Notes: Low Voltage Motor - 460/3/60, 575/3/60 and 400/3/50
Medium Voltage Motor - 2300/3/60, 4160/3/60 and 3300/3/50
X, Y, and Z Designates Location for Center of Gravity

# DIMENSIONAL DATA




RIGHT SIDE WHEN VIEWING CONTROL BOX

NOTES

1 - IF A DOORWAY OR OTHER PROPERLY LOCATED OPENING IS USED FOR TUBE REMOVAL THE SUGGESTED MINIMUM CLEARANCE IS 36"

2 - SUGGESTED CLEARANCES AROUND THE MACHINE ARE MINIMUM REQUIREMENTS. IT IS STRONGLY RECOMMENDED THAT AT LEAST ONE OF THESE CLEARANCE REQUIREMENTS EXCEED THE MINIMUM TO ALLOW FOR COMPRESSOR OR MOTOR SERVICING.

3 - WHEN LOOKING AT 2 PASS COOLER HEAD CONNECTIONS, FLUID OUTLET IS LEFT CONNECTION, FLUID INLET IS RIGHT CONNECTION AS SUPPLIED BY FACTORY. CUSTOMER MAY REVERSE THIS ARRANGEMENT BUT LEAVING FLUID TEMPERATURE SENSOR MUST BE RELOCATED TO FLUID OUTLET.

4 - SEE PAGE 38 FOR VESSEL CONNECTION SIZES

5 - ' A ' DIMENSION (OVERALL WIDTH) IS USING THE STANDARD LOW VOLTAGE MOTOR, WHEN MEDIUM VOLTAGE MOTOR IS USED ADD ' M ' DIMENSION TO ' A ' FOR OVERALL WIDTH.

6 - CONSULT NEC and LOCAL CODES FOR REQUIRED ELECTRICAL PANEL CLEARANCES.

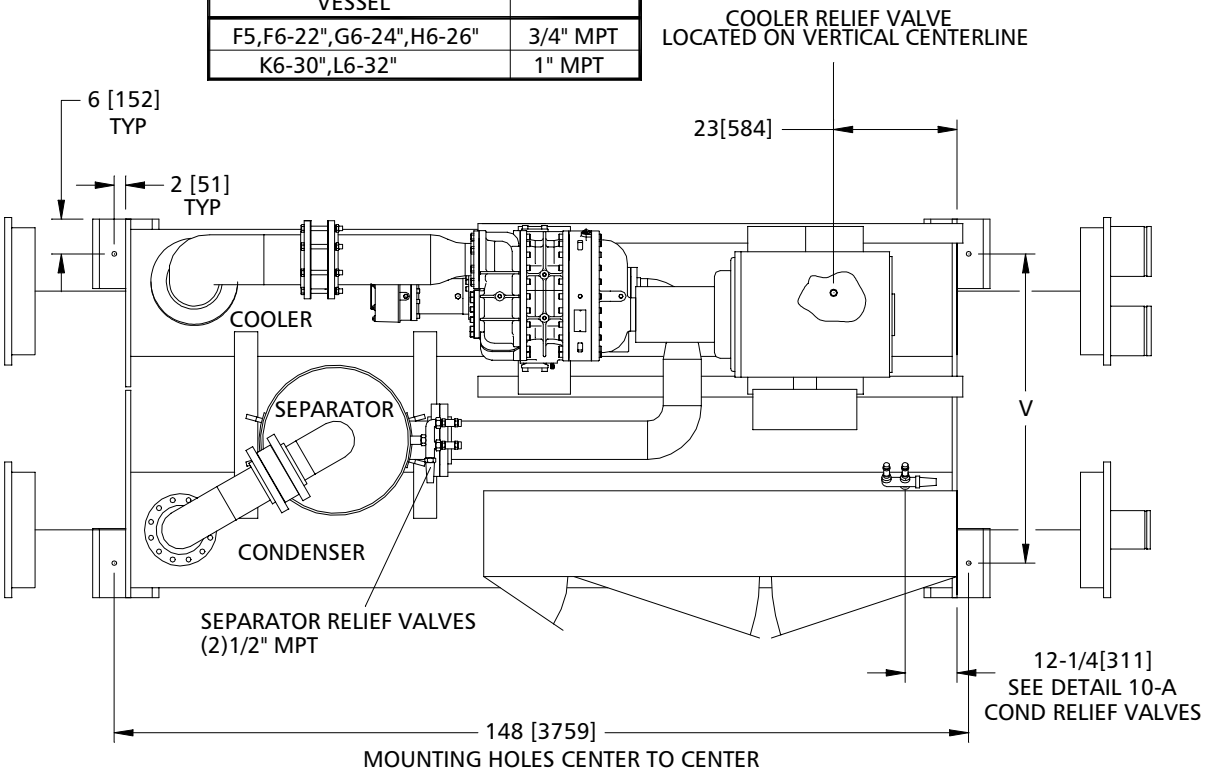
# DIMENSIONAL DATA

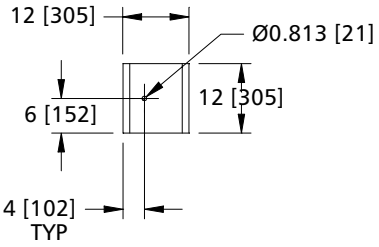
| Model | Cooler | Cond. | A | C | Cl | C2 | C3 |
|---|---|---|---|---|---|---|---|
| **PCXi 030—60 Hz** | | | | | | | |
| Standard Vessel Set | F6-22" | E6,E7-20" | 65-1/2[1664] | 169-5/8[4308] | 174-5/8[4435] | 174-1/8[4423] | 174-3/8[4429] |
| Single Oversized Vessel Set | G6-24" | E6,E7-20" | 70[1778] | 170-1/8[4321] | 175-1/8[4448] | 174-5/8[4436] | 176-1/2[4483] |
| Double Oversized Vessel Set | H6-26" | F6-22" | 71[1803] | 171-3/4[4362] | 176-3/4[4489] | 168[4267] | 173-7/8[4417] |
| **PCXi 040—60 Hz** | | | | | | | |
| Standard Vessel Set | H6-26" | F6-22" | 71[1803] | 171-3/4[4362] | 176-3/4[4489] | 168[4267] | 173-7/8[4417] |
| Single Oversized Vessel Set | K6-30" | G6-24" | 73-7/8[1877] | 171-3/4[4362] | 179-3/8[4556] | 175-5/8[4461] | 179-1/8[4550] |
| Double Oversized Vessel Set | L6-32" | H6-26" | 75[1905] | 171-1/8[4347] | 179-7/8[4569] | 176-1/8[4474] | 179-5/8[4563] |
| **PCXi 050—60 Hz** | | | | | | | |
| Standard Vessel Set | K6-30" | G6-24" | 73-7/8[1877] | 171-3/4[4362] | 179-3/8[4556] | 175-5/8[4461] | 179-1/8[4550] |
| Single Oversized Vessel Set | L6-32" | H6-26" | 75[1905] | 171-1/8[4347] | 179-7/84569] | 176-1/8[44741 | 179-5/8[4563] |
| **PCXi 030—50 Hz** | | | | | | | |
| Standard Vessel Set | F5,F6-22" | D6-18" | 64-3/4[1645] | 164-1/2[4169 | 168-1/4[4274] | 168-1/8[4271] | 168-5/8[4283] |
| Single Oversized Vessel Set | F5,F6-22" | E6,E7-20" | 65-1/2[1664] | 169-5/8[4308] | 174-5/8[4435] | 174-1/8[4423] | 174-3/8[4429] |
| Double Oversized Vessel Set | G6-24" | E6,E7-20" | 70[1778] | 170-1/8[4321] | 175-1/8[4448] | 174-5/8[4436] | 176-1/2[4483] |
| **PCXi 040—50 Hz** | | | | | | | |
| Standard Vessel Set | G6-24" | E7-20" | 70[1778] | 170-1/8[4321] | 175-1/8[4448] | 174-5/8[4436] | 176-1/2[4483] |
| Single Oversized Vessel Set | H6-26" | F6-22" | 71[1803] | 171-3/4[4362] | 176-3/4[4489] | 168[4267] | 173-7/8[4417] |
| Double Oversized Vessel Set | K6-30" | G6-24" | 73-7/8[1877] | 171-3/4[4362] | 179-3/8[4556] | 175-5/8[446] | 179-1/8[4550] |
| **PCXi 050—50 Hz** | | | | | | | |
| Standard Vessel Set | H6-26" | F6-22" | 71[1803] | 171-3/4[4362] | 176-3/4[4489] | 168[4267] | 173-7/8[4417] |
| Single Oversized Vessel Set | K6-30" | G6-24" | 73-7/8[1877] | 171-3/4[4362] | 179-3/8[4556] | 175-5/8[4461] | 179-1/8[4550] |
| Double Oversized Vessel Set | L6-32" | H6-26" | 75[1905] | 171-1/8[4347] | 179-7/8[4569] | 176-1/8[4474] | 179-5/8[4563] |

| Model | Cooler | Cond. | F | G | K | L | M |
|---|---|---|---|---|---|---|---|
| **PCXi 030—60 Hz** | | | | | | | |
| Standard Vessel Set | F6-22" | E6,E7-20" | 16-5/8[422] | 18-1/4[464] | 11-3/4[298] | 12-3/4[324] | 14-7/8[378] |
| Single Oversized Vessel Set | G6-24" | E6,E7-20" | 16-5/8[422] | 19-1/4[489] | 11-3/4[298] | 14[356] | 13-1/2[343] |
| Double Oversized Vessel Set | H6-26" | F6-22" | 17-5/8[448] | 20-1/4[514] | 12-3/4[324] | 15[381] | 12-3/8[314] |
| **PCXi 040—60 Hz** | | | | | | | |
| Standard Vessel Set | H6-26" | F6-22" | 17-5/8[448] | 20-1/4[514] | 12-3/4[324] | 15[381] | 12-3/8[314] |
| Single Oversized Vessel Set | K6-30" | G6-24" | 18-5/8[473] | 22-1/4[565] | 14[356] | 16-5/8[422] | 10-5/8[270] |
| Double Oversized Vessel Set | L6-32" | H6-26" | 19-5/8[499] | 23-1/4[591] | 15[381] | 18[457] | 13-3/8[340] |
| **PCXi 050—60 Hz** | | | | | | | |
| Standard Vessel Set | K6-30" | G6-24" | 18-5/81473] | 22-1/4[565] | 14[356] | 16-5/8[422] | 10-5/8[270] |
| Single Oversized Vessel Set | L6-32" | H6-26" | 19-5/8[499] | 23-1/4[591] | 15[381] | 18[457] | 13-3/8[340] |
| **PCXi 030—50 Hz** | | | | | | | |
| Standard Vessel Set | F5,F6-22" | D6-18" | 15-5/8[397] | 18-1/4[464] | 10-1/2[267] | 12-3/4[324] | 14-3/4[375] |
| Single Oversized Vessel Set | F5,F6-22" | E6,E7-20" | 16-5/8[422] | 18-1/4[464] | 11-3/4[298] | 12-3/4[324] | 14-7/8[378] |
| Double Oversized Vessel Set | G6-24" | E6,E7-20" | 16-5/8[422] | 19-1/4[489] | 11-3/4[298] | 14[356] | 13-1/2[343] |
| **PCXi 040—50 Hz** | | | | | | | |
| Standard Vessel Set | G6-24" | E7-20" | 16-5/8[422] | 19-1/4[489] | 11-3/4[298] | 14[356] | 13-1/2[343] |
| Single Oversized Vessel Set | H6-26" | F6-22" | 17-5/8[448] | 20-1/4[514] | 12-3/4[324] | 15[381] | 12-3/8[314] |
| Double Oversized Vessel Set | K6-30" | G6-24" | 18-5/8[473] | 22-1/4[565] | 14[356] | 16-5/8[422] | 10-5/8[270] |
| **PCXi 050—50 Hz** | | | | | | | |
| Standard Vessel Set | H6-26" | F6-22" | 17-5/8[448] | 20-1/4[514] | 12-3/4[324] | 15[381] | 12-3/8[314] |
| Single Oversized Vessel Set | K6-30" | G6-24" | 18-5/8[473] | 22-1/4[565] | 14[356] | 16-5/8[422] | 10-5/8[270] |
| Double Oversized Vessel Set | L6-32" | H6-26" | 19-5/8[499] | 23-1/4[591] | 15[381] | 18[457] | 13-3/8[340] |

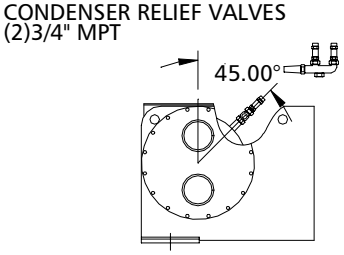
# DIMENSIONAL DATA

| COOLER RELIEF VALVE SIZE | |
|---|---|
| VESSEL | |
| F5,F6-22",G6-24",H6-26" | 3/4" MPT |
| K6-30",L6-32" | 1" MPT |

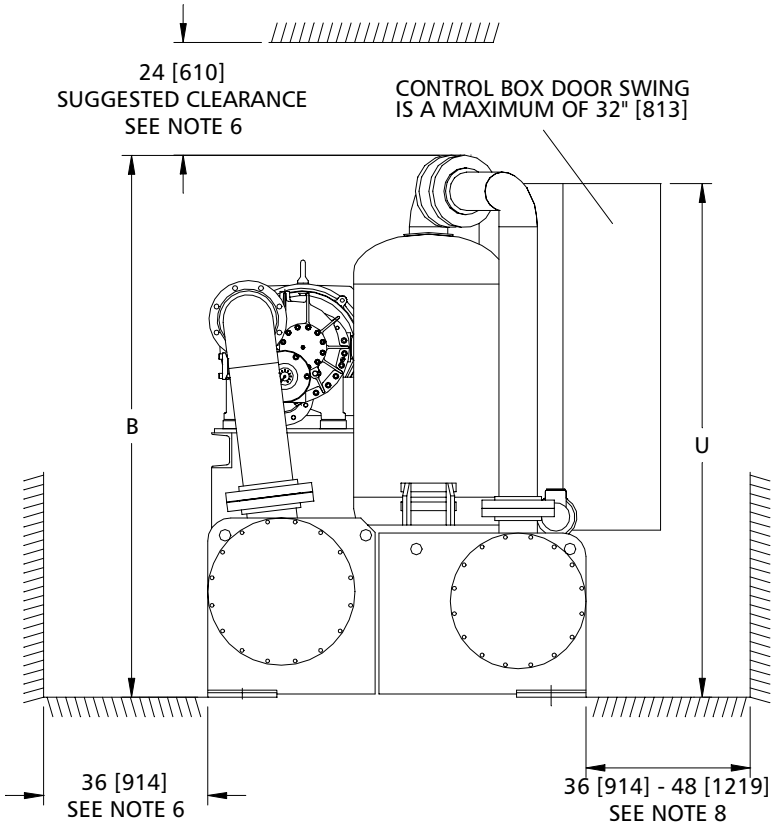



MOUNTING PAD DETAIL




DETAIL 10-A
CONDENSER RELIEF VALVE DETAIL




LEFT SIDE VIEW WHEN VIEWING CONTROL BOX
RIGHT HAND VESSEL CONNECTIONS SHOWN

# DIMENSIONAL DATA

WATER CONNECTION SELECTION

COOLER

| | | |
|---|---|---|
| 1 PASS, LH | ← | |
| 1 PASS, RH | → | |
| 2 PASS, LH | ← | |
| 2 PASS, RH | → | |
| 3 PASS, LH | ← | |
| 3 PASS, RH | → | |

CONDENSER

| | | |
|---|---|---|
| 2 PASS, LH | ← | |
| 2 PASS, RH | → | |

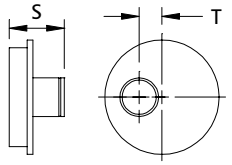
HAND = LEAVING WATER CONNECTION LOCATION
WHEN VIEWED FACING CONTROL BOX

## NOTES

1 - WATER PIPING TO BE SUPPORTED TO MINIMIZE LOAD ON UNIT
2 - ALL DIMENSIONS ARE IN INCHES AND [MILLIMETERS]
3 - VENT AND DRAIN CONNECTIONS PROVIDED ON COOLER AND CONDENSER HEADS
4 - SUFFICIENT ROOM MUST BE ALLOWED FOR COOLER & CONDENSER CONNECTIONS
5 - IF UNIT IS EQUIPPED WITH SKID OPTION ADD AN ADDITIONAL 1/2"[13] TO ALL VERTICAL DIMENSIONS THAT BEGIN AT THE FLOOR
6 - SUGGESTED CLEARANCES AROUND THE MACHINE ARE MINIMUM REQUIREMENTS. IT IS STRONGLY RECOMMENDED THAT AT LEAST ONE OF THESE CLEARANCES REQUIREMENTS EXCEED THE MINIMUM TO ALLOW FOR COMPRESSOR OR MOTOR SERVICING.
7 - WATER CONNECTIONS OF 1 PASS VESSELS ARE ON CENTER LINE OF VESSEL. FOR COOLER USE DIMENSIONS `G' & `L'.
8 - CONSULT NEC and LOCAL CODES FOR REQUIRED ELECTRICAL PANEL CLEARANCES.

| Model | Cooler | Cond. | B | U | V |
|---|---|---|---|---|---|
| ***PCXi* 030—60 Hz** | | | | | |
| Standard Vessel Set | F6-22" | E6,E7-20" | 93-3/4[2381] | 89-1/8[2264] | 53-1/2[1359] |
| Single Oversized Vessel Set | G6-24" | E6,E7-20" | 93-1/2[2375] | 89-1/8[2264] | 58[1473] |
| Double Oversized Vessel Set | H6-26" | F6-22" | 93-3/4[2381] | 91-1/8[2315] | 59[1499] |
| ***PCXi* 040—60 Hz** | | | | | |
| Standard Vessel Set | H6-26" | F6-22" | 94-3/4[2407] | 91-1/8[2315] | 59[1499] |
| Single Oversized Vessel Set | K6-30" | G6-24" | 95[2413] | 93-1/8[2366] | 61-7/8[1572] |
| Double Oversized Vessel Set | L6-32" | H6-26" | 97-1/2[2477] | 95-1/8[2416] | 63[1600] |
| ***PCXi* 050—60 Hz** | | | | | |
| Standard Vessel Set | K6-30" | G6-24" | 95-3/4[2432] | 93-1/8[2366] | 61-7/8[1572] |
| Single Oversized Vessel Set | L6-32" | H6-26" | 98-1/2[2502] | 95-1/8[2416] | 63[1600] |
| ***PCXi* 030—50 Hz** | | | | | |
| Standard Vessel Set | F5,F6-22" | D6-18" | 92-1/8[2340] | 87-1/8[2213] | 52-3/4[1340] |
| Single Oversized Vessel Set | F5,F6-22" | E6,E7-20" | 93-1/4[2369] | 89-1/8[2264] | 53-1/2[1359] |
| Double Oversized Vessel Set | G6-24" | E6,E7-20" | 93[2362] | 89-1/8[2264] | 58[1473] |
| ***PCXi* 040—50 Hz** | | | | | |
| Standard Vessel Set | G6-24" | E7-20" | 94[2388] | 89-1/8[2264] | 58[1473] |
| Single Oversized Vessel Set | H6-26" | F6-22" | 94-1/4[2394] | 91-1/8[2315] | 59[1499] |
| Double Oversized Vessel Set | K6-30" | G6-24" | 94-1/2[2400] | 93-1/8[2366] | 61-7/8[1572] |
| ***PCXi* 050—50 Hz** | | | | | |
| Standard Vessel Set | H6-26" | F6-22" | 94-3/4[2407] | 91-1/8[2315] | 59[1499] |
| Single Oversized Vessel Set | K6-30" | G6-24" | 95[2413] | 93-1/8[2366] | 61-7/8[1572] |
| Double Oversized Vessel Set | L6-32" | H6-26" | 97-1/2[2477] | 95-1/8[2416] | 63[1 600] |

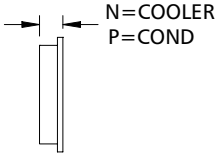
# DIMENSIONAL DATA



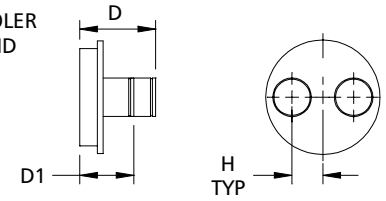

3 PASS HEAD(COOLER ONLY)

NOTE WHEN VIEWING 3 PASS COOLER HEAD
CONN IS ALWAYS TO THE LEFT OF CENTER


1 PASS HEAD(COOLER ONLY)



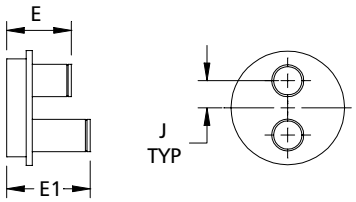

RETURN HEAD




2 PASS COOLER HEAD

NOTE WHEN VIEWING 2 PASS COOLER HEAD
IF CONN'S ARE DIFFERENT LENGTHS THE
LONGEST CONN. IS ALWAYS ON THE RIGHT

| WATER CONNECTION SIZES(SHOWN IN INCHES ONLY) | | | | | | | |
|---|---|---|---|---|---|---|---|
| VESSEL | COOLER | | | VESSEL | CONDENSER | | |
| | 1 PASS | 2 PASS | 3 PASS | | 1 PASS | 2 PASS | 3 PASS |
| F5-22" | 10" | 8" | 6" | D6-18" | NOT AVAIL | 6" | NOT AVAIL |
| F6-22" | 10" | 8" | 8" | E6-20" | NOT AVAIL | 8" | NOT AVAIL |
| G6-24" | 12" | 8" | 8" | E7-20" | NOT AVAIL | 8" | NOT AVAIL |
| H6-26" | 12" | 10" | 8" | F6-22" | NOT AVAIL | 8" | NOT AVAIL |
| K6-30" | 14" | 10" | 8" | G6-24" | NOT AVAIL | 10" | NOT AVAIL |
| L6-32" | 14" | 10" | 8" | H6-26" | NOT AVAIL | 10" | NOT AVAIL |




2 PASS COND HEAD

NOTE WHEN VIEWING COND HEAD, IF CONN'S
ARE DIFFERENT LENGTHS THE LONGEST
CONN. IS ALWAYS ON THE BOTTOM

| Model | Cooler | Cond. | D | D1 | E | E1 | H | J |
|---|---|---|---|---|---|---|---|---|
| ***PCXi* 030—60 Hz** | | | | | | | | |
| Standard Vessel Set | F6-22" | E6,E7-20" | 12-1/2[318] | 12-1/2[318] | 12[305] | 18[457] | 6-7/8[1751] | 6-1/8[156] |
| Single Oversized Vessel Set | G6-24" | E6,E7-20" | 13[330] | 13[330] | 12[305] | 18[457] | 6-7/8[175] | 6-1/8[156] |
| Double Oversized Vessel Set | H6-26" | F6-22" | 20-1/8[511] | 15-1/8[384] | 12-1/2[318] | 12-1/2[318] | 7-3/8[187] | 6-7/8[175] |
| ***PCXi* 040—60 Hz** | | | | | | | | |
| Standard Vessel Set | H6-26" | F6-22" | 20-1/8[5111 | 15-1/8[384] | 12-1/2[318] | 12-1/2[318] | 7-3/8[187] | 6-7/8[175] |
| Single Oversized Vessel Set | K6-30" | G6-24" | 15-5/8[397] | 15-5/8[397] | 14-5/8[372] | 19-5/8[499] | 8-1/8[207] | 6-7/8[175] |
| Double Oversized Vessel Set | L6-32" | H6-26" | 15-5/8[397] | 15-5/8[397] | 15-1/8[384] | 20-1/8[511] | 8-7/8[226] | 7-3/8[187] |
| ***PCXi* 050—60 Hz** | | | | | | | | |
| Standard Vessel Set | K6-30" | G6-24" | 15-5/8[397] | 15-5/8[397] | 14-5/8[372] | 19-5/8[499] | 8-1/8[207] | 6-7/8[175] |
| Single Oversized Vessel Set | L6-32" | H6-26" | 15-5/8[397] | 15-5/8[397] | 15-1/8[384] | 20-1/8[511] | 8-7/8[226] | 7-3/8[187] |
| ***PCXi* 030—50 Hz** | | | | | | | | |
| Standard Vessel Set | F5,F6-22" | D6-18" | 12-1/2[318] | 12-1/2[318] | 11-5/8[295] | 11-5/8[295] | 6-7/8[175] | 5-5/8[143] |
| Single Oversized Vessel Set | F5,F6-22" | E6,E7-20" | 12-1/2[318] | 12-1/2[318] | 12[305] | 18[457] | 6-7/8[175] | 6-1/8[156] |
| Double Oversized Vessel Set | G6-24" | E6,E7-20" | 13[330] | 13[330] | 12[305] | 18[457] | 6-7/8[175] | 6-1/8[156] |
| ***PCXi* 040—50 Hz** | | | | | | | | |
| Standard Vessel Set | G6-24" | E7-20" | 13[330] | 13[330] | 12[305] | 18[457] | 6-7/8[175] | 6-1/8[156] |
| Single Oversized Vessel Set | H6-26" | F6-22" | 120-1/8[511] | 15-1/8[384] | 12-1/2[318] | 12-1/2[318] | 7-3/8[187] | 6-7/8[175] |
| Double Oversized Vessel Set | K6-30" | G6-24" | 15-5/8[397] | 15-5/8[397] | 14-5/8[372] | 19-5/8[499] | 8-1/81207] | 6-7/8[175] |
| ***PCXi* 050—50 Hz** | | | | | | | | |
| Standard Vessel Set | H6-26" | F6-22" | 20-1/8[511] | 15-1/8[384] | 12-1/2[318] | 12-1/2[318] | 7-3/8[187] | 6-7/8[175] |
| Single Oversized Vessel Set | K6-30" | G6-24" | 15-5/8[397] | 15-5/8[397] | 14-5/8[372] | 19-5/8[499] | 8-1/8[207] | 6-7/8[175] |
| Double Oversized Vessel Set | L6-32" | H6-26" | 15-5/8[3971] | 15-5/8[397]] | 15-1/8[384] | 20-1/8[511] | 8-7/8[226] | 7-3/8[187] |

| Model | Cooler | Cond. | N | P | R | S | T |
|---|---|---|---|---|---|---|---|
| ***PCXi* 030—60 Hz** | | | | | | | |
| Standard Vessel Set | F6-22" | E6,E7-20" | 7-1/2[191] | 7[178] | 12[305] | 12-1/4[311] | 6-3/4[171] |
| Single Oversized Vessel Set | G6-24" | E6,E7-20" | 8[203] | 7[178] | 12-1/2[318] | 14-3/8[365] | 7-5/8[194] |
| Double Oversized Vessel Set | H6-26" | F6-22" | 6-3/8[162] | 7-1/2[191] | 11-3/8[289] | 14-7/8[378] | 8-1/8[207] |
| ***PCXi* 040—60 Hz** | | | | | | | |
| Standard Vessel Set | H6-26" | F6-22" | 6-3/8[162] | 7-1/2[191] | 11-3/8[289] | 14-7/8[378] | 8-1/8[207] |
| Single Oversized Vessel Set | K6-30" | G6-24" | 6-7/8[175] | 8[203] | 11-7/8[302] | 15-3/8[391] | 9-1/2[241] |
| Double Oversized Vessel Set | L6-32" | H6-26" | 6-7/8[175] | 6-3/8[162] | 111-7/8[302] | 15-3/8[391] | 10-1/8[257] |
| ***PCXi* 050—60 Hz** | | | | | | | |
| Standard Vessel Set | K6-30" | G6-24" | 6-7/8[175] | 8[203] | 11-7/8[302] | 15-3/8[391] | 9-1/2[241] |
| Single Oversized Vessel Set | L6-32" | H6-26" | 6-7/8[175] | 6-3/8[162] | 11-7/8[302] | 15-3/8[391] | 10-1/8[257] |
| ***PCXi* 030—50 Hz** | | | | | | | |
| Standard Vessel Set | F5,F6-22" | D6-18" | 7-1/2[191] | 6-1/2[165] | 12[305] | 12-1/4[311] | 6-3/4[171] |
| Single Oversized Vessel Set | F5,F6-22" | E6,E7-20" | 7-1/2[191] | 7[178] | 12[305] | 12-1/4[311] | 6-3/4[171] |
| Double Oversized Vessel Set | G6-24" | E6,E7-20" | 8[203] | 7[178] | 12-1/2[318] | 14-3/8[365] | 7-5/8[194] |
| ***PCXi* 040—50 Hz** | | | | | | | |
| Standard Vessel Set | G6-24" | E7-20" | 8[203] | 7[178] | 112-1/2[318] | 14-3/8[365] | 7-5/8[194] |
| Single Oversized Vessel Set | H6-26" | F6-22" | 6-3/8[162] | 7-1/2[191] | 11-3/8[289] | 14-7/8[378] | 8-1/8[207] |
| Double Oversized Vessel Set | K6-30" | G6-24" | 6-7/8[175] | 8[203] | 11-7/8[302] | 15-3/8[391] | 9-1/2[241] |
| ***PCXi* 050—50 Hz** | | | | | | | |
| Standard Vessel Set | H6-26" | F6-22" | 6-3/8[162] | 7-1/2[191] | 11-3/8[289] | 14-7/8[378] | 8-1/8[207] |
| Single Oversized Vessel Set | K6-30" | G6-24" | 6-7/8[175] | 8[203] | 11-7/8[302] | 15-3/8[391] | 9-1/2[241] |
| Double Oversized Vessel Set | L6-32" | H6-26" | 6-7/8[175] | 6-3/8[162] | 11-7/8[302] | 115-3/8[391] | 10-1/8[257] |

# TYPICAL SEQUENCE OF OPERATION

The Dunham-Bush Rotary Screw Water Chiller depends on its on-board microcomputer for control. For initial start-up, the following conditions must be met:

- Chilled water pump running
- Chilled water flow switch made
- Customer control contact closed
- Control and compressor switches on
- Main system voltage turned on
- All safety conditions satisfied
- Reset pressed on microcomputer keypad
- Compressor has not started within the last 20 minutes
- Leaving chilled water temperature 2°F(1°C) or more above set point
- Oil sump temperature is greater than 70°F(21°C)

The microcomputer starts the oil pump by energizing 4CP (control point). If capacity indicator is below 8% and a minimum of 27 psid (186 kPa) oil pressure is established, seconds later the microcomputer signals 2CR (control ready) which starts the compressor motor.

When the compressor starts, the microcomputer monitors leaving water temperature, ramp schedule, and load limiting to control load and unload solenoids. The refrigerant level sensor and discharge temperature are used to control the refrigerant modulating motor. When minimum compressor capacity exceeds system load and water temperature falls below set point, the compressor and oil pump are shut down.

The control system is composed of several microcomputer boards, a display board and analog and digital sensors. The display board has a 20-key keypad and a 2 x 40 LCD display. The keypad and display can be used to determine the status of the compressor, oil pump, and refrigeration system. Various set points can also be displayed and altered.

The status of the machine can also be monitored by a computer terminal either locally or remotely by a modem. The terminal must be able to handle RS232 communications.

The microcomputer controls the leaving water temperature within a narrow dead band by pulsing load and/or unload solenoids on the compressor. The load and unload solenoids position the compressor's slide valve to control the capacity. The microcomputer determines a desired level of loading and varies pulse duration depending on the difference between load target and actual load. The load target is varied based on rate of approach to desired temperature (derivative control) preventing significant temperature oscillations. The current limit functions override the temperature control.

When a maximum desired current is specified by amp limit, the compressor will not load above that point. If the amps rise above the limit set point, the computer will send an unload signal to the compressor until the current drops below the set point.

Another feature of the microcomputer is ramp control, which is the ability to vary load time of the package from start. The user can program the computer so that it loads at a pre-determined rate. Two variables are used to define the ramp profile: Ramp Rate and Start Point. Ramp rate defines the length of time the unit takes to load from start point to full load. Start point is the point of full load at which the ramp begins.

When optional hot gas bypass has been supplied, an output from the computer controls the solenoid. The solenoid is turned on if the target percent capacity of the compressor drops below the hot gas bypass set point. If the target percent capacity then climbs above the hot gas bypass set point, the solenoid is turned off.

If desired, the chilled water temperature can be (optionally) raised by a 0-5 VDC analog signal provided by an external controller. The reset signal must be between 0 VDC and 5 VDC, with 0 VDC being no reset and 5 VDC being maximum reset. The maximum temperature reset (increase) desired must be stored in CWR MAX. For example, to raise the chilled water set point from 44°F (6.7°C) to 50°F(10°C) with a 5 VDC input, 6.0(3.3) is stored in CWR MAX.

If (optional) demand limiting is desired, a 0 to 5 VDC signal must be supplied to the Demand Limit terminals shown on the wiring diagram. Supplying 0 volts will have no effect, and 5 volts will have maximum limiting. The demand limit works automatically by lowering the HOLD and UNLOAD amp limits for the compressor. This does not change the amp limit set points.

If the condenser water control option is furnished, the analog output signal is changed based on discharge pressure. If below the set point (typically 160 psig), the output will stay at OVDC. As pressure rises above the set point, the voltage increases linearly until the output reaches maximum (5VDC or 10VDC) at the high set point (typically 190 psig).

# PHYSICAL SPECIFICATIONS: 60 HZ

## PCXi 030

| Model No. | PCXi 030 - 60 HZ | | | | | |
|---|---|---|---|---|---|---|
| | Standard Vessel Set | | Single Oversized Vessel Set | | Double Oversized Vessel Set | |
| | English | S. I. Units | English | S. I. Units | English | S. I. Units |
| Nominal Capacity: tons/(kWo) | 276 | 942 | 278 | 949 | 279 | 952 |
| Compressor Model | 2010 | | 2010 | | 2010 | |
| Motor RPM | 3550 | | 3550 | | 3550 | |
| **Flooded Cooler - (Code)** | **F6** | | **G6** | | **H6** | |
| Cooler Shell Diameter in./(cm) | 22 | 559 | 24 | 610 | 26 | 660 |
| Cooler Tube Length: in./(cm) | 144 | 3658 | 144 | 3658 | 144 | 3658 |
| Design Working Pressure: | | | | | | |
| Water Side: psig(kPa) | 150 | 1034 | 150 | 1034 | 150 | 1034 |
| Refrigerant Side: psig/(kPa) | 300 | 2069 | 300 | 2069 | 300 | 2069 |
| Water Volume (2 Pass): gal./(Litres) | 60.8 | 230 | 71.6 | 271 | 88.2 | 334 |
| **Optional Single Pass Cooler** | | | | | | |
| **Minimum Flow Rate**: GPM/(L/s) | 481 | 30.3 | 555 | 35 | 671 | 42.3 |
| Pressure Drop: Ft. Water (kPa) | 1.16 | 3.47 | 1.14 | 3.41 | 1.16 | 3.47 |
| **Maximum Flow Rate:** GPM/(L/s) | 2406 | 151.8 | 2777 | 175.2 | 3354 | 211.6 |
| Pressure Drop: Ft. Water/(kPa) | 21.58 | 64.5 | 20.87 | 62.4 | 21.49 | 64.2 |
| **Standard Two Pass Cooler** | | | | | | |
| **Minimum Flow Rate:** GPM/(L/s) | 243 | 15.3 | 278 | 17.5 | 344 | 21.7 |
| Pressure Drop: Ft. Water/(kPa) | 2.23 | 6.67 | 2.22 | 6.64 | 2.29 | 6.84 |
| **Maximum Flow Rate:** GPM/(L/s) | 1193 | 75.3 | 1389 | 87.6 | 1633 | 103 |
| Pressure Drop: Ft. Water/(kPa) | 39.56 | 118.2 | 40.6 | 121.4 | 37.94 | 113.4 |
| **Optional Three Pass Cooler** | | | | | | |
| **Minimum Flow Rate:** GPM/(L/s) | 164 | 10.3 | 192 | 12.1 | 227 | 14.3 |
| Pressure Drop: Ft. Water/(kPa) | 3.56 | 10.64 | 3.49 | 10.43 | 3.7 | 11.06 |
| **Maximum Flow Rate:** GPM/(L/s) | 733 | 46.2 | 861 | 54.3 | 997 | 62.9 |
| Pressure Drop: Ft. Water/(kPa) | 52.81 | 157.8 | 52.2 | 156 | 53.36 | 159.5 |
| **Condenser Code** | **E6** | | **E7** | | **F6** | |
| Condenser Shell Diameter: in./(cm) | 20 | 508 | 20 | 508 | 22 | 559 |
| Condenser Tube Length: in./(cm) | 144 | 3658 | 144 | 3658 | 144 | 3658 |
| Design Working Pressure | | | | | | |
| Water Side: psig/(kPa) | 150 | 1034 | 150 | 1034 | 150 | 1034 |
| Refrigerant Side: psig/(kPa) | 300 | 2069 | 300 | 2069 | 300 | 2069 |
| Water Volume: Gal/(Litres) | 66.9 | 253 | 73.9 | 280 | 93.2 | 353 |
| **Standard Two Pass Condenser:** | | | | | | |
| **Minimum Flow Rate:** GPM/(L/s) | 291 | 18.4 | 349 | 22 | 409 | 25.8 |
| Pressure Drop: Ft. Water/(kPa) | 2.44 | 7.29 | 2.8 | 8.37 | 2.55 | 7.62 |
| **Maximum Flow Rate:** GPM/(L/s) | 1435 | 90.5 | 1495 | 94.3 | 1983 | 125.1 |
| Pressure Drop: Ft. Water/(kPa) | 37.96 | 113.5 | 34.32 | 102.6 | 39.26 | 117.3 |
| **General Data** | | | | | | |
| Shipping Wt. w/ Low Volt Motor: lbs/(kg) | 13720 | 6223 | 14515 | 6584 | 15980 | 7249 |
| Operating Wt. w/ Low Volt Motor: lbs/(kg) | 14780 | 6704 | 15725 | 7133 | 17500 | 7938 |
| Shipping Wt. w/ Medium Volt Motor: lbs/(kg) | 14870 | 6745 | 15665 | 7106 | 17135 | 7772 |
| Operating Wt. w/ Medium Volt Motor: lbs/(kg) | 15930 | 7226 | 16875 | 7655 | 18650 | 8460 |
| Operating Charge R-22: lbs/(kg) | 572 | 260 | 624 | 283 | 780 | 354 |

Note:
Low Voltage Motor 460/3/60, 575/3/60 and 400/3/50
Medium Voltage Motor 2300/3/60, 4160/3/60 and 3300/3/50

# PHYSICAL SPECIFICATIONS: 60 HZ

## PCXi 040

| Model No. | PCXi 040 - 60 HZ | | | | | |
|---|---|---|---|---|---|---|
| | Standard Vessel Set | | Single Oversized Vessel Set | | Double Oversized Vessel Set | |
| | English | S. I. Units | English | S. I. Units | English | S. I. Units |
| Nominal Capacity: tons/(kWo) | 400 | 1365 | 404 | 1378 | 408 | 1392 |
| Compressor Model | 2015 | | 2015 | | 2015 | |
| Motor RPM | 3550 | | 3550 | | 3550 | |
| **Flooded Cooler - (Code)** | **H6** | | **K6** | | **L6** | |
| Cooler Shell Diameter in./(cm) | 26 | 660 | 30 | 762 | 32 | 813 |
| Cooler Tube Length: in./(cm) | 144 | 3658 | 144 | 3658 | 144 | 3658 |
| Design Working Pressure: | | | | | | |
| Water Side: psig(kPa) | 150 | 1034 | 150 | 1034 | 150 | 1034 |
| Refrigerant Side: psig/(kPa) | 300 | 2069 | 300 | 2069 | 300 | 2069 |
| Water Volume (2 Pass): gal./(Litres) | 88.2 | 334 | 109.2 | 413 | 133.4 | 505 |
| **Optional Single Pass Cooler** | | | | | | |
| **Minimum Flow Rate**: GPM/(L/s) | 671 | 42.3 | 794 | 50.1 | 994 | 62.7 |
| Pressure Drop: Ft. Water (kPa) | 1.16 | 3.47 | 1.16 | 3.47 | 1.12 | 3.59 |
| **Maximum Flow Rate:** GPM/(L/s) | 3354 | 211.6 | 3970 | 250.5 | 4968 | 313.4 |
| Pressure Drop: Ft. Water/(kPa) | 21.49 | 64.2 | 20.39 | 63.9 | 22.43 | 67.0 |
| **Standard Two Pass Cooler** | | | | | | |
| **Minimum Flow Rate:** GPM/(L/s) | 344 | 21.7 | 407 | 25.7 | 507 | 32.0 |
| Pressure Drop: Ft. Water/(kPa) | 2.29 | 6.84 | 2.3 | 6.87 | 2.31 | 6.90 |
| **Maximum Flow Rate:** GPM/(L/s) | 1633 | 103.0 | 1936 | 122.1 | 2435 | 153.6 |
| Pressure Drop: Ft. Water/(kPa) | 37.94 | 113.4 | 38.43 | 114.9 | 39.51 | 118.1 |
| **Optional Three Pass Cooler** | | | | | | |
| **Minimum Flow Rate:** GPM/(L/s) | 227 | 14.3 | 284 | 17.9 | 329 | 20.8 |
| Pressure Drop: Ft. Water/(kPa) | 3.7 | 11.06 | 3.75 | 11.21 | 3.53 | 10.55 |
| **Maximum Flow Rate:** GPM/(L/s) | 997 | 62.9 | 1232 | 77.7 | 1535 | 96.8 |
| Pressure Drop: Ft. Water/(kPa) | 53.36 | 159.5 | 53.04 | 158.5 | 57.08 | 170.6 |
| **Condenser Code** | **F6** | | **G6** | | **H6** | |
| Condenser Shell Diameter: in./(cm) | 22 | 559 | 24 | 610 | 26 | 660 |
| Condenser Tube Length: in./(cm) | 144 | 3658 | 144 | 3658 | 144 | 3658 |
| Design Working Pressure | | | | | | |
| Water Side: psig/(kPa) | 150 | 1034 | 150 | 1034 | 150 | 1034 |
| Refrigerant Side: psig/(kPa) | 300 | 2069 | 300 | 2069 | 300 | 2069 |
| Water Volume: Gal/(Litres) | 93.2 | 353 | 111.4 | 422 | 135.6 | 513 |
| **Standard Two Pass Condenser:** | | | | | | |
| **Minimum Flow Rate:** GPM/(L/s) | 409 | 25.8 | 500 | 31.5 | 602 | 38.0 |
| Pressure Drop: Ft. Water/(kPa) | 2.55 | 7.62 | 2.64 | 7.89 | 2.69 | 8.04 |
| **Maximum Flow Rate:** GPM/(L/s) | 1983 | 125.1 | 2262 | 142.7 | 2710 | 171.0 |
| Pressure Drop: Ft. Water/(kPa) | 39.26 | 117.3 | 35.33 | 105.6 | 36.0 | 107.6 |
| **General Data** | | | | | | |
| Shipping Wt. w/ Low Volt Motor: lbs/(kg) | 17010 | 7716 | 19105 | 8666 | 20755 | 9414 |
| Operating Wt. w/ Low Volt Motor: lbs/(kg) | 18530 | 8405 | 20945 | 9501 | 23000 | 10433 |
| Shipping Wt. w/ Medium Volt Motor: lbs/(kg) | 17710 | 8033 | 19805 | 8984 | 21455 | 9732 |
| Operating Wt. w/ Medium Volt Motor: lbs/(kg) | 19235 | 8725 | 21650 | 9820 | 23705 | 10753 |
| Operating Charge R-22: lbs/(kg) | 780 | 354 | 1137 | 516 | 1336 | 606 |

Note:
Low Voltage Motor 460/3/60, 575/3/60 and 400/3/50
Medium Voltage Motor 2300/3/60, 4160/3/60 and 3300/3/50

# PHYSICAL SPECIFICATIONS: 60 HZ

## PCXi 050

| Model No. | PCXi 050 - 60 HZ | | | | | |
|---|---|---|---|---|---|---|
| | Standard Vessel Set | | Single Oversized Vessel Set | | Double Oversized Vessel Set | |
| | English | S. I. Units | English | S. I. Units | English | S. I. Units |
| Nominal Capacity: tons/(kWo) | 477 | 1628 | 483 | 1648 | N/A | N/A |
| Compressor Model | 2018 | | 2018 | | N/A | |
| Motor RPM | 3550 | | 3550 | | N/A | |
| **Flooded Cooler - (Code)** | **K6** | | **L6** | | **N/A** | |
| Cooler Shell Diameter in./(cm) | 30 | 762 | 32 | 813 | N/A | N/A |
| Cooler Tube Length: in./(cm) | 144 | 3658 | 144 | 3658 | N/A | N/A |
| Design Working Pressure: | | | | | | |
| Water Side: psig(kPa) | 150 | 1034 | 150 | 1034 | N/A | N/A |
| Refrigerant Side: psig/(kPa) | 300 | 2069 | 300 | 2069 | N/A | N/A |
| Water Volume (2 Pass): gal./(Litres) | 109.2 | 413.4 | 133.4 | 505 | N/A | N/A |
| **Optional Single Pass Cooler** | | | | | | |
| **Minimum Flow Rate**: GPM/(L/s) | 794 | 50.1 | 994 | 62.7 | N/A | N/A |
| Pressure Drop: Ft. Water (kPa) | 1.16 | 3.47 | 1.16 | 3.47 | N/A | N/A |
| **Maximum Flow Rate:** GPM/(L/s) | 3970 | 250.5 | 4968 | 313.4 | N/A | N/A |
| Pressure Drop: Ft. Water/(kPa) | 21.39 | 63.9 | 22.43 | 67.0 | N/A | N/A |
| **Standard Two Pass Cooler** | | | | | | |
| **Minimum Flow Rate:** GPM/(L/s) | 407 | 25.7 | 507 | 32.0 | N/A | N/A |
| Pressure Drop: Ft. Water/(kPa) | 2.30 | 6.87 | 2.31 | 6.90 | N/A | N/A |
| **Maximum Flow Rate:** GPM/(L/s) | 1936 | 122.1 | 2435 | 153.6 | N/A | N/A |
| Pressure Drop: Ft. Water/(kPa) | 38.43 | 114.9 | 39.51 | 118.1 | N/A | N/A |
| **Optional Three Pass Cooler** | | | | | | |
| **Minimum Flow Rate:** GPM/(L/s) | 284 | 17.9 | 329 | 20.8 | N/A | N/A |
| Pressure Drop: Ft. Water/(kPa) | 3.75 | 11.21 | 3.53 | 10.55 | N/A | N/A |
| **Maximum Flow Rate:** GPM/(L/s) | 1232 | 77.7 | 1535 | 96.8 | N/A | N/A |
| Pressure Drop: Ft. Water/(kPa) | 53.04 | 158.5 | 5708 | 170.6 | N/A | N/A |
| **Condenser Code** | **G6** | | **H6** | | **N/A** | |
| Condenser Shell Diameter: in./(cm) | 24 | 610 | 26 | 660 | N/A | N/A |
| Condenser Tube Length: in./(cm) | 144 | 3658 | 144 | 3658 | N/A | N/A |
| Design Working Pressure | | | | | | |
| Water Side: psig/(kPa) | 150 | 1034 | 150 | 1034 | N/A | N/A |
| Refrigerant Side: psig/(kPa) | 300 | 2069 | 300 | 2069 | N/A | N/A |
| Water Volume: Gal/(Litres) | 111.4 | 422 | 135.6 | 513 | N/A | N/A |
| **Standard Two Pass Condenser:** | | | | | | |
| **Minimum Flow Rate:** GPM/(L/s) | 504 | 31.8 | 602 | 38.0 | N/A | N/A |
| Pressure Drop: Ft. Water/(kPa) | 2.68 | 8.01 | 2.69 | 8.04 | N/A | N/A |
| **Maximum Flow Rate:** GPM/(L/s) | 2243 | 141.5 | 2710 | 171.0 | N/A | N/A |
| Pressure Drop: Ft. Water/(kPa) | 34.86 | 104.2 | 36.0 | 107.6 | N/A | N/A |
| **General Data** | | | | | | |
| Shipping Wt. w/ Low Volt Motor: lbs/(kg) | 19675 | 8925 | 21330 | 9675 | N/A | N/A |
| Operating Wt. w/ Low Volt Motor: lbs/(kg) | 21515 | 9759 | 23560 | 10687 | N/A | N/A |
| Shipping Wt. w/ Medium Volt Motor: lbs/(kg) | 20355 | 9233 | 22000 | 9979 | N/A | N/A |
| Operating Wt. w/ Medium Volt Motor: lbs/(kg) | 22195 | 10068 | 24245 | 10998 | N/A | N/A |
| Operating Charge R-22: lbs/(kg) | 1137 | 516 | 1336 | 606 | N/A | N/A |

Note:
Low Voltage Motor 460/3/60, 575/3/60 and 400/3/50
Medium Voltage Motor 2300/3/60, 4160/3/60 and 3300/3/50

# PHYSICAL SPECIFICATIONS: 60 HZ

## PCXi 030

| Model No. | PCXi 030 - 50 HZ | | | | | |
|---|---|---|---|---|---|---|
| | Standard Vessel Set | | Single Oversized Vessel Set | | Double Oversized Vessel Set | |
| | English | S. I. Units | English | S. I. Units | English | S. I. Units |
| Nominal Capacity: tons/(kWo) | 246 | 840 | 249 | 850 | 251 | 857 |
| Compressor Model | 2010 | | 2010 | | 2010 | |
| Motor RPM | 2960 | | 2960 | | 2960 | |
| **Flooded Cooler - (Code)** | **F5** | | **F6** | | **G6** | |
| Cooler Shell Diameter in./(cm) | 22 | 559 | 22 | 559 | 24 | 610 |
| Cooler Tube Length: in./(cm) | 144 | 3658 | 144 | 3658 | 144 | 3658 |
| Design Working Pressure: | | | | | | |
| Water Side: psig(kPa) | 150 | 1034 | 150 | 1034 | 150 | 1034 |
| Refrigerant Side: psig/(kPa) | 300 | 2069 | 300 | 2069 | 300 | 2069 |
| Water Volume (2 Pass): gal./(Litres) | 51.6 | 195 | 60.8 | 230 | 71.6 | 271 |
| **Optional Single Pass Cooler** | | | | | | |
| Minimum Flow Rate: GPM/(L/s) | 389 | 34.5 | 481 | 30.3 | 555 | 35.0 |
| Pressure Drop: Ft. Water/(kPa) | 1.14 | 3.41 | 1.16 | 3.47 | 1.14 | 3.41 |
| Maximum Flow Rate: GPM/(L/s) | 1946 | 122.8 | 2406 | 151.8 | 2777 | 175.2 |
| Pressure Drop: Ft. Water/(kPa) | 20.88 | 62.4 | 21.58 | 64.5 | 20.87 | 62.4 |
| **Standard Two Pass Cooler** | | | | | | |
| Minimum Flow Rate: GPM/(L/s) | 201 | 12.7 | 243 | 15.3 | 278 | 17.5 |
| Pressure Drop: Ft. Water/(kPa) | 2.33 | 6.96 | 2.23 | 6.67 | 2.22 | 6.64 |
| Maximum Flow Rate: GPM/(L/s) | 939 | 59.2 | 1193 | 75.3 | 1389 | 87.6 |
| Pressure Drop: Ft. Water/(kPa) | 37.29 | 111.5 | 39.56 | 118.2 | 40.6 | 121.4 |
| **Optional Three Pass Cooler** | | | | | | |
| Minimum Flow Rate: GPM/(L/s) | 135 | 8.5 | 164 | 10.3 | 192 | 12.1 |
| Pressure Drop: Ft. Water/(kPa) | 3.5 | 10.46 | 3.56 | 10.64 | 3.49 | 10.43 |
| Maximum Flow Rate: GPM/(L/s) | 606 | 38.2 | 733 | 46.2 | 861 | 54.3 |
| Pressure Drop: Ft. Water/(kPa) | 52.41 | 156.7 | 52.81 | 157.8 | 52.2 | 156 |
| **Condenser Code** | **D6** | | **E6** | | **E7** | |
| Condenser Shell Diameter: in./(cm) | 18 | 457 | 20 | 508 | 20 | 508 |
| Condenser Tube Length: in./(cm) | 144 | 3658 | 144 | 3658 | 144 | 3658 |
| Design Working Pressure | | | | | | |
| Water Side: psig/(kPa) | 150 | 1034 | 150 | 1034 | 150 | 1034 |
| Refrigerant Side: psig/(kPa) | 300 | 2069 | 300 | 2069 | 300 | 2069 |
| Water Volume: Gal/(Litres) | 55.4 | 210 | 66.9 | 253 | 73.9 | 280 |
| **Standard Two Pass Condenser:** | | | | | | |
| **Minimum Flow Rate:** GPM/(L/s) | 251 | 15.8 | 291 | 18.4 | 349 | 22.0 |
| Pressure Drop: Ft. Water/(kPa) | 2.71 | 8.10 | 2.44 | 7.29 | 2.8 | 8.37 |
| **Maximum Flow Rate:** GPM/(L/s) | 1435 | 90.5 | 1435 | 90.5 | 1495 | 94.3 |
| Pressure Drop: Ft. Water/(kPa) | 37.96 | 113.5 | 37.96 | 113.5 | 34.32 | 102.6 |
| **General Data** | | | | | | |
| Shipping Wt. w/ Low Volt Motor: lbs/(kg) | 12885 | 5845 | 13645 | 6189 | 14435 | 6548 |
| Operating Wt. w/ Low Volt Motor: lbs/(kg) | 13770 | 6246 | 14705 | 6670 | 15650 | 7099 |
| Shipping Wt. w/ Medium Volt Motor: lbs/(kg) | 14035 | 6366 | 14790 | 6709 | 15590 | 7072 |
| Operating Wt. w/ Medium Volt Motor: lbs/(kg) | 14926 | 6770 | 15855 | 7192 | 16795 | 7618 |
| Operating Charge R-22: lbs/(kg) | 520 | 236 | 572 | 260 | 624 | 283 |

Note:
Low Voltage Motor 460/3/60, 575/3/60 and 400/3/50
Medium Voltage Motor 2300/3/60, 4160/3/60 and 3300/3/50

# PHYSICAL SPECIFICATIONS: 50 HZ

## PCXi 040

| Model No. | PCXi 040 - 50 HZ | | | | | |
|---|---|---|---|---|---|---|
| | Standard Vessel Set | | Single Oversized Vessel Set | | Double Oversized Vessel Set | |
| | English | S. I. Units | English | S. I. Units | English | S. I. Units |
| Nominal Capacity: tons/(kWo) | 357 | 1218 | 361 | 1232 | 364 | 1242 |
| Compressor Model | 2015 | | 2015 | | 2015 | |
| Motor RPM | 2960 | | 2960 | | 2960 | |
| **Flooded Cooler - (Code)** | **G6** | | **H6** | | **K6** | |
| Cooler Shell Diameter in./(cm) | 24 | 610 | 26 | 660 | 30 | 762 |
| Cooler Tube Length: in./(cm) | 144 | 3658 | 144 | 3658 | 144 | 3658 |
| Design Working Pressure: | | | | | | |
| Water Side: psig(kPa) | 150 | 1034 | 150 | 1034 | 150 | 1034 |
| Refrigerant Side: psig/(kPa) | 300 | 2069 | 300 | 2069 | 300 | 2069 |
| Water Volume (2 Pass): gal./(Litres) | 71.6 | 271 | 88.2 | 334 | 109.2 | 413 |
| **Optional Single Pass Cooler** | | | | | | |
| Minimum Flow Rate: GPM/(L/s) | 555 | 35.0 | 671 | 42.3 | 794 | 50.1 |
| Pressure Drop: Ft. Water/(kPa) | 1.14 | 3.41 | 1.16 | 3.47 | 1.16 | 3.47 |
| Maximum Flow Rate: GPM/(L/s) | 2777 | 175.2 | 3354 | 211.6 | 3970 | 250.5 |
| Pressure Drop: Ft. Water/(kPa) | 20.87 | 62.4 | 21.49 | 64.2 | 21.39 | 63.9 |
| **Standard Two Pass Cooler** | | | | | | |
| Minimum Flow Rate: GPM/(L/s) | 278 | 17.5 | 344 | 21.7 | 407 | 25.7 |
| Pressure Drop: Ft. Water/(kPa) | 2.22 | 6.64 | 2.29 | 6.84 | 2.3 | 6.87 |
| Maximum Flow Rate: GPM/(L/s) | 1389 | 87.6 | 1633 | 103.0 | 1936 | 122.1 |
| Pressure Drop: Ft. Water/(kPa) | 40.6 | 121.4) | 37.94 | 113.4 | 38.43 | 114.9 |
| **Optional Three Pass Cooler** | | | | | | |
| Minimum Flow Rate: GPM/(L/s) | 192 | 12.1 | 227 | 14.3 | 284 | 17.9 |
| Pressure Drop: Ft. Water/(kPa) | 3.49 | 10.43 | 3.7 | 11.06 | 3.75 | 11.21 |
| Maximum Flow Rate: GPM/(L/s) | 861 | 54.3 | 997 | 62.9 | 1232 | 77.7 |
| Pressure Drop: Ft. Water/(kPa) | 52.2 | 156.0 | 53.36 | 159.5 | 53.04 | 158.5 |
| **Condenser Code** | **E7** | | **F6** | | **G6** | |
| Condenser Shell Diameter: in./(cm) | 20 | 508 | 22 | 559 | 24 | 610 |
| Condenser Tube Length: in./(cm) | 144 | 3658 | 144 | 3658 | 144 | 3658 |
| Design Working Pressure | | | | | | |
| Water Side: psig/(kPa) | 150 | 1034 | 150 | 1034 | 150 | 1034 |
| Refrigerant Side: psig/(kPa) | 300 | 2069 | 300 | 2069 | 300 | 2069 |
| Water Volume: Gal/(Litres) | 73.9 | 280 | 93.2 | 353 | 111.4 | 422 |
| **Standard Two Pass Condenser:** | | | | | | |
| **Minimum Flow Rate:** GPM/(L/s) | 349 | 22.0 | 409 | 25.8 | 500 | 31.5 |
| Pressure Drop: Ft. Water/(kPa) | 2.8 | 8.37 | 2.55 | 7.62 | 2.64 | 7.89 |
| **Maximum Flow Rate:** GPM/(L/s) | 1495 | 94.3 | 1983 | 125.1 | 2262 | 142.7 |
| Pressure Drop: Ft. Water/(kPa) | 34.32 | 102.6 | 39.26 | 117.3 | 35.33 | 105.6 |
| **General Data** | | | | | | |
| Shipping Wt. w/ Low Volt Motor: lbs/(kg) | 15170 | 6881 | 16630 | 7543 | 18730 | 8496 |
| Operating Wt. w/ Low Volt Motor: lbs/(kg) | 16380 | 7430 | 18155 | 8235 | 20565 | 9328 |
| Shipping Wt. w/ Medium Volt Motor: lbs/(kg) | 16115 | 7310 | 17585 | 7977 | 19680 | 8927 |
| Operating Wt. w/ Medium Volt Motor: lbs/(kg) | 17325 | 7859 | 19105 | 8666 | 21520 | 9761 |
| Operating Charge R-22: lbs/(kg) | 624 | 283 | 780 | 354 | 1137 | 516 |

Note:
Low Voltage Motor 460/3/60, 575/3/60 and 400/3/50
Medium Voltage Motor 2300/3/60, 4160/3/60 and 3300/3/50

# PHYSICAL SPECIFICATIONS: 50 HZ

## PCXi 050

| Model No. | PCXi 050 - 50 HZ | | | | | |
|---|---|---|---|---|---|---|
| | Standard Vessel Set | | Single Oversized Vessel Set | | Double Oversized Vessel Set | |
| | English | S. I. Units | English | S. I. Units | English | S. I. Units |
| Nominal Capacity: tons/(kWo) | 427 | 1457 | 432 | 1474 | 437 | 1491 |
| Compressor Model | 2018 | | 2018 | | 2018 | |
| Motor RPM | 2960 | | 2960 | | 2960 | |
| **Flooded Cooler - (Code)** | **H6** | | **K6** | | **L6** | |
| Cooler Shell Diameter in./(cm) | 26 | 660 | 30 | 762 | 32 | 813 |
| Cooler Tube Length: in./(cm) | 144 | 3658 | 144 | 3658 | 144 | 3658 |
| Design Working Pressure: | | | | | | |
| Water Side: psig(kPa) | 150 | 1034 | 150 | 1034 | 150 | 1034 |
| Refrigerant Side: psig/(kPa) | 300 | 2069 | 300 | 2069 | 300 | 2069 |
| Water Volume (2 Pass): gal./(Litres) | 88.2 | 334 | 109.2 | 413 | 133.4 | 505 |
| **Optional Single Pass Cooler** | | | | | | |
| Minimum Flow Rate: GPM/(L/s) | 671 | 42.3 | 794 | 50.1 | 994 | 62.7 |
| Pressure Drop: Ft. Water/(kPa) | 1.16 | 3.47 | 1.16 | 3.47 | 1.2 | 3.59 |
| Maximum Flow Rate: GPM/(L/s) | 3354 | 211.6 | 3970 | 250.5 | 4968 | 313.4 |
| Pressure Drop: Ft. Water/(kPa) | 21.49 | 64.2 | 21.39 | 63.9 | 22.43 | 67.0 |
| **Standard Two Pass Cooler** | | | | | | |
| Minimum Flow Rate: GPM/(L/s) | 344 | 21.7 | 407 | 25.7 | 507 | 32.0 |
| Pressure Drop: Ft. Water/(kPa) | 2.29 | 6.84 | 2.30 | 6.87 | 2.31 | 6.90 |
| Maximum Flow Rate: GPM/(L/s) | 1633 | 103.0 | 1936 | 122.1 | 2435 | 153.6 |
| Pressure Drop: Ft. Water/(kPa) | 37.94 | 113.4 | 38.43 | 114.9 | 39.51 | 118.1 |
| **Optional Three Pass Cooler** | | | | | | |
| Minimum Flow Rate: GPM/(L/s) | 227 | 14.3 | 284 | 17.9 | 329 | 20.8 |
| Pressure Drop: Ft. Water/(kPa) | 3.7 | 11.06 | 3.75 | 11.21 | 3.53 | 10.55 |
| Maximum Flow Rate: GPM/(L/s) | 997 | 62.9 | 1232 | 77.7 | 1535 | 96.8 |
| Pressure Drop: Ft. Water/(kPa) | 53.36 | 159.5 | 53.04 | 158.5 | 57.08 | 170.6 |
| **Condenser Code** | **F6** | | **G6** | | **H6** | |
| Condenser Shell Diameter: in./(cm) | 22 | 559 | 24 | 610 | 26 | 660 |
| Condenser Tube Length: in./(cm) | 144 | 3658 | 144 | 3658 | 144 | 3658 |
| Design Working Pressure | | | | | | |
| Water Side: psig/(kPa) | 150 | 1034 | 150 | 1034 | 150 | 1034 |
| Refrigerant Side: psig/(kPa) | 300 | 2069 | 300 | 2069 | 300 | 2069 |
| Water Volume: Gal/(Litres) | 93.2 | 353 | 111.4 | 422 | 135.6 | 513 |
| **Standard Two Pass Condenser:** | | | | | | |
| **Minimum Flow Rate:** GPM/(L/s) | 409 | 25.8 | 500 | 31.5 | 602 | 38.0 |
| Pressure Drop: Ft. Water/(kPa) | 2.55 | 7.62 | 2.64 | 7.89 | 2.69 | 8.04 |
| **Maximum Flow Rate:** GPM/(L/s) | 1983 | 125.1 | 2262 | 142.7 | 2710 | 171.0 |
| Pressure Drop: Ft. Water/(kPa) | 39.26 | 117.3 | 35.23 | 105.6 | 36.0 | 107.6 |
| **General Data** | | | | | | |
| Shipping Wt. w/ Low Volt Motor: lbs/(kg) | 17400 | 7893 | 19500 | 8845 | 21145 | 9591 |
| Operating Wt. w/ Low Volt Motor: lbs/(kg) | 18915 | 8580 | 21340 | 9680 | 23380 | 10605 |
| Shipping Wt. w/ Medium Volt Motor: lbs/(kg) | 18075 | 8199 | 20175 | 9151 | 21825 | 9900 |
| Operating Wt. w/ Medium Volt Motor: lbs/(kg) | 19595 | 8888 | 22015 | 9986 | 24065 | 10916 |
| Operating Charge R-22: lbs/(kg) | 780 | 354 | 1137 | 516 | 1336 | 606 |

Note:
Low Voltage Motor 460/3/60, 575/3/60 and 400/3/50
Medium Voltage Motor 2300/3/60, 4160/3/60 and 3300/3/50

# ELECTRICAL DATA

| Motor Size (HP) | | **200** | 200 | **250** | 250 | **300** | 300 | **350** | 350 | **400** | 400 | **450** | 450 | **500** | 500 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Motor Class | | **STD** | PREM | **STD** | PREM | **STD** | PREM | **STD** | PREM | **STD** | PREM | **STD** | PREM | **STD** | PREM |
| Compressor Motor Code | | E | E | F | F | G | G | H | H | J | J | K | K | L | L |
| **460/3/60** | FLA | 221 | 225 | 283 | 277 | 335 | 325 | 387 | 378 | 440 | 428 | 494 | 476 | 544 | 526 |
| | LRA | 1580 | 1450 | 1644 | 1825 | 2197 | 2200 | 2501 | 2550 | 3110 | 2900 | 3550 | 3220 | 3900 | 3600 |
| | Y-D START | 527 | 483 | 548 | 608 | 732 | 733 | 834 | 850 | 1037 | 967 | 1183 | 1073 | 1300 | 1200 |
| | S S START | 442 | 450 | 566 | 554 | 670 | 650 | 774 | 756 | 880 | 856 | 988 | 952 | 1088 | 1052 |
| | MFS | 350 | 350 | 450 | 450 | 500 | 500 | 600 | 600 | 700 | 700 | 800 | 800 | 800 | 800 |
| | MCA | 280 | 285 | 358 | 350 | 423 | 410 | 488 | 477 | 554 | 539 | 622 | 599 | 684 | 662 |
| | FL EFF | 94.7 | 95.7 | 94.0 | 95.8 | 94.6 | 96.1 | 95.3 | 96.2 | 94.9 | 96.1 | 95.0 | 96.2 | 95.3 | 96.5 |
| **575/3/60** | FLA | 177 | 178 | 226 | 224 | 268 | 260 | 309 | 302 | 352 | 342 | 395 | 380 | 435 | 421 |
| | LRA | 1264 | 1160 | 1315 | 1440 | 1760 | 1760 | 2000 | 2040 | 2490 | 2320 | 2840 | 2600 | 3120 | 2900 |
| | Y-D START | 421 | 387 | 438 | 480 | 587 | 587 | 667 | 680 | 830 | 773 | 947 | 867 | 1040 | 967 |
| | S S START | 354 | 356 | 453 | 448 | 536 | 520 | 618 | 605 | 704 | 685 | 790 | 760 | 870 | 842 |
| | MFS | 300 | 300 | 350 | 350 | 450 | 450 | 500 | 500 | 600 | 600 | 600 | 600 | 700 | 700 |
| | MCA | 224 | 226 | 286 | 283 | 338 | 328 | 389 | 381 | 443 | 431 | 497 | 478 | 547 | 529 |
| | FL EFF | 94.7 | 95.7 | 94.0 | 95.8 | 94.6 | 96.1 | 95.3 | 96.2 | 94.9 | 96.1 | 95.0 | 96.2 | 95.3 | 96.5 |
| **2300/3/60** | FLA | 45.2 | 45 | 56 | 55 | 67 | 66 | 77.3 | 77 | 87.7 | 87 | 98.5 | 98 | 108.2 | 108 |
| | LRA | 326 | 340 | 364 | 380 | 459 | 485 | 520 | 580 | 575 | 616 | 653 | 691 | 738 | 766 |
| | MFS | 70 | 70 | 90 | 90 | 110 | 110 | 125 | 125 | 150 | 150 | 150 | 150 | 175 | 175 |
| | MCA | 57 | 57 | 70 | 69 | 84 | 83 | 97 | 97 | 110 | 109 | 124 | 123 | 136 | 135 |
| | FL EFF | 94.0 | 94.6 | 94.0 | 94.6 | 94.1 | 94.8 | 94.2 | 95.2 | 94.5 | 95.2 | 94.8 | 95.2 | 95.3 | 95.2 |
| 460V - oil pump | MFS | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 15 |
| 460V - oil pump | MCA | 13 | 13 | 13 | 13 | 13 | 13 | 13 | 13 | 13 | 13 | 13 | 13 | 13 | 13 |
| **4160/3/60** | FLA | 25 | 25 | 31 | 30.5 | 37.1 | 36.6 | 42.8 | 42 | 48.4 | 48 | 54.5 | 54 | 59.8 | 59 |
| | LRA | 196 | 205 | 218 | 228 | 276 | 291 | 312 | 350 | 345 | 370 | 392 | 415 | 443 | 460 |
| | MFS | 40 | 40 | 50 | 50 | 60 | 60 | 70 | 70 | 80 | 80 | 90 | 90 | 100 | 100 |
| | MCA | 32 | 32 | 39 | 39 | 47 | 46 | 54 | 53 | 61 | 60 | 69 | 68 | 75 | 74 |
| | FL EFF | 94.0 | 94.6 | 94.0 | 94.6 | 94.1 | 94.8 | 94.2 | 95.0 | 94.5 | 95.2 | 94.8 | 95.2 | 95.3 | 95.6 |
| 460V - oil pump | MFS | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 15 |
| 460V - oil pump | MCA | 13 | 13 | 13 | 13 | 13 | 13 | 13 | 13 | 13 | 13 | 13 | 13 | 13 | 13 |
| **400/3/50** | FLA | 259 | 232 | 323 | 285 | 390 | 335 | 450 | 389 | 512 | 441 | 580 | 491 | — | — |
| | LRA | 1620 | 1523 | 1680 | 1916 | 2240 | 2310 | 2540 | 2678 | 3150 | 3045 | 3580 | 3381 | — | — |
| | Y-D START | 540 | 508 | 560 | 639 | 747 | 770 | 847 | 893 | 1050 | 1015 | 1193 | 1127 | — | — |
| | S S START | 518 | 464 | 646 | 570 | 780 | 670 | 900 | 778 | 1024 | 882 | 1160 | 982 | — | — |
| | MFS | 450 | 400 | 500 | 500 | 600 | 500 | 700 | 600 | 800 | 700 | 1000 | 800 | — | — |
| | MCA | 329 | 295 | 409 | 361 | 493 | 424 | 568 | 491 | 645 | 556 | 730 | 619 | — | — |
| | FL EFF | 94.6 | 94.7 | 94.0 | 94.8 | 94.2 | 95.1 | 94.3 | 95.2 | 94.3 | 95.1 | 94.6 | 95.2 | — | — |
| **3300/3/50** | FLA | 32 | 32 | 40 | 40 | 48 | 48 | 56 | 55 | 63 | 62 | 71 | 70 | — | — |
| | LRA | 186 | 195 | 204 | 212 | 270 | 285 | 280 | 320 | 305 | 350 | 374 | 400 | — | — |
| | MFS | 50 | 50 | 70 | 70 | 80 | 80 | 90 | 90 | 110 | 100 | 110 | 110 | — | — |
| | MCA | 40 | 40 | 50 | 50 | 60 | 60 | 70 | 69 | 79 | 78 | 89 | 88 | — | — |
| | FL EFF | 93.0 | 93.6 | 93.0 | 93.6 | 93.1 | 93.8 | 93.2 | 94.1 | 93.8 | 94.4 | 94.0 | 94.4 | — | — |
| 400V - oil pump | MFS | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 15 | — | — |
| 400V - oil pump | MCA | 13 | 13 | 13 | 13 | 13 | 13 | 13 | 13 | 13 | 13 | 13 | 13 | — | — |
| **Oil Pump Data** | | | | | | | | | | | | | | | |
| 400/3/50 | FLA | 4.6 | 4.6 | 4.6 | 4.6 | 4.6 | 4.6 | 4.6 | 4.6 | 4.6 | 4.6 | 4.6 | 4.6 | 4.6 | 4.6 |
| 460/3/60 | FLA | 3.7 | 3.7 | 3.7 | 3.7 | 3.7 | 3.7 | 3.7 | 3.7 | 3.7 | 3.7 | 3.7 | 3.7 | 3.7 | 3.7 |
| 575/3/60 | FLA | 2.72 | 2.72 | 2.72 | 2.72 | 2.72 | 2.72 | 2.72 | 2.72 | 2.72 | 2.72 | 2.72 | 2.72 | 2.72 | 2.72 |

**Notes:**

a. 400V, 460V, and 575V units will be provided with control power transformers in the starter for single power connection.
b. 400/460/575 Volt Motors, the 84 dba Motor is standard
c. 2300V and 4160V units will require a separate 460/3/60 service for oil pump and control transformer.
d. 3300V units will require a separate 400/3/50 service for oil pump and control transformer.

**Legend:**

FLA - Full Load Amps
LRA - Locked Rotor Amps
MCA - Minimum Circuit Ampacity
MFS - Maximum Fuse Size
FL EFF - Full Load Efficiency
SS Start - Solid State Starting (Standard Starting Method)
Y-D Start - Y Delta Starting (Optional Starting Method)

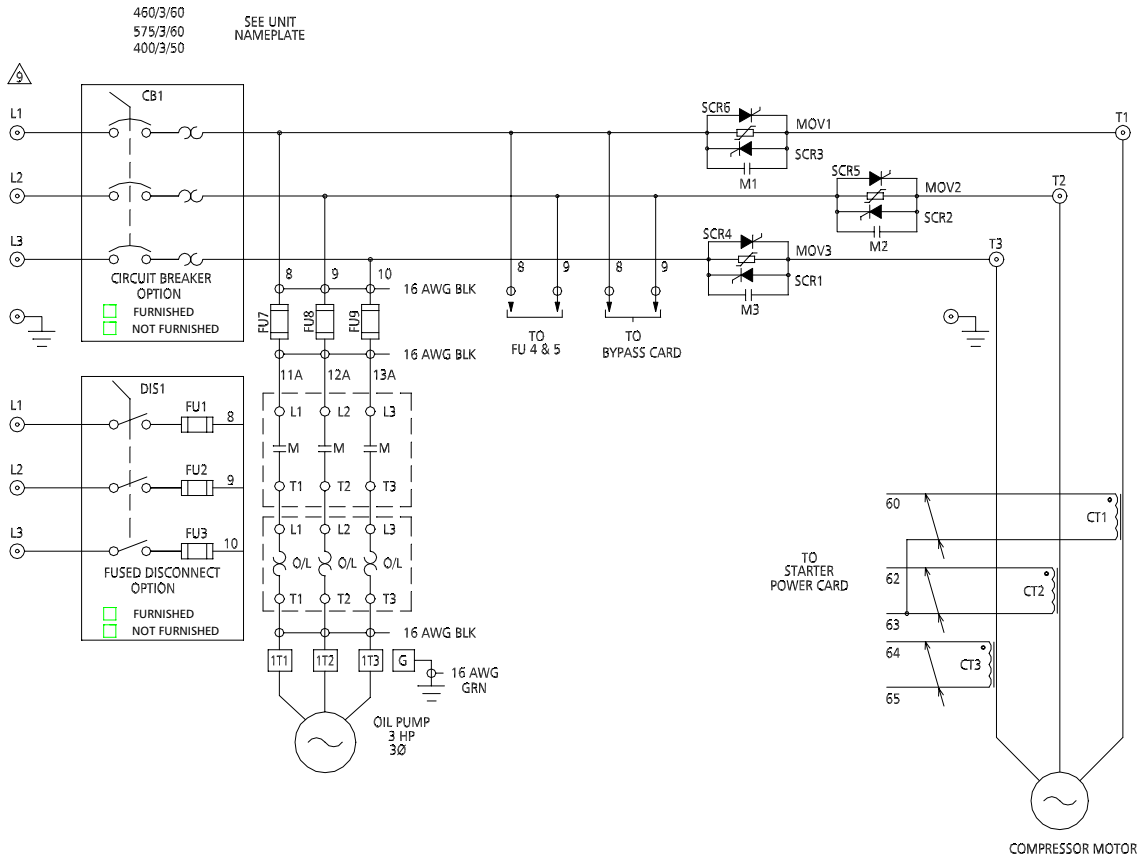
# ELECTRICAL FIELD CONNECTION DATA

| Motor Size (HP) (Standard [S] and Premium [P]) | | | 200 | 250 [S] | 250 [P] | 300 [S] | 300 [P] | 350 | 400 [S] | 400 [P] | 450 [S] | 450 [P] | 500 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Compressor Motor Code | | | ES & EP | FS | FP | GS | GP | HS & HP | JS | JP | KS | KP | LS & LP |
| **Unit Mounted - Solid State Starters ONLY** | | | | | | | | | | | | | |
| 460/3/60 | Terminal Block "Standard" | # of Conductors (4) | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| | | Wire Range | #6-350 | #6-350 | #6-350 | #6-350 | #6-350 | #6-350 | #2-600 | #2-600 | #2-600 | #2-600 | #2-600 |
| | Circuit Breaker "Optional" | Trip Amps | 400A | 400A | 400A | 600A | 600A | 600A | 600A | 600A | 800A | 800A | 800A |
| | | # of Conductors (4) | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 3 | 3 | 3 |
| | | Wire Range | 3/0-500 | 3/0-500 | 3/0-500 | 3/0-500 | 3/0-500 | 3/0-500 | 3/0-500 | 3/0-500 | #1-500 | #1-500 | #1-500 |
| | Fused Disconnect "Optional" | Rating in amps | 400A | 400A | 400A | 600A | 600A | 600A | 600A | 600A | 800A | 800A | 800A |
| | | # of Conductors (4) | 1 | 1 | 1 | 2 | 2 | 2 | 2 | 2 | 3 | 3 | 3 |
| | | Wire Range | #2-600 | #2-600 | #2-600 | #2-600 | #2-600 | #2-600 | #2-600 | #2-600 | #1-500 | #1-500 | #1-500 |
| 575/3/60 | Terminal Block "Standard" | # of Conductors (4) | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| | | Wire Range | #6-350 | #6-350 | #6-350 | #6-350 | #6-350 | #6-350 | #2-600 | #2-600 | #2-600 | #2-600 | #2-600 |
| | Circuit Breaker "Optional" | Trip Amps | 250A | 400A | 400A | 400A | 400A | 600A | 600A | 600A | 600A | 600A | 600A |
| | | # of Conductors (4) | 1 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| | | Wire Range | #6-350 | 3/0-500 | 3/0-500 | 3/0-500 | 3/0-500 | 3/0-500 | 3/0-500 | 3/0-500 | 3/0-500 | 3/0-500 | 3/0-500 |
| | Fused Disconnect "Optional" | Rating in amps | 400A | 400A | 400A | 400A | 400A | 600A | 600A | 600A | 600A | 600A | 600A |
| | | # of Conductors (4) | 1 | 1 | 1 | 1 | 1 | 2 | 2 | 2 | 2 | 2 | 2 |
| | | Wire Range | #2-600 | #2-600 | #2-600 | #2-600 | #2-600 | #2-600 | #2-600 | #2-600 | #2-600 | #2-600 | #2-600 |
| 400/3/50 | Terminal Block "Standard" | # of Conductors (4) | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | NA |
| | | Wire Range | #6-350 | #6-350 | #6-350 | #6-350 | #6-350 | #2-600 | #2-600 | #2-600 | #2-600 | #2-600 | NA |
| | Circuit Breaker "Optional" | Trip Amps | 400A | 600A | 400A | 600A | 600A | 600A | 800A | 600A | 800A | 800A | NA |
| | | # of Conductors (4) | 2 | 2 | 2 | 2 | 2 | 2 | 3 | 2 | 3 | 3 | NA |
| | | Wire Range | 3/0-500 | 3/0-500 | 3/0-500 | 3/0-500 | 3/0-500 | 3/0-500 | #1-500 | 3/0-500 | #1-500 | #1-500 | NA |
| | Fused Disconnect "Optional" | Rating in amps | 400A | 600A | 400A | 600A | 600A | 600A | 600A | 600A | 800A | 800A | NA |
| | | # of Conductors (4) | 1 | 2 | 1 | 2 | 2 | 2 | 3 | 2 | 3 | 3 | NA |
| | | Wire Range | #2-600 | #2-600 | #2-600 | #2-600 | #2-600 | #2-600 | #1-500 | #2-600 | #1-500 | #1-500 | NA |
| **Unit Mounted - Wye Delta Starters ONLY** | | | | | | | | | | | | | |
| 460/3/60 | Terminal Block "Standard" | # of Conductors (4) | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| | | Wire Range | #2-300 | #1-500 | #1-500 | #1-500 | #1-500 | #1-500 | #1-500 | #1-500 | #1-500 | #1-500 | #2-600 |
| | Circuit Breaker "Optional" | Trip Amps | 400A | 400A | 400A | 600A | 600A | 600A | 600A | 600A | 800A | 800A | 800A |
| | | # of Conductors (4) | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 3 | 3 | 3 |
| | | Wire Range | 3/0-500 | 3/0-500 | 3/0-500 | 3/0-500 | 3/0-500 | 3/0-500 | 3/0-500 | 3/0-500 | #1-500 | #1-500 | #1-500 |
| | Fused Disconnect "Optional" | Rating in amps | 400A | 400A | 400A | 600A | 600A | 600A | 600A | 600A | CF | CF | CF |
| | | # of Conductors (4) | 1 | 1 | 1 | 2 | 2 | 2 | 2 | 2 | CF | CF | CF |
| | | Wire Range | #2-600 | #2-600 | #2-600 | #2-600 | #2-600 | #2-600 | #2-600 | #2-600 | CF | CF | CF |
| 575/3/60 | Terminal Block "Standard" | # of Conductors (4) | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| | | Wire Range | #3-2/0 | #2-300 | #2-300 | #2-300 | #2-300 | #1-500 | #1-500 | #1-500 | #1-500 | #1-500 | #1-500 |
| | Circuit Breaker "Optional" | Trip Amps | 250A | 400A | 400A | 400A | 400A | 600A | 600A | 600A | 600A | 600A | 600A |
| | | # of Conductors (4) | 1 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| | | Wire Range | #6-350 | 3/0-500 | 3/0-500 | 3/0-500 | 3/0-500 | 3/0-500 | 3/0-500 | 3/0-500 | 3/0-500 | 3/0-500 | 3/0-500 |
| | Fused Disconnect "Optional" | Rating in amps | 400A | 400A | 400A | 400A | 400A | 600A | 600A | 600A | 600A | 600A | 600A |
| | | # of Conductors (4) | 1 | 1 | 1 | 1 | 1 | 2 | 2 | 2 | 2 | 2 | 2 |
| | | Wire Range | #2-600 | #2-600 | #2-600 | #2-600 | #2-600 | #2-600 | #2-600 | #2-600 | #2-600 | #2-600 | #2-600 |
| 400/3/50 | Terminal Block "Standard" | # of Conductors (4) | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 4 | 4 | NA |
| | | Wire Range | #2-300 | #1-500 | #2-300 | #1-500 | #1-500 | #1-500 | #1-500 | #1-500 | #2-600 | #2-600 | NA |
| | Circuit Breaker "Optional" | Trip Amps | 400A | 600A | 400A | 600A | 600A | 600A | 800A | 600A | 800A | 800A | NA |
| | | # of Conductors (4) | 2 | 2 | 2 | 2 | 2 | 2 | 3 | 2 | 3 | 3 | NA |
| | | Wire Range | 3/0-500 | 3/0-500 | 3/0-500 | 3/0-500 | 3/0-500 | 3/0-500 | #1-500 | 3/0-500 | #1-500 | #1-500 | NA |
| | Fused Disconnect "Optional" | Rating in amps | 400A | 600A | 400A | 600A | 600A | 600A | CF | 600A | CF | CF | NA |
| | | # of Conductors (4) | 1 | 2 | 1 | 2 | 2 | 2 | CF | 2 | CF | CF | NA |
| | | Wire Range | #2-600 | #2-600 | #2-600 | #2-600 | #2-600 | #2-600 | CF | #2-600 | CF | CF | NA |
| **Remote Mounted - Wye Delta Starters ONLY** | | | | | | | | | | | | | |
| 460/3/60 | Terminal Block "Standard" | # of Conductors (4) | 2 | 2 | 2 | 2 | 4 | 4 | 4 | 4 | 4 | 4 | 4 |
| | | Wire Range | #6-250 | #6-250 | #6-250 | #6-250 | #4-500 | #4-500 | #4-500 | #4-500 | #4-500 | #4-500 | #4-500 |
| | Circuit Breaker "Optional" | Trip Amps | 400A | 400A | 400A | 600A | 600A | 600A | 600A | 600A | 800A | 800A | 800A |
| | | # of Conductors (4) | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 3 | 2 | 3 |
| | | Wire Range | 3/0-250 | 3/0-250 | 3/0-250 | 250-500 | 250-500 | 250-500 | 250-500 | 250-500 | 2/0-400 | 250-500 | 2/0-400 |
| | Fused Disconnect "Optional" | Rating in amps | 400A | 400A | 400A | 600A | 600A | 600A | 600A | 600A | 800A | 800A | 800A |
| | | # of Conductors (4) | 1 | 1 | 1 | 2 | 2 | 2 | 2 | 2 | 4 | 2 | 4 |
| | | Wire Range | #2-600 | #2-600 | #2-600 | #2-600 | #2-600 | #2-600 | #2-600 | #2-600 | #2-600 | #2-600 | #2-600 |
| 575/3/60 | Terminal Block "Standard" | # of Conductors (4) | 2 | 2 | 2 | 2 | 2 | 2 | 4 | 4 | 4 | 4 | 4 |
| | | Wire Range | #6-250 | #6-250 | #6-250 | #6-250 | #6-250 | #6-250 | #4-500 | #4-500 | #4-500 | #4-500 | #4-500 |
| | Circuit Breaker "Optional" | Trip Amps | 250A | 400A | 400A | 400A | 400A | 400A | 600A | 600A | 600A | 600A | 600A |
| | | # of Conductors (4) | 1 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| | | Wire Range | #6-350 | 3/0-250 | 3/0-250 | 3/0-250 | 3/0-250 | 3/0-250 | 250-500 | 250-500 | 250-500 | 250-500 | 250-500 |
| | Fused Disconnect "Optional" | Rating in amps | 400A | 400A | 400A | 400A | 400A | 600A | 600A | 600A | 600A | 600A | 600A |
| | | # of Conductors (4) | 1 | 1 | 1 | 1 | 1 | 2 | 2 | 2 | 2 | 2 | 2 |
| | | Wire Range | #2-600 | #2-600 | #2-600 | #2-600 | #2-600 | #2-600 | #2-600 | #2-600 | #2-600 | #2-600 | #2-600 |
| 400/3/50 | Terminal Block "Standard" | # of Conductors (4) | 2 | 2 | 2 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | NA |
| | | Wire Range | #6-250 | #6-250 | #6-250 | #4-500 | #4-500 | #4-500 | #4-500 | #4-500 | #4-500 | #4-500 | NA |
| | Circuit Breaker "Optional" | Trip Amps | 400A | 600A | 400A | 600A | 600A | 600A | 800A | 600A | 800A | 800A | NA |
| | | # of Conductors (4) | 2 | 2 | 2 | 2 | 2 | 2 | 3 | 2 | 3 | 3 | NA |
| | | Wire Range | 3/0-250 | 250-500 | 3/0-250 | 3/0-500 | 250-500 | 250-500 | 2/0-400 | 250-500 | 2/0-400 | 2/0-400 | NA |
| | Fused Disconnect "Optional" | Rating in amps | 400A | 600A | 400A | 600A | 600A | 600A | 800A | 600A | 800A | 800A | NA |
| | | # of Conductors (4) | 1 | 2 | 1 | 2 | 2 | 2 | 4 | 2 | 4 | 4 | NA |
| | | Wire Range | #2-600 | #2-600 | #2-600 | #2-600 | #2-600 | #2-600 | #2-600 | #2-600 | #2-600 | #2-600 | NA |

**Notes:**
1. All field wiring used to connect the PCX$_i$ Chillers must be Copper.
2. Wire sizes 250 and larger are Kcmil.
3. Remote mounted Medium Voltage Starters provided with Buss-Bar connections.
4. Number of conductors per pole.

NA = Not Available
CF = Consult Factory

# POWER WIRING DIAGRAM: TYPICAL SOLID STATE UNIT MOUNTED STARTER•




JUMPER LISTING AND SETTINGS

CHART 1 ⚠4

| CPU CARD JUMPER | DESCRIPTION | POSITION (1-2) OR IN | POSITION (2-3) OR OUT | AS BUILT |
|---|---|---|---|---|
| JPC3 | DECEL\BRAKING | DISABLE | ENABLE | 1-2 |
| JPC5 | LCD START BUTTON | ENABLE | DISABLE | 2-3 |
| JPC7 | O/L RESET AUTO/MANUAL | AUTO | MANUAL | 2-3 |
| JPC11 | PWM OUTPUT | ENABLE | DISABLE | 1-2 |
| JPC12 | GATE FIRING | PULSE | BLOCK | IN |
| JPC13 | LCD STOP BUTTON | ENABLE | DISABLE | 2-3 |
| JPC15 | EPROM SIZE | 27C256 | 27C512 | 2-3 |
| JPC16 | COMM SELECT | RS-232 | RS-485 | OUT |
| JPC17 | EQUIP INTEGRAL BYPASS | YES | NO | 1-2 |
| JPC18 | STANDARD | | | 2-3 |
| JPC19 | FAULT RESET AUTO/MANUAL | AUTO | MANUAL | 2-3 |
| JPC22 | RS-485 COMM | ENABLE | DISABLE | OUT |
| JPC23 | SERIAL COMM | DISABLE | ENABLE | IN |

CHART 2

| POWER CARD JUMPER | DESCRIPTION | POSITION (1-2) | POSITION (2-3) | AS BUILT |
|---|---|---|---|---|
| JPP2 | LINE SYNCHING | L-L | L-N | 1-2 |
| JPP3 | LINE SYNCHING | L-L | L-N | 1-2 |
| JPP4 | LINE SYNCHING | L-L | L-N | 1-2 |

CHART 3

| MOTOR RLA | CT RATIO | CT BURDEN SW1 | |
|---|---|---|---|
| | | POS 1 | POS 2 |
| 200-500A | 2640:1 | ON | ON |
| 501-1200A | 5760:1 | ON | ON |

⚠1 LED STATUS WITH POWER APPLIED AND PRIOR TO RUN COMMAND.
"ON" "OFF"

⚠2 K3 RELAY SHOWN IN DE-ENERGIZED STATE. K3 CONTACT WILL CLOSE WHEN POWER IS APPLIED. K3 CONTACT WILL OPEN ON STOP COMMAND OR SYSTEM FAULT.

⚠3 K4 RELAY SHOWN IN DE-ENERGIZED STATE.
K4 CONTACT AT TBP3 1 & 2 WILL OPEN AND
K4 CONTACT AT TBP3 2 & 3 WILL CLOSE ON SYSTEM FAULT.
K4 RELAY INDICATES FAULT ON POWER-UP UNTIL STARTER SELF-CHECK IS COMPLETE.

⚠4 JUMPERS DENOTED AS IN/OUT ARE 2 PIN JUMPERS.

⚠5 BUNDLE SEPARATELY FROM CONTROL WIRING.

⚠6 TERMINAL IDENTIFICATIONS ARE CUSTOMER REQUIRED.

⚠7 ALL WIRING TO BE 16 AWG RED UNLESS OTHERWISE NOTED.

⚠8 FOR CURRENT TRANSFORMER RATIO AND POWER CARD SW1 SETTINGS SEE CHART 3.

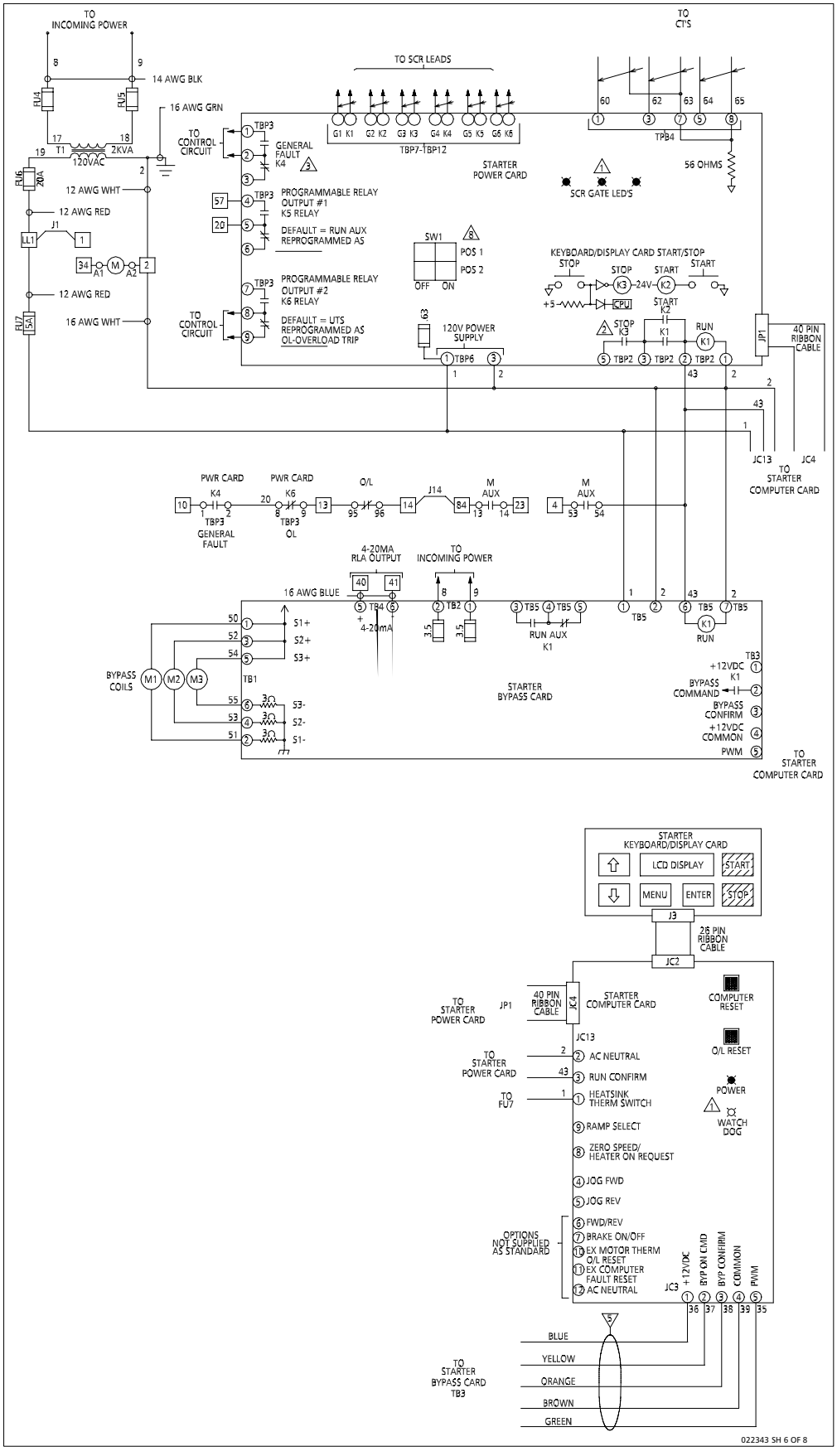
⚠9 ALL FIELD WIRING MUST COMPLY WITH LOCAL,STATE, & NATIONAL CODES.
USE COPPER CONDUCTORS ONLY.

STANDARD LEGEND

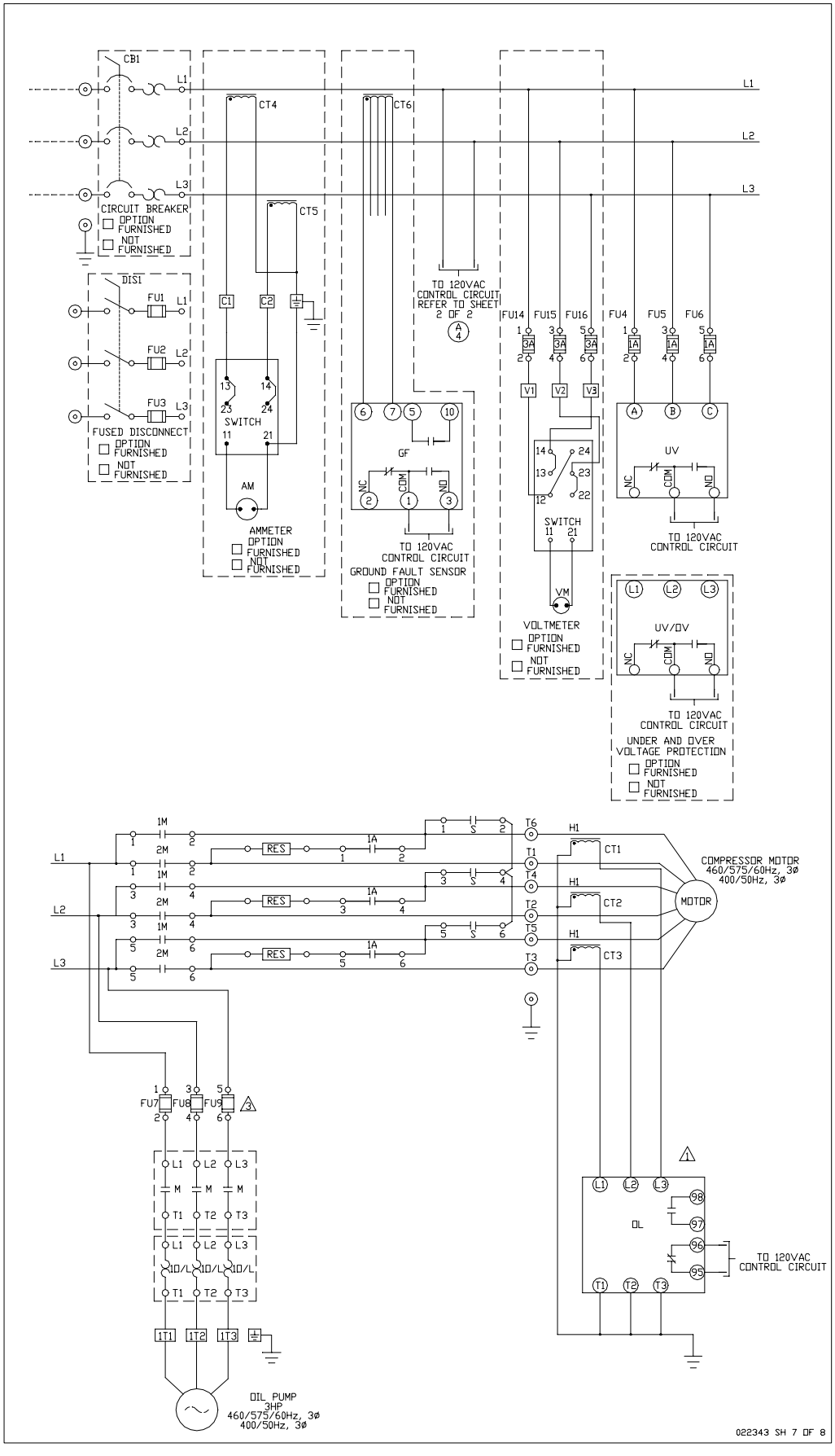
- WIRE NODE SYMBOL MAY HAVE TERMINAL BLOCK
- FACTORY SUPPLIED TERMINAL BLOCK
- TERMINAL STRIP
- POWER CONNECTION
- TWISTED PAIR
- TWISTED SHIELDED PAIR
- FIELD WIRING

022343 SH 5 OF 8

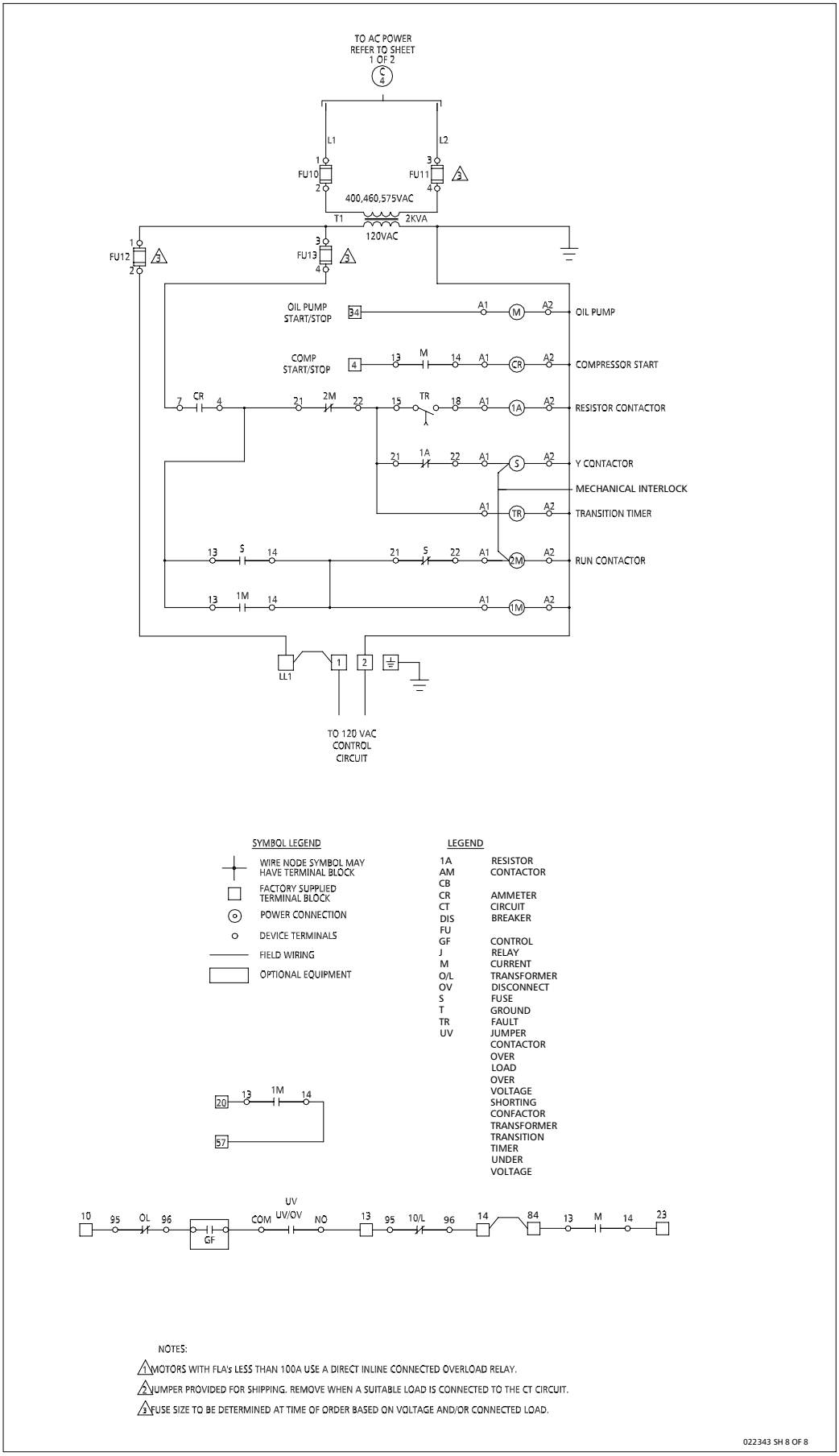
# POWER WIRING DIAGRAM: TYPICAL SOLID STATE UNIT MOUNTED STARTER•



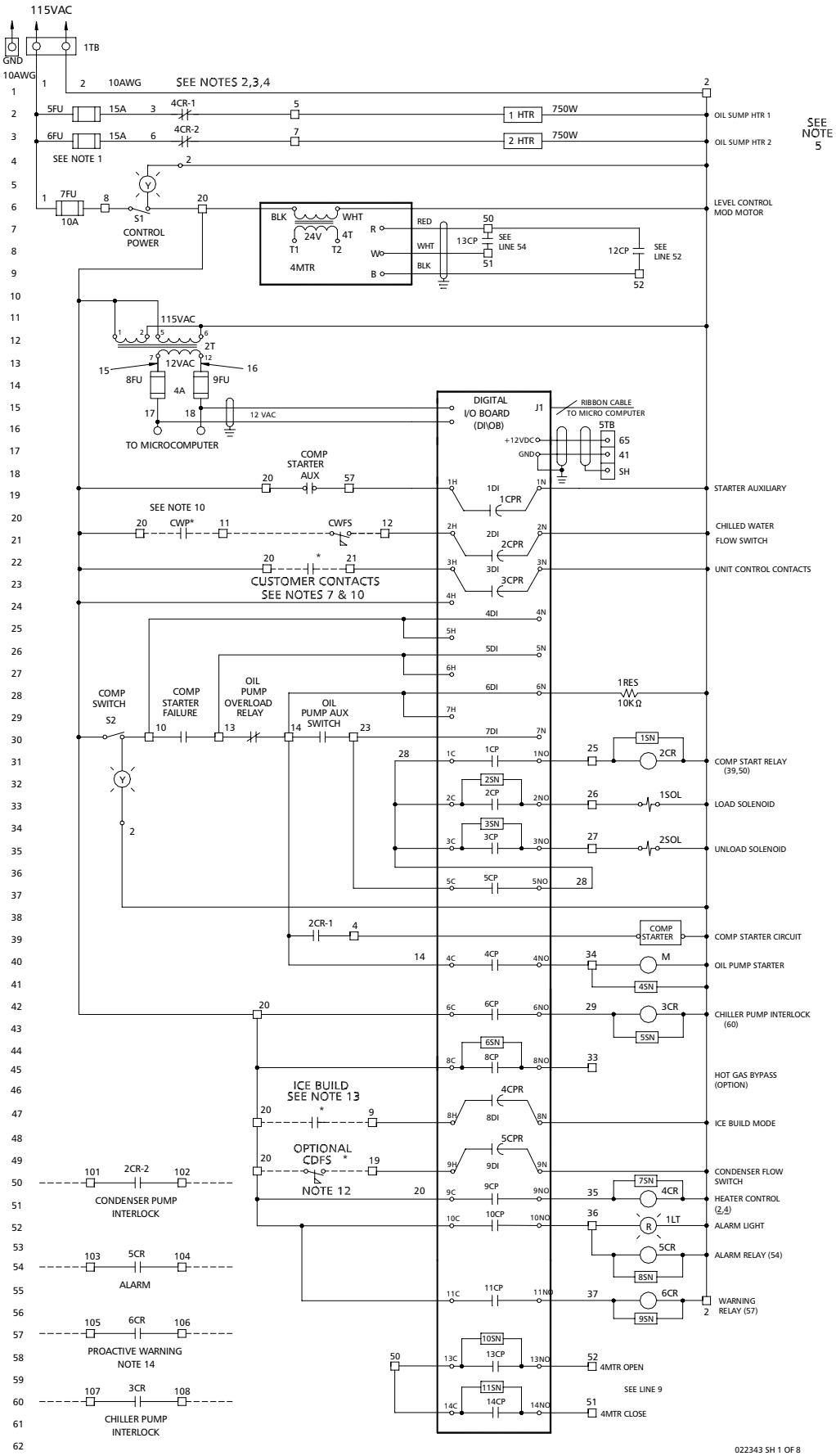
# Power Wiring Diagram: Typical Wye-Delta Unit Mounted Starter •



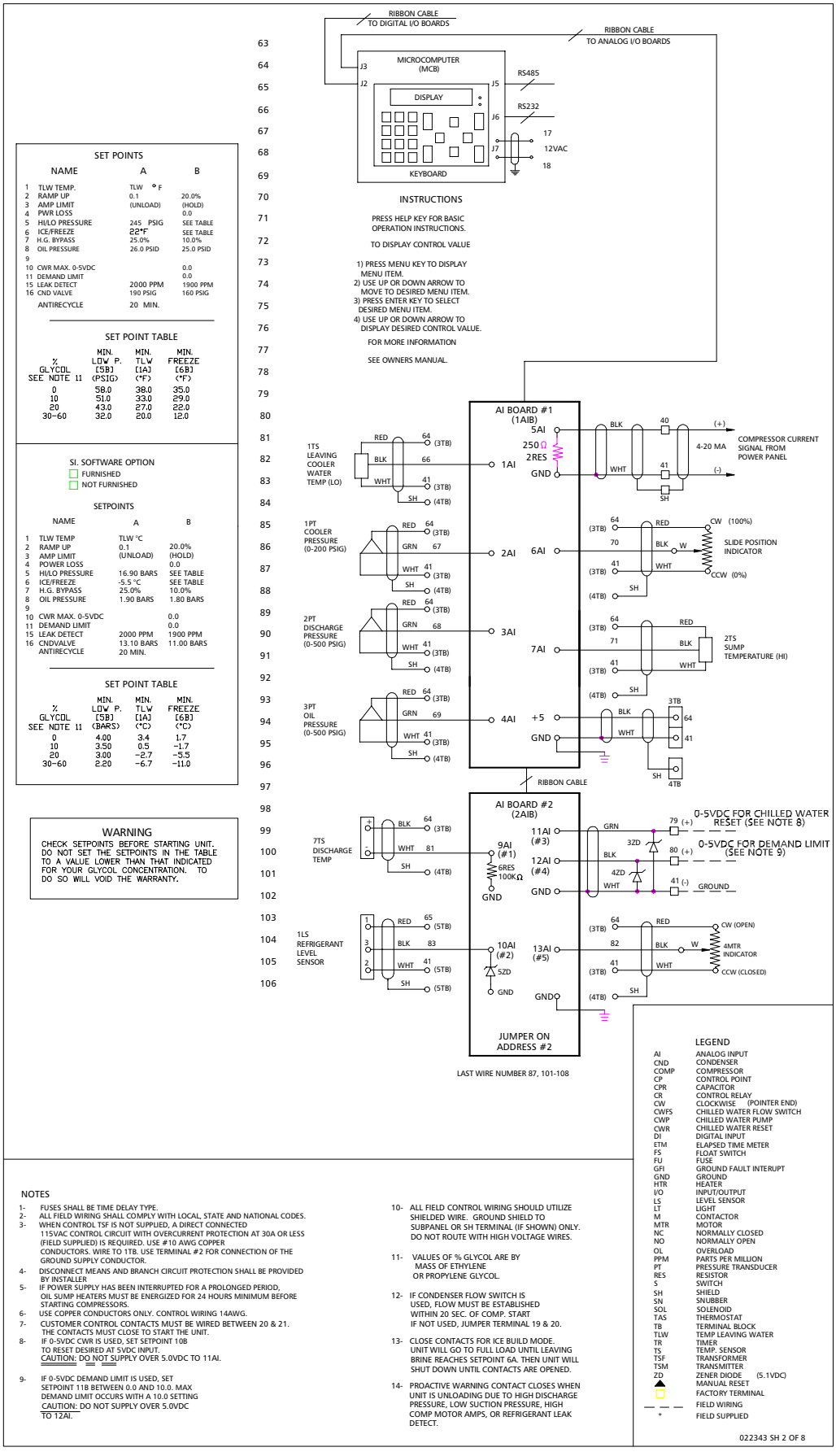
# POWER WIRING DIAGRAM: TYPICAL WYE-DELTA UNIT MOUNTED STARTER •



# TYPICAL CONTROL WIRING DIAGRAM



# TYPICAL CONTROL WIRING DIAGRAM




### SET POINTS

| | NAME | A | B |
|---|---|---|---|
| 1 | TLW TEMP. | TLW °F | |
| 2 | RAMP UP | 0.1 | 20.0% |
| 3 | AMP LIMIT | (UNLOAD) | (HOLD) |
| 4 | PWR LOSS | | 0.0 |
| 5 | HI/LO PRESSURE | 245 PSIG | SEE TABLE |
| 6 | ICE/FREEZE | 22°F | SEE TABLE |
| 7 | H.G. BYPASS | 25.0% | 10.0% |
| 8 | OIL PRESSURE | 26.0 PSID | 25.0 PSID |
| 9 | | | |
| 10 | CWR MAX. 0-5VDC | | 0.0 |
| 11 | DEMAND LIMIT | | 0.0 |
| 15 | LEAK DETECT | 2000 PPM | 1900 PPM |
| 16 | CND VALVE | 190 PSIG | 160 PSIG |
| | ANTIRECYCLE | 20 MIN. | |

### SET POINT TABLE

| % GLYCOL SEE NOTE 11 | MIN. LOW P. [5B] (PSIG) | MIN. TLW [1A] (°F) | MIN. FREEZE [6B] (°F) |
|---|---|---|---|
| 0 | 58.0 | 38.0 | 35.0 |
| 10 | 51.0 | 33.0 | 29.0 |
| 20 | 43.0 | 27.0 | 22.0 |
| 30-60 | 32.0 | 20.0 | 12.0 |

SI. SOFTWARE OPTION

☐ FURNISHED
☐ NOT FURNISHED

### SETPOINTS

| | NAME | A | B |
|---|---|---|---|
| 1 | TLW TEMP | TLW °C | |
| 2 | RAMP UP | 0.1 | 20.0% |
| 3 | AMP LIMIT | (UNLOAD) | (HOLD) |
| 4 | POWER LOSS | | 0.0 |
| 5 | HI/LO PRESSURE | 16.90 BARS | SEE TABLE |
| 6 | ICE/FREEZE | -5.5 °C | SEE TABLE |
| 7 | H.G. BYPASS | 25.0% | 10.0% |
| 8 | OIL PRESSURE | 1.90 BARS | 1.80 BARS |
| 9 | | | |
| 10 | CWR MAX. 0-5VDC | | 0.0 |
| 11 | DEMAND LIMIT | | 0.0 |
| 15 | LEAK DETECT | 2000 PPM | 1900 PPM |
| 16 | CNDVALVE | 13.10 BARS | 11.00 BARS |
| | ANTIRECYCLE | 20 MIN. | |

### SET POINT TABLE

| % GLYCOL SEE NOTE 11 | MIN. LOW P. [5B] (BARS) | MIN. TLW [1A] (°C) | MIN. FREEZE [6B] (°C) |
|---|---|---|---|
| 0 | 4.00 | 3.4 | 1.7 |
| 10 | 3.50 | 0.5 | -1.7 |
| 20 | 3.00 | -2.7 | -5.5 |
| 30-60 | 2.20 | -6.7 | -11.0 |

**WARNING**

CHECK SETPOINTS BEFORE STARTING UNIT. DO NOT SET THE SETPOINTS IN THE TABLE TO A VALUE LOWER THAN THAT INDICATED FOR YOUR GLYCOL CONCENTRATION. TO DO SO WILL VOID THE WARRANTY.

### NOTES

1- FUSES SHALL BE TIME DELAY TYPE.
2- ALL FIELD WIRING SHALL COMPLY WITH LOCAL, STATE AND NATIONAL CODES.
3- WHEN CONTROL TSF IS NOT SUPPLIED, A DIRECT CONNECTED 115VAC CONTROL CIRCUIT WITH OVERCURRENT PROTECTION AT 30A OR LESS (FIELD SUPPLIED) IS REQUIRED. USE #10 AWG COPPER CONDUCTORS. WIRE TO 1TB. USE TERMINAL #2 FOR CONNECTION OF THE GROUND SUPPLY CONDUCTOR.
4- DISCONNECT MEANS AND BRANCH CIRCUIT PROTECTION SHALL BE PROVIDED BY INSTALLER
5- IF POWER SUPPLY HAS BEEN INTERRUPTED FOR A PROLONGED PERIOD, OIL SUMP HEATERS MUST BE ENERGIZED FOR 24 HOURS MINIMUM BEFORE STARTING COMPRESSORS.
6- USE COPPER CONDUCTORS ONLY. CONTROL WIRING 14AWG.
7- CUSTOMER CONTROL CONTACTS MUST BE WIRED BETWEEN 20 & 21. THE CONTACTS MUST CLOSE TO START THE UNIT.
8- IF 0-5VDC CWR IS USED, SET SETPOINT 10B TO RESET DESIRED AT 5VDC INPUT. CAUTION: DO NOT SUPPLY OVER 5.0VDC TO 11AI.
9- IF 0-5VDC DEMAND LIMIT IS USED, SET SETPOINT 11B BETWEEN 0.0 AND 10.0. MAX DEMAND LIMIT OCCURS WITH A 10.0 SETTING CAUTION: DO NOT SUPPLY OVER 5.0VDC TO 12AI.
10- ALL FIELD CONTROL WIRING SHOULD UTILIZE SHIELDED WIRE. GROUND SHIELD TO SUBPANEL OR SH TERMINAL (IF SHOWN) ONLY. DO NOT ROUTE WITH HIGH VOLTAGE WIRES.
11- VALUES OF % GLYCOL ARE BY MASS OF ETHYLENE OR PROPYLENE GLYCOL.
12- IF CONDENSER FLOW SWITCH IS USED, FLOW MUST BE ESTABLISHED WITHIN 20 SEC. OF COMP. START IF NOT USED, JUMPER TERMINAL 19 & 20.
13- CLOSE CONTACTS FOR ICE BUILD MODE. UNIT WILL GO TO FULL LOAD UNTIL LEAVING BRINE REACHES SETPOINT 6A. THEN UNIT WILL SHUT DOWN UNTIL CONTACTS ARE OPENED.
14- PROACTIVE WARNING CONTACT CLOSES WHEN UNIT IS UNLOADING DUE TO HIGH DISCHARGE PRESSURE, LOW SUCTION PRESSURE, HIGH COMP MOTOR AMPS, OR REFRIGERANT LEAK DETECT.

### LEGEND

| | |
|---|---|
| AI | ANALOG INPUT |
| CND | CONDENSER |
| COMP | COMPRESSOR |
| CP | CONTROL POINT |
| CPR | CAPACITOR |
| CR | CONTROL RELAY |
| CW | CLOCKWISE (POINTER END) |
| CWFS | CHILLED WATER FLOW SWITCH |
| CWP | CHILLED WATER PUMP |
| CWR | CHILLED WATER RESET |
| DI | DIGITAL INPUT |
| ETM | ELAPSED TIME METER |
| FS | FLOAT SWITCH |
| FU | FUSE |
| GFI | GROUND FAULT INTERUPT |
| GND | GROUND |
| HTR | HEATER |
| I/O | INPUT/OUTPUT |
| LS | LEVEL SENSOR |
| LT | LIGHT |
| M | CONTACTOR |
| MTR | MOTOR |
| NC | NORMALLY CLOSED |
| NO | NORMALLY OPEN |
| OL | OVERLOAD |
| PPM | PARTS PER MILLION |
| PT | PRESSURE TRANSDUCER |
| RES | RESISTOR |
| S | SWITCH |
| SH | SHIELD |
| SN | SNUBBER |
| SOL | SOLENOID |
| TAS | THERMOSTAT |
| TB | TERMINAL BLOCK |
| TLW | TEMP LEAVING WATER |
| TR | TIMER |
| TS | TEMP. SENSOR |
| TSF | TRANSFORMER |
| TSM | TRANSMITTER |
| ZD | ZENER DIODE (5.1VDC) |
| ▲ | MANUAL RESET |
| □ | FACTORY TERMINAL |
| — — — | FIELD WIRING |
| * | FIELD SUPPLIED |

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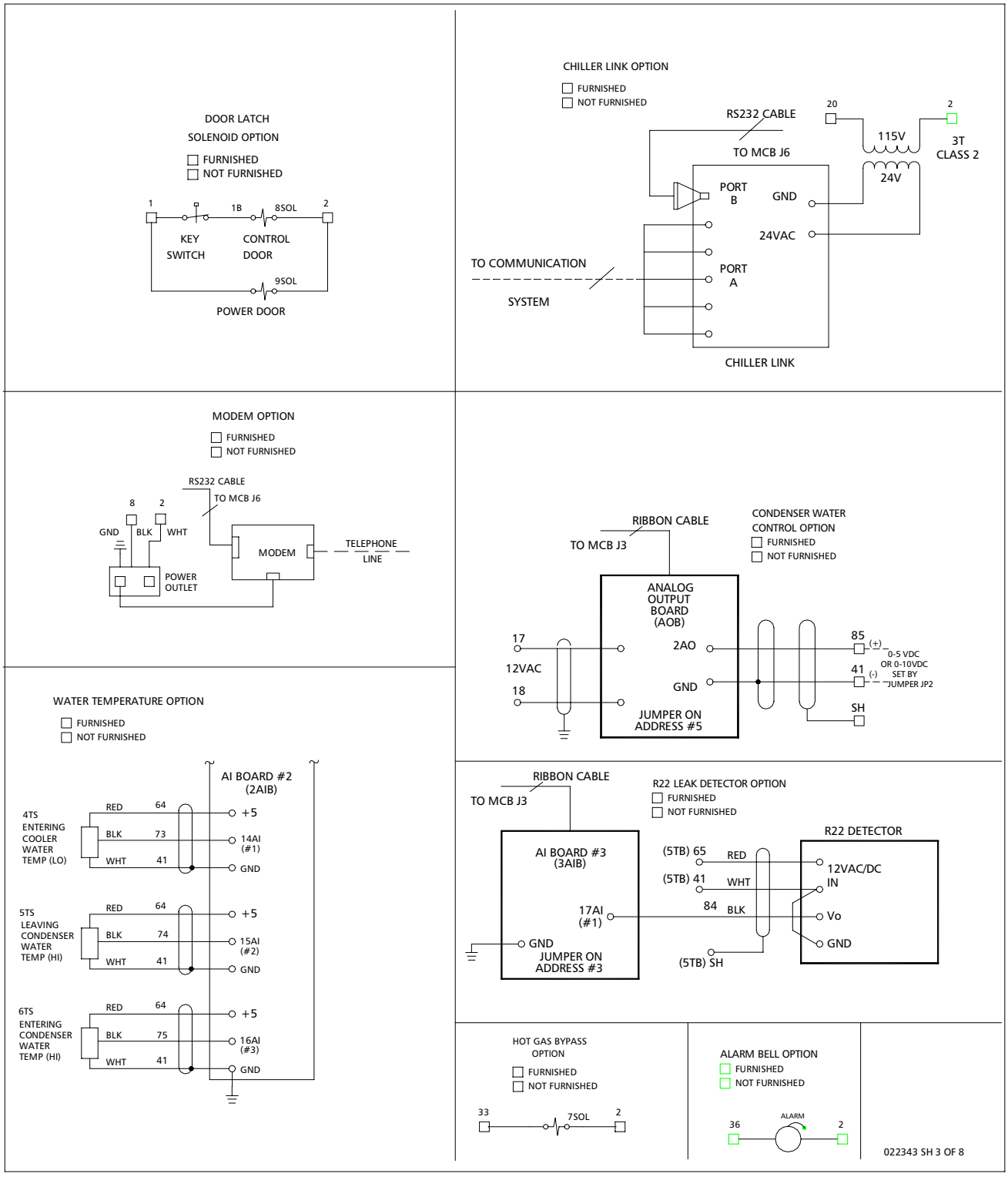
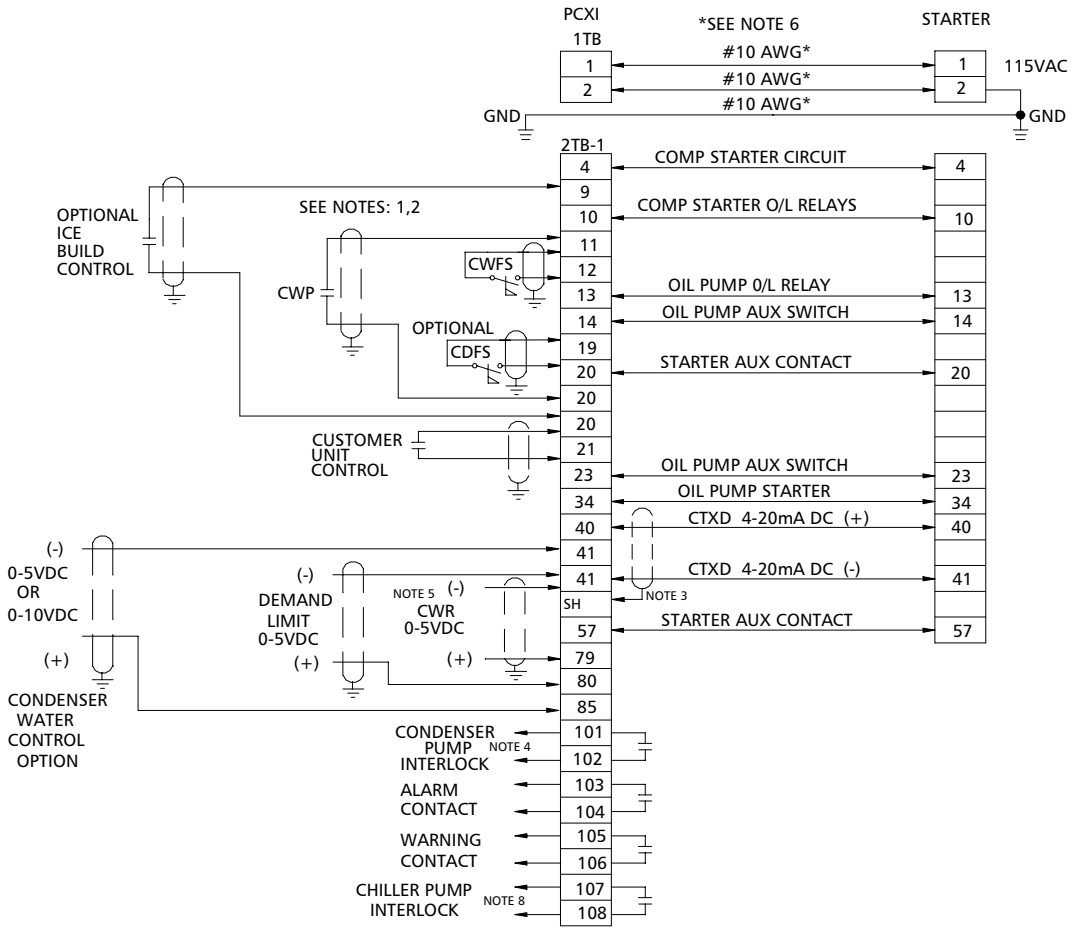
# TYPICAL CONTROL WIRING DIAGRAM: OPTIONS



# TYPICAL OPTIONAL INTERCONNECTION WIRING DIAGRAM




LEGEND

| | |
|---|---|
| AUX | AUXILIARY |
| CDFS | CONDENSER WATER FLOW SWITCH (OPTIONAL) |
| CTXD | CURRENT TRANSDUCER |
| CWFS | CHILLED WATER FLOW SWITCH |
| CWP | CHILLED WATER PUMP AUX. SWITCH |
| CWR | CHILLED WATER RESET |
| GND | GROUND |
| O/L | OVERLOAD |

NOTES:

1. SHIELDED CABLE SHOULD BE UTILIZED FOR CWFS, CDFS, CWP, CUSTOMER CONTROL, CWR, DEMAND LIMIT, CURRENT TRANSDUCER WIRING, AND CONDENSER WATER CONTROL OPTION.
2. GROUND ONLY ONE END OF EACH SHIELDED CABLE IN THE UNIT CONTROL PANEL OR STARTER PANEL.
3. TERMINAL "SH" IS PROVIDED FOR WIRING CURRENT TRANSDUCER SHIELDING ONLY. INSULATE THE SHIELD UP TO THE SH TERMINAL.
4. THE CONDENSER PUMP INTERLOCK MUST BE USED TO ENABLE THE CONDENSER PUMP CONTROL CIRCUIT. CONTACT RATING: 125VAC-10A 250VAC-5A
5. DO NOT SUPPLY OVER 5.0VDC. DEMAND LIMIT AND CWR ARE OPTIONAL.
6. FOR EXTENDED DISTANCE BETWEEN PCXI AND STARTER, CONDUCTORS MUST BE SIZED TO ENSURE 115VAC+/-10% AT 1TB.
7. INTERCONNECTING 115VAC WIRING SHOULD BE 14 AWG MINIMUM EXCEPT AS NOTED. SHIELDED CABLE CAN BE 16 AWG.
8. THE CHILLER PUMP INTERLOCK CAN BE USED TO ENABLE THE CHILLER PUMP CONTROL CIRCUIT, IF DESIRED.
9. REF. 022165

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# PRODUCT SPECIFICATION

## Part 1: General

### 1.01 Work Included

A. Provide a complete Water Cooled Packaged Chiller utilizing rotary screw compressors suitable for indoor installation and be controlled by a Full Function Microcomputer Controller. Contractor shall furnish and install chillers as shown and scheduled on the drawings. Units shall be installed in accordance with this specification.
B. Chillers shall be selected for use with water / (___% ethylene or propylene glycol).

### 1.02 Quality Assurance

A. Unit construction shall be designed to conform to ANSI / ASHRAE 15 latest version safety standards, NEC (USA), and ASME Section VIII Division I (USA) applicable codes.
B. Unit shall have ETL (USA) and cETL (Canadian) approval (60Hz)
C. The unit shall comply with all local codes.
D. Unit efficiency shall meet or exceed ASHRAE Standard 90.1, latest version
E. The unit shall be rated and certified in accordance with ARI Standard 550/590, latest version.
F. The unit shall be fully tested at the factory with all options mounted and wired on low voltage units.

### 1.03 Design Base

A. The construction drawings indicate a system based on a selected manufacturer of equipment and the design data available to the Engineer during construction document preparation. Electrical services, size, configuration and space allocations are consistent with that manufacturer's recommendations and requirements.
B. Other listed or approved manufacturers are encouraged to provide equipment on this project; however, it shall be the Contractor's and/or Supplier's responsibility to assure the equipment is consistent with the design base. No compensation will be approved for revisions required by the design base or other manufacturers for any different services, space, clearances, etc.

### 1.04 Related Work Specified Elsewhere

A. General Provisions: Section 15XXX
B. General Completion and Start-up: Section 15XXX
C. Equipment & Pipe Identification: Section 15XXX
D. Tests: Section 15XXX
E. Vibration Isolation: Section 15XXX
F. Chilled Water System: Section 15XXX

### 1.05 Submittals

A. Submit shop drawings on each piece of equipment specified in accordance with Specifications Section 15010, General Provisions.
B. Furnish three (3) sets of Operations and Maintenance Data.
C. Furnish one (1) copy of submittal for each chiller unit to the Temperature Control Contractor.

### 1.06 Delivery and Handling

A. The unit shall be delivered to the job site completely assembled and charged with refrigerant and oil by the manufacturer.
B. Delivery and handling shall comply with the manufacturer's instruction for rigging and handling.
C. The unit controls shall be capable of withstanding 150°F (66°C) storage temperature in the control panel for an indefinite period of time.

### 1.07 Start-Up

A. The contractor shall provide labor to accomplish the check, test and start-up procedure as recommended by the unit manufacturer.
B. The start-up serviceman shall provide and complete the manufacturer's check, test and start forms. One copy shall be sent to the engineer and one copy to the manufacturer's factory.
C. The unit manufacturer shall provide a factory-trained serviceman to supervise the original start-up of the units for final operation.

**1.08 Warranty**

A. The equipment supplier shall provide a warranty on the entire refrigeration system, **exclusive of refrigerant,** for a period of one (1) year from date of start-up or 18 months from date of shipment, whichever occurs first. **The compressors shall have a two (2) year limited warranty** from date of start-up or 30 months from date of shipment, whichever occurs first.
B. (Provide an optional extended three (3) year warranty on the compressors only, 5 years total).
C. The open drip-proof squirrel cage compressor motor, shall have a **two (2) year limited warranty** from date of start-up or 30 months from date of shipment, whichever occurs first.
D. (Provide an optional extended three (3) year warranty on the compressor motor only, 5 years total).
E. The start-up date shall be certified by the Mechanical Contractor, and provided to the Manufacturer, Engineer and Owner.
F. (During the warranty period, the equipment supplier shall furnish the services of an authorized service agency for all labor associated with parts replacement or repair, and start-up of the refrigeration equipment at the beginning of each cooling season. The equipment supplier shall also furnish the services of an authorized service agent for one maintenance visit during winter months of operation; the Owner shall designate such time.)

**1.09 Maintenance**

Maintenance of the chillers shall be the responsibility of the owner and performed in accordance with the manufacturer's instructions.

## Part 2: Products

**2.01 Water Cooled Rotary Screw Water Chillers**

**2.02 Acceptable Manufacturers**

A. Dunham-Bush, Inc.
B. (Approved equal)

**2.03 General**

A. Furnish and install as shown on the plans and specifications, a Dunham-Bush Inc. water cooled packaged chiller, Model ***PCX****i* ____ B. The unit is to be a completely assembled package consisting of the open drive positive displacement helical-axial, twin rotor, direct-drive screw compressor, cooler, condenser, external oil separator, positive displacement open drive oil pump, and unit starter mounted and wired to the microcomputer control center.
B. The packaged chiller shall be factory assembled, and charged with a full charge of R____ and oil. The unit shall be given a factory functional test run and shipped with the full operating charge of refrigerant and oil.
C. The units shall be built in accordance with all applicable national and local codes including the ANSI safety code; the National Electrical Code and applicable ASME Code for Unfired Pressure Vessels.
D. The unit shall meet or exceed the latest version of ASHRAE Standard 90.1 Energy Efficiency Code.

**2.04 Performance**

The unit capacity shall not be less than shown on the capacity schedules and drawings. Unit performance shall be rated in accordance with ARI Standard 550/590, latest revision.

**2.05 Construction**

The unit construction shall be of a "Structural Vessel Design" where the shells form a structural base permitting rigging, handling and installation without additional structural steel. The compressor, motor, oil separator, piping, and electrical control center shall all be mounted on the structural vessel base. The unit base foot mounts will be welded to the vessel tubesheets. The motor and compressor base will be welded to the structural vessel base. The unit control center, shall be constructed of 16 gauge and the line voltage starter enclosure will be 12 gauge with 14 gauge galvanized steel doors. The entire assembly shall be painted to resist corrosion. Electrical enclosures shall be finished with a baked powder high grade outdoor quality coating system which exceeds 500 hour salt spray requirements when tested in accordance with the ASTM-B-117 specifications.

## 2.06 Cooler

The cooler shall be flooded type, with refrigerant in the shell and fluid in the tubes, cleanable shell and tube type vessel. The shell and tubesheets shall be fabricated and machined from carbon steel. Removable heads shall be supplied for cleaning and servicing of cooler tubes. Vent and drain plugs shall be provided in each head. Tubes shall be enhanced inner and outer surface seamless copper, mechanically expanded into the heavy carbon steel tubesheets. Base performance on fluid velocity not less than 3 feet per second (fps) (0.9144 m/s) nor more than 12 fps (3.658 m/s), and a fouling factor of 0.0001 hr•ft²•°F/BTU (0.018 M²•°C/kW). The flooded cooler shall have a built-in distributor for feeding refrigerant evenly under the tube bundle to produce a uniform boiling action, and baffle plates shall be provided to ensure vapor separation. The cooler shall be fitted with an oil recovery system. The oil recovery system will ensure the cooler operates at peak efficiency at all times and shall provide optimal energy efficiency during extended periods of part load operation. The coolers shall be available in one, two or three pass design as indicated on the drawings with Victaulic (or optional flanged connections) fluid connections. Stub-out connections will not be acceptable. The shell side of the cooler is to be equipped with a single pressure relief device.

Coolers shall be designed, constructed, stamped and inspected to comply with latest edition ASME code for unfired pressure vessels. Refrigerant shell side design working pressure shall be minimum 300 psig (2069 kPa). The tube side fluid design working pressure shall be minimum 150 psig (1034 kPa).

(The cooler shall be insulated with a single or double layer (CSLI-Cooler Single Layer Insulation or CDLI-Cooler Double Layer Insulation) of ¾" thick closed-cell urethane insulation with a .28 K factor at 75°F mean temperature.)

## 2.07 Oil System

The compressor shall be provided with a complete pressure fed lubrication system including a positive displacement gear or screw type open-drive oil pump, independently driven. Positive lubrication shall be provided prior to compressor start-up. An oil strainer, oil pressure regulator, and replaceable core oil filter, shall be provided to filter 100% of the oil supplied to the compressor. The oil pressure regulating valve shall ensure proper oil pressure at all operating conditions. Pressure differential oil systems will not be acceptable unless the flooded cooler is fitted with an oil recovery system that will ensure the cooler will operate at peak efficiency at all times, including extended periods of part load operation.

## 2.08 Condenser

The condenser shell shall be fabricated from carbon steel with welded tubesheets, machined from heavy carbon steel. Tubes shall be enhanced inner and outer surface seamless copper, mechanically-expanded into the heavy carbon steel tubesheets. Removable heads shall be supplied for cleaning and servicing of condenser tubes. Vent and drain plugs shall be provided in each head. They shall be available in two or three pass configuration as required on the schedule or drawings with mechanically grooved victaulic or optional flanged connections. Base performance on fluid velocity shall not be less than 3 feet per second (fps) (0.9144 m/s) nor more than 12 fps (3.658 m/s) and a fouling factor of 0.00025 hr•ft² •°F/BTU (0.044 M²•°C/kW). The chiller shall be selected to operate satisfactorily at entering condenser fluid temperature down to 60°F (15.6°C) providing head pressure control is maintained, by modulating the condenser water flow. The contractor shall pipe the connections with mechanically grooved elbows that enable the head and elbow to be removed, for service and rodding of the condenser tubes, without disturbing any piping. The shell side of the condenser shall have dual relief valves with by-pass valve and provision for refrigerant recovery. The condenser shall be sized for full pump-down capacity. If the condenser cannot store the entire refrigerant charge, the contractor shall furnish an approved refrigerant recovery unit and an adequate quantity of DOT approved cylinders to store the entire charge.

Condensers shall be designed, constructed, stamped and inspected to comply with latest edition ASME code for unfired pressure vessels. Refrigerant shell side design working pressure shall be minimum 300 psig (2069 kPa) and fluid tube side design working pressure shall be minimum 150 psig (1034 kPa).

## 2.09 Compressor

A. Provide a positive displacement helical-axial, twin rotor, direct-drive screw compressor with infinite slide-valve capacity control with an external 3550 RPM (60Hz) or 2950 RPM (50Hz) direct-drive motor with not less than 115% service factor.
B. The compressor motor shall be of the open drip-proof, squirrel cage induction type, factory mounted on a rigid structural steel base for proper alignment of compressor and motor shafts.
C. Each compressor shall have a suction check valve and a discharge check valve.

D. The compressor capacity control shall be obtained by an electrically initiated, hydraulically actuated, slide valve to provide infinite capacity control.
E. The compressor and motor shall have a standard **Two Year Limited Warranty**.

**2.10 Capacity Control**

A. An infinitely variable capacity control system that is capable of matching the demand requirement of the system.
B. A microcomputer-based controller shall modulate a compressor slide valve, in response to supply water temperature and current to maintain water temperature within ½°F of set point. This system is to provide precise and stable control of supply water temperature over the complete range of operating conditions. It shall be capable of a system capacity control range of 100% to 20% at specified conditions. (Provide hot gas bypass to provide capacity control to 10% of the unit capability).

**2.11 Refrigerant Control System**

The packaged chiller shall use a positive pressure refrigerant that will not require a purge system.

The unit shall be furnished with a finite refrigerant control system, to optimize efficiency and compressor protection. This refrigerant control system shall prevent the flow of efficiency robbing refrigerant vapor in the condenser from entering the cooler at reduced load, by directly modulating a motorized refrigerant valve in the liquid line entering the cooler.

The refrigerant control system, by means of a liquid level float assembly, shall measure the level of liquid refrigerant in the flooded cooler and restrict refrigerant flow entering the cooler upon a rise in the level, helping to prevent liquid carry over and possible compressor liquid slugging. **Fixed orifice control systems are not acceptable.**

**2.12 Control Center**

A. Control Center shall be NEMA 1 fully enclosed, baked powder coated steel control panel with hinged access doors. Dual compartments, separating the safety and operating controls from the power controls, are to be provided. Controls shall include:
   1. Separate terminal blocks for main power, and 115 VAC control power.
   2. (Unit mounted Solid State Starters 460/3/60, 575/3/60 or 400/3/50 operation).
   3. (Unit mounted WYE-Delta Starters 460/3/60, 575/3/60 or 400/3/50 operation).
   4. (Remote mounted WYE-Delta Starters for 460/3/60, 575/3/60 or 400/3/50 operation).
   5. (Remote mounted Across-The-Line Starters for 2300/3/60, 4160/3/60, 3300/3/50 operation).
   6. Complete labeling of all control components.
   7. Numbering of wires and terminal strips for easier wire tracing.
   8. Terminals for customer digital input to enable/disable unit.
   9. Dry contacts for chiller water and condensing water pump control.
   10. Dry contacts for pre-alarm warning.
   11. Dry contacts for unit alarm.
   12. (Control transformer).
   13. (Over/under voltage relay).
   14. Operation and safety lights visible from unit exterior including: power on; alarm; compressor switch on.
   15. (Control panel door latch solenoid to prevent door opening before turning off power to the unit).
   16. (Analog ammeter with 3-phase selector switch).
   17. (Analog voltmeter with 3-phase selector switch).
   18. (Compressor elapsed time meter).
   19. (Compressor cycle counter).
   20. (Entering chilled water temperature sensor).
B. Control Center's individual Microcomputer shall provide compressor loading based on leaving water temperature throughout the full range of operation. It shall have a two-line 80 character alphanumeric Liquid Crystal display utilizing an easy-to-understand menu-driven software. It shall be proactive in control and accommodate system anomalies such as high condensing pressure, low suction pressure, and high compressor motor amp draw by controlling loading to keep the unit running, but at reduced capacity, until the fault is fixed. Battery backed-up real time clock and memory with over 10 years life and automatic recharge of lithium ion battery that requires no service.

C. Microcomputer: individual chiller controller shall provide for:
   1. Unit control**:**
      a. Loading and unloading of the compressor based on leaving water temperature.
      b. Seven-day time clock with schedules for machine control.
      c. Proactive control to unload the compressors based on high pressure, low pressure, and high amp draw to reduce nuisance trips.
      d. (Control of hot gas bypass circuit).
      e. Dry contact for cooler pump interlocks.
      f. Dry contact for condenser pump interlocks.
      g. Terminals for customer enable/disable of unit.
      h. Dry contact for unit pre-alarm warning.
      i. Dry contact for unit alarm.
   2. Unit Protection:
      a. Low refrigerant suction pressure
      b. High refrigerant discharge pressure
      c. Automatic restart from power outage.
      d. Cooler freeze protection
      e. Compressor current limiting
      f. Anti-recycling protection
      g. Sensor error
      h. Cooler-condenser water flow loss
      i. Low oil differential pressure
      j. Low oil temperature
      k. Over current protection.
      l. Phase loss, phase reversal and phase imbalance.
      m. Ramp control for timed unit loading when the return water temperature is 5°F above leaving water set point
      n. Starter fault
      o. Oil pump starter fault
   3. Microcomputer - Readouts shall provide the following:
      a. Compressor run time and cycles
      b. Leaving liquid temperature
      c. Compressor motor ampere draw
      d. Suction pressure
      e. Discharge pressure
      f. Unit control contacts
      g. Chilled water flow switch
      h. Chilled water reset
      i. Digital Outputs
      j. Compressor control status
      k. Unloader control status
      l. Liquid line valve control status
      m. Alarm control status
      n. Control power status
      o. (Condenser water flow indication)
      p. Utility demand limit
      q. Percent slide valve loading
      r. Oil pressure
      s. Oil sump temperature
      t. Oil seal temperature
   4. Microcomputer - Set-points shall provide the following:
      a. High discharge pressure
      b. Low suction pressure
      c. Freeze protection temperature
      d. Leaving cooler fluid temperature
      e. Low suction unload
      f. High discharge unload
      g. High & low compressor amperes
      h. Chilled water reset
      i. Demand limit reset

5. Microcomputer - Alarm History shall provide the following:
   a. The 8 most recent alarms can be displayed
   b. Low suction pressure
   c. High discharge pressure
   d. Freeze protection cutout
   e. No run
   f. No stop
   g. Loss of cooler fluid flow
   h. Power failure
   i. Temperature sensor error
   j. Low oil pressure
   k. (Refrigerant leak detector)
   l. Refrigerant valve control fault
   m. Pressure sensor error
   n. Compressor start fault
   o. Compressor slide valve error
   p. Low discharge superheat
   q. High sump temperature
   r. High oil seal temperature
   s. Oil pump starter fault
6. Microcomputer Remote Monitoring Capabilities:
   a. Telephone Modem (option):
      The microcomputer is complete with an RS232 communications port and all hardware and software necessary to remotely monitor and control the packaged chiller through the optional phone modem. A dedicated phone line is required.
   b. Remote Monitor Display Terminal (RMDT option):
      The Remote Monitor Display Terminal is supplied with a 14" monitor, two (2) RS232 serial ports, 6 foot 115 volt power cord and an enhanced PC keyboard. The RMDT can be hard wired up to 50 feet away from the chiller for remote monitoring and operating of the one or multiple units.
      This option allows remote start-stop, chilled water set-point changes, and reading of all microcomputer screens including operating condition, faults, and fault history.
   c. BMS - Building Management System Terminal:
      A BMS (Building Management System) may interface with the chiller microcomputer and provide the same level of monitoring and operating control as above, when the BMS company has implemented the communications protocol.
      Dunham-Bush has an open communications protocol policy with most BMS companies.
   d. (ChillerLINK {CHLK option}):
      The Chiller*LINK* shall be supplied for communication from the Chiller to the BMS through BACnet or MODBUS communicating systems.

**2.13 Starting Equipment:**

A. (Unit mounted Solid State Starters 460/3/60, 575/3/60 or 400/3/50 shall include the following features:).
Control circuit transformer with primary and secondary fusing
Oil pump starter
Oil pump overloads
Current transformer for compressor motor load control
NEMA 1 enclosure
Bypass contactor for eliminating SCR heat generation
Programmable starting profiles
Controlled inrush and torque
Stepless acceleration to full speed
Adjustable acceleration rate
Programmable motor protection
Electronic overload
Instant over current protection
Current imbalance
Under and over voltage and phase monitoring
Ground fault interrupt
Electric panel door latch to provide the safety and security required by local codes. Main power must be disconnected to gain entry to the power and control electrical panels. The control panel can be accessed with a keylock actuated override switch.

Embedded diagnostics
Integral display
Digital metering of volts and amps
Built-in self testing
Pending fault indicator

B. (Unit mounted WYE-Delta Starters 460/3/60, 575/3/60 or 400/3/50 shall include the following features:).
Control circuit transformer with primary and secondary fusing
Oil pump starter
Oil pump overloads
Under voltage relay
Current transformer for compressor motor load control
Controlled inrush 33% of nominal locked rotor amps (LRA)
Controlled torque 33%
Two acceleration steps to full speed
Under voltage and phase monitoring relay
(Over and Under voltage and phase monitoring relay)
(Circuit Breakers with through-the-door interlocking handle).
(Fused-disconnect switch with through-the-door interlocking handle.)
(Ground fault interrupt relay)
(Volt and amp meters with selector switches for three phase meter reading)
(Electric Panel Door Latch Solenoid to provide the safety and security required by local codes. Main power must be disconnected to gain entry to the power and control electrical panels. The control panel can be accessed with a key-lock actuated override switch).

C. (Remote mounted WYE-Delta Starters for 460/3/60, 575/3/60 or 400/3/50 operation).
Control circuit transformer with primary and secondary fusing
Oil pump starter
Oil pump overloads
Current transformer for compressor motor load control
Fixed starting profiles
Controlled inrush 33% of nominal locked rotor amps (LRA)
Controlled torque 33%
Two acceleration steps to full speed
Under voltage and phase monitoring relay
(Over and Under voltage and phase monitoring relay)
(Circuit Breakers with through-the-door interlocking handle).
(Fused-disconnect switch with through-the-door interlocking handle.)
(Ground fault interrupt relay)
(Volt and amp meters with selector switches for three phase meter reading)
(Electric Panel Door Latch Solenoid to provide the safety and security required by local codes. Main power must be disconnected to gain entry to the power and control electrical panels. The control panel can be accessed with a key-lock actuated override switch).

D. (Remote mounted Across-The-Line Starters for 2300/3/60, 4160/3/60, 3300/3/50 operation shall include the following features).
Control circuit transformer with primary and secondary fusing
Oil pump starter (460/3/60 or 400/3/50) separate voltage source required
Oil pump overloads
Draw out contactor with fused isolation switch
Current transformer for compressor motor load control
Under voltage and phase monitoring relay
(Over and Under voltage and phase monitoring relay)
(Ground fault interrupt relay)
(Volt and amp meters with selector switches for three phase meter reading)
(Electric Panel Door Latch Solenoid to provide the safety and security required by local codes. Main power must be disconnected to gain entry to the power and control electrical panels. The control panel can be accessed with a key-lock actuated override switch).

## 2.14 Additional Equipment

A. (Alarm Bell mounted and wired to indicate a common alarm fault).
(Electric Panel Door Latch Solenoid to provide the safety and security required by local codes. Main power must be disconnected to gain entry to the power and control electrical panels. The control panel can be accessed with a key-lock actuated override switch).

B. (Chiller*LINK* Communication Module for communication with (BMS) building management systems through BacNet or Modbus communication systems).
C. (Systems International Display provides microcomputer controller information displayed in SI units, temperature in °C and pressure in BARS).
D. (R22 Refrigerant Sensor, mounted on the unit between the cooler and condenser, senses R22 in the equipment room and reports this information to the unit microcomputer controller).
E. (Water Temperature Monitoring for entering and leaving water temperatures for both the cooler and condenser fluids).
F. (Condenser Water Control provides analog output that can be used to control condenser water flow. The 0-5VDC or 0-10VDC signal increases as discharge pressure rises above a setpoint (TYP 160 psig). This should produce an increase in the condenser water flow.)
G. (Hot gas bypass valve to permit operation down to 10% of the unit capability).
H. (Shipping Less Refrigerant to enable shipping by means that do not allow shipping with refrigerant charges installed in the unit. The chiller must be built and tested and the refrigerant removed after testing.)
I. (Cooler Single Layer Insulation for factory installed ¾ inch layer of closed cell cooler insulation).
J. (Cooler Double Layer Insulation for factory installed two ¾ inch layers of closed cell cooler insulation).
K. (Flow Switch shipped loose for field mounting and wiring).
L. (Vibration Isolators shipped loose: spring or rubber-in-shear).
M. (Alarm Bell shipped loose to be mounted remote of the chiller and wired to the common alarm contacts by the contractor).
N. (Remote Monitor Display Terminal to provide remote monitoring and enabling/disabling of the chill control plus reading of all microcomputer screens).

## Part 3: Execution

### 3.01 Installation Work By Mechanical Contractor

A. Install on a flat surface level within 1/16 inch per foot and of sufficient strength to support concentrated loading. Place vibration isolators under the unit.
B. Assemble and install all components furnished loose by manufacturer as recommended by the manufacturer's literature.
C. Complete all water and electrical connections so unit water circuits and electrical circuits are serviceable.
D. Provide and install valves in water piping upstream and downstream of the cooler water connections to provide means of isolating cooler for maintenance and to balance and trim system.
E. Provide soft sound and vibration eliminator connections to the cooler and condenser water inlet and outlet as well as electrical connections to the unit.
F. Interlock chillers through a flow switch in the chilled water line to the chilled water pump to ensure the unit can operate only when water flow is established.
G. Furnish and install taps for thermometers and pressure gauges in water piping adjacent to inlet and outlet connections of the evaporator.
H. Provide and install drain valves with capped hose ends to each cooler and condenser head drain fitting.
I. Install vent cocks to each cooler and condenser head vent fitting.

### 3.02 Work By Temperature Control Contractor

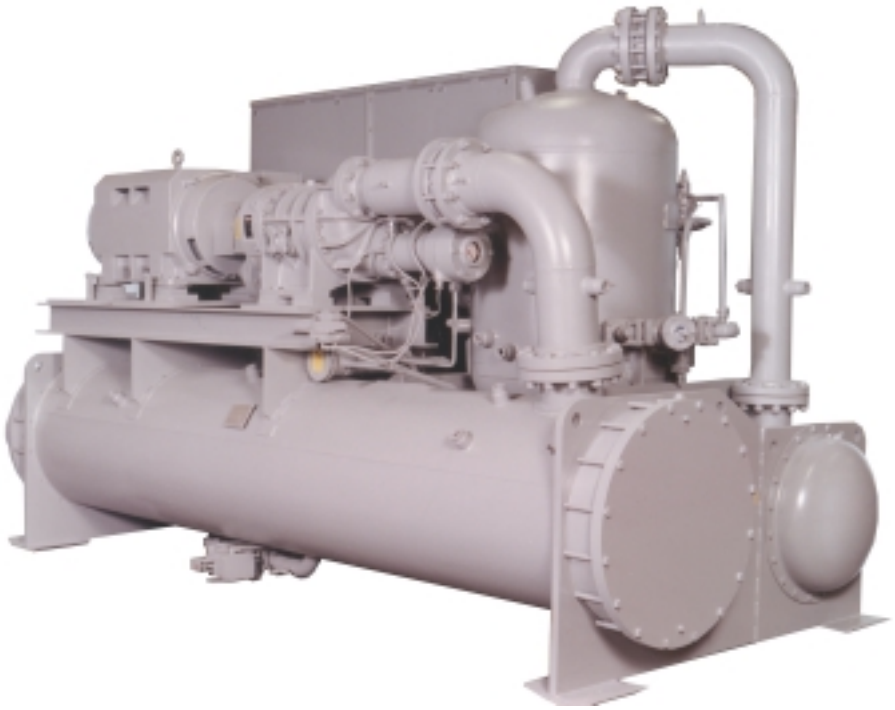
A. Furnish interlock wiring per manufacturer's recommendations and install loose control components furnished by chiller manufacturer.

### 3.03 Work By Electrical Contractor

A. Furnish power wiring to chiller control panel and obtain required code approval.
B. Furnish and install approved disconnect switch.

END OF SECTION

**Specification subject to change without notice.**



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September 1999

Form No. 6068