



# POSEIDON

Water Cooled Screw Liquid Chillers

WCFX-E 50/60Hz

Cooling Capacity: 60 to 1000 TR (211 to 3517 kW)



**DUNHAM-BUSH®**

Products that perform...By people who care

# INTRODUCTION

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The Dunham-Bush POSEIDON series WCFX-E Water Cooled Rotary Screw Flooded Chillers are available from 60 to 1000 TR [211 to 3517 kW]. These units are supplied with rotary screw compressors that are backed by more than 45 years of experience. The WCFX-E series are Dunham-Bush premium chillers for commercial and industrial applications where installers, consultants and building owners require maximum quality and optimal performances especially at part load. The WCFX-E series are certified to AHRI Standard 550-590, meets ASHRAE Standard 90.1, and ETL listed.

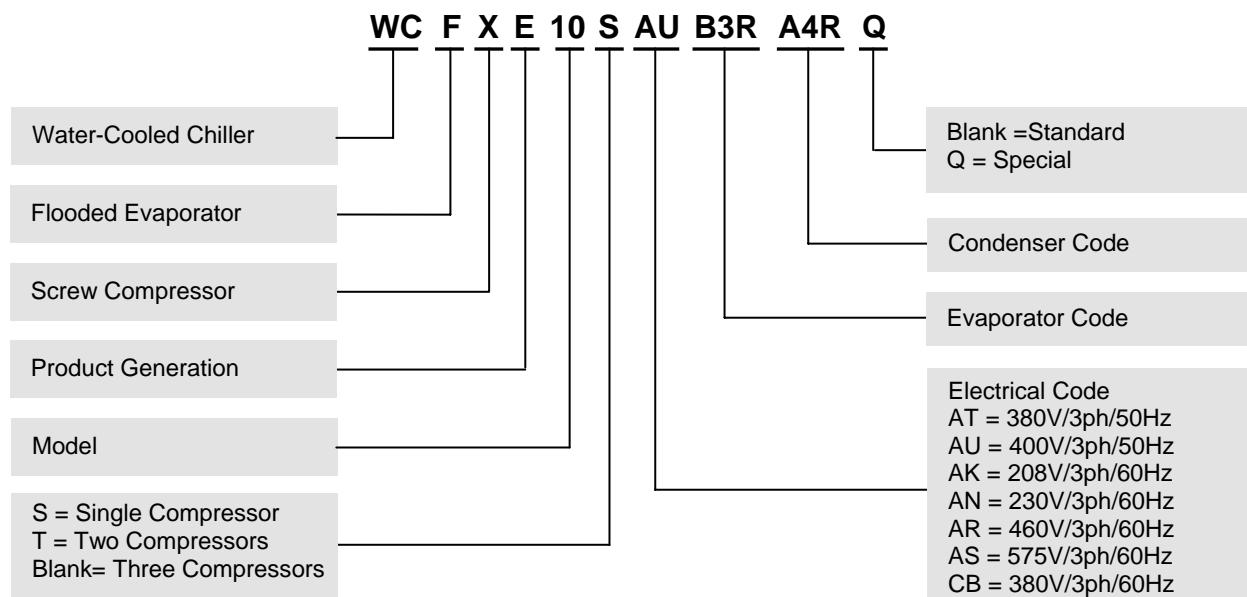
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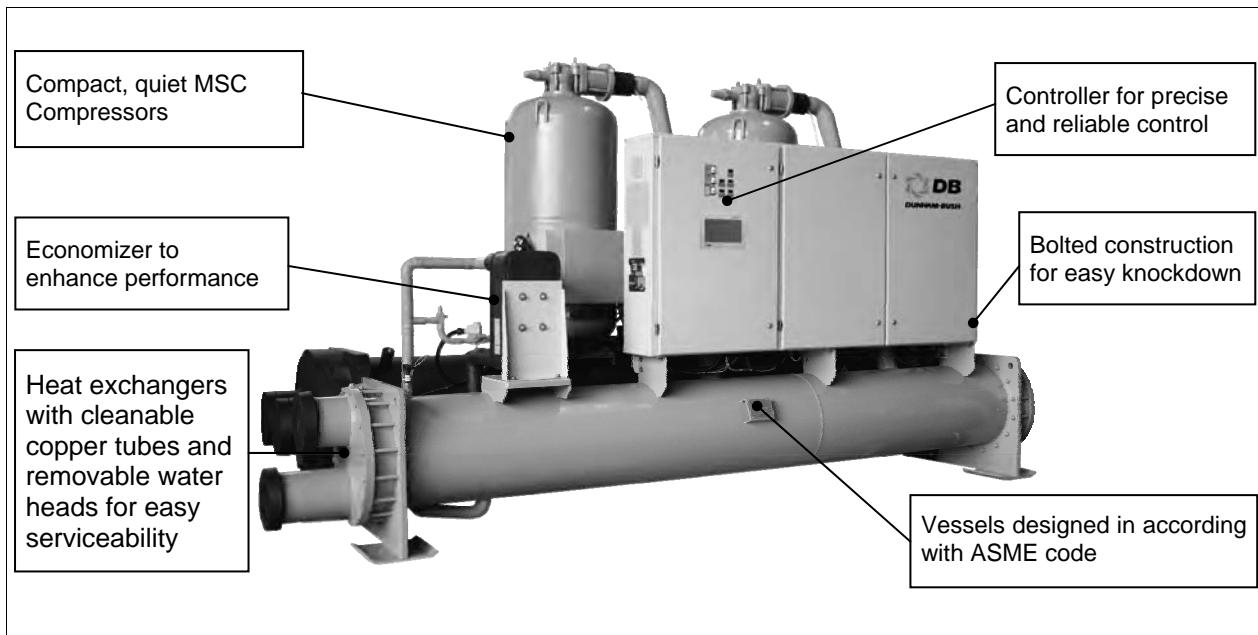
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## NOMENCLATURE

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# COMPONENTS



## GENERAL CHARACTERISTICS

### General

- 40 models from 60 to 1000 TR [211 to 3517 kW]
- Multiple compressors models provide unparallel redundancy and reliability, with enhanced superior part load energy efficiency
- Compact footprint design is available to reduce required installation area
- The unit is designed to operates with R134a, the environment friendly refrigerant with zero **ODP** (Ozone Depletion Potential)
- Package capacity reduction can goes down to as low as 8.5% without Hotgas Bypass (HGBP) for multiple screw compressors models
- ETL listed for 60Hz models

### Computer Performance Ratings

Dunham-Bush WCFX-E Chillers are available from 60 to 1000 TR [211 to 3517 kW]. Large number of combinations of heat exchangers, compressors and motors make it impractical to publish tabular ratings for each combination. A chiller may be selected to match a certain building requirements by your Dunham-Bush Sales Representatives using WCFX-E Computer Selection Program. Selection print out includes required data such as:

- Chiller Capacity

- kW Input
- Evaporator and Condenser Fluid Temperature
- Evaporator and Condenser Pressure Drop
- Evaporator and Condenser Tube Water Velocities
- Electrical Data
- Part-Load Performance

Contact our local Dunham-Bush Sales Representative for Customized Solutions that can be offered to meet your specific application needs.

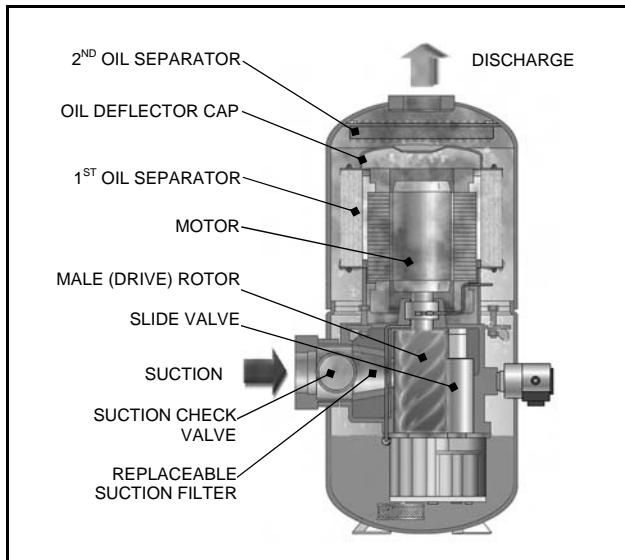
### Compressor(s)

- New generation of Dunham-Bush MSC Vertical Screw Compressors with Unique Patented Twin Screw compressor technology, offers efficiency improvement, high reliability and lower sound level.
- Optimized oil management with 2 integral oil separators. Multi-layered mesh element effectively separates oil from the gas stream
- Vertical screw design with unparallel reliability on compressor lubrication; rotor bearings are submerged in oil that guarantees rotor lubrication whenever the compressor is in operation
- Patented screw profile design which is specially designed for R134a application, to assure operation at highest efficiencies

# GENERAL CHARACTERISTICS

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- ✿ Optimized volume ratio, VI port position and geometry for best efficiency
- ✿ Consistent loading and unloading with hydraulically actuated slide valve mechanism; a rugged and trouble-free design
- ✿ No external oil pump required
- ✿ Hermetic design eliminates casing leakage, with no requirement for internal parts service, no periodic compressor tear down and overhaul



- ✿ Direct driven design eliminates gear set; improve efficiency and reliability
- ✿ Suction and discharge service valves are provided to each compressor for the ease of servicing
- ✿ Smaller foot print

## Evaporator / Condenser

- ✿ Shell-and-tube type heat exchanger
- ✿ Flooded type evaporator
- ✿ 2-pass arrangement. 1-pass or 3-pass arrangement available as option
- ✿ Integral finned copper tubes to maximized heat transfer area
- ✿ Cleanable and removable copper tubes for easy serviceability
- ✿ Removable water heads for service
- ✿ Victaulic Groove Water connection comply to ANSI/AWWA C-606
- ✿ Evaporator comes with 1" [25mm] thick closed cell insulation
- ✿ Standard relief valve(s) – ¾" [19mm] FPT
- ✿ Pressure test up to 220psig for refrigerant side, and 195psig for water side
- ✿ Condenser design capable for full pump down operation

## Electronic Expansion Valve (EEV)

- ✿ EEV is used for precise control of liquid refrigerant flow into the evaporator
- ✿ Refrigerant liquid level in evaporator is controlled at precise level for optimum performance
- ✿ Refrigerant in evaporator is superheated as desired before entering into compressors

## Economizer

- ✿ The economizer circuit consists of plate type heat exchanger, expansion valve and solenoid valve
- ✿ Refrigerant is sub-cooled at economizer before entering the evaporator; the flash refrigerant from economizer is fed into compressor at intermediate pressure.
- ✿ The economizer increased cooling capacity by means of the sub-cooling circuit, or 2-stage refrigerant expansion
- ✿ Cooling capacity is increased significantly with marginal increases in kW-input, thus, unit EER is improved

## Control Panel

- ✿ Electrical enclosure fabricated by heavy gauge sheet steel with powder coated baked finishing.
- ✿ Single point power connection for all models
- ✿ Circuit breaker for each compressor motor
- ✿ Unit mounted reduced inrush starter for compressor
- ✿ Solid state motor protector module for compressors
- ✿ Step down transformer for control circuit
- ✿ Main power supply monitoring module provide protection on under or over voltage, phase reversal, phase losses and imbalance
- ✿ Unit mounted Remote/Off/Local (R/O/L) selector switch, an operation and servicing friendly feature
- ✿ Vision 2020i – the state-of-art Dunham-Bush proactive advanced controller monitors the unit operation and maintains optimal operation of the unit. Vision 2020i, an intelligent controller that is able to operate the unit with optimum efficiency at off-design conditions. Vision 2020i adapts to any abnormal operating conditions and will execute preventive controls and actions for safety protections

# UNIT FEATURES

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## VISION 2020i CONTROLLER



Vision 2020i, an advance programmable Micro controller designed specifically for the applications and precise control of Dunham-Bush Rotary Screw compressor chillers, WCFX-E.

The controller is provided with a set of terminals that connected to various devices such as temperature sensors, pressure and current transducers, solenoid valves, control relays and etc. Required controller boards are provided to handle different number of input and output requirements:

The unit algorithm program and operating parameters are stored in FLASH-MEMORY that does not require a back-up battery. The program can be loaded through PC or programming key.

Vision 2020i controller is equipped with a user friendly DBG5 graphical touch screen color display panel. DBG5 display terminal has dedicated touch keys that provides easy access to the unit operating conditions, control set points, trend graphs and alarm histories.

Each unit's controller can be configured and connected to the local DBLAN network that allows multiple units sequencing control without additional hardware. The DBLAN is local area network made up of several chillers' controller.

### Display and User Terminal

Vision 2020i controller is designed to work with the DBG5 terminal display, a 7" TFT, 65k colors, LED backlit touch screen graphical display panel. DBG5 terminal display allows carrying out all program operations. The user terminal allows displaying the unit working conditions, compressor run times, alarm history and modifying the parameters. The display also has an automatically self-test of the controller at system start-up. Multiple messages will be displayed, automatically scrolling from each message to the next. All of these messages are displayed in English on the display terminal.

Touch keys on DBG5 graphical display panel allow user to access information and settings, based on security level of the password. For more detail of Display Terminal operation, please refer to the Unit Operation Manual.

Easily accessible measurements include:

- ✿ Leaving chilled water temperature
- ✿ Rate of Change for leaving chilled water temperature
- ✿ Evaporator pressure

- ✿ Condenser pressure
- ✿ Compressor discharge temperature and superheat
- ✿ Current drawn by each compressor
- ✿ Compressor capacity (percentage of FLA, Full Load Amps)
- ✿ Run hours of each compressor
- ✿ Number of starts of each compressor
- ✿ Electronic Expansion Valve (EEV) Opening Percentage
- ✿ Compressors motor status
- ✿ Oil Level Status, Water Flow Switch Status, Remote Start/Stop Command Status
- ✿ Trend graph of leaving chilled water temperature

### Capacity Control

Leaving chilled water temperature control is accomplished by entering the water temperature set point and placing the controller in automatic control. The unit will monitor all control function and move the slide valve to the required operating position to match closely to the actual building load requirement. This will put the chiller operation at optimum efficiency at all time, and thus, maximized the energy saving of the chiller plant operation.

The compressor ramp (loading) cycle is programmable and may be set for specific building requirements. Remote adjustment of the leaving chilled water set point is accomplished either through High Level Interfacing (HLI) via BMS communication, or Low Level Interfacing (LLI) via an external hardwired, 4 to 20mA chilled water reset control signal. Remote reset of compressor current limiting function can 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 controller may be programmed with 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 ensure system reliability:

- ✿ Low evaporator pressure
- ✿ High condenser pressure
- ✿ Freeze protection
- ✿ Low suction discharge pressure differential
- ✿ Low compressor oil level
- ✿ Compressor run error
- ✿ Power loss
- ✿ Chilled water flow loss
- ✿ Sensor error
- ✿ Compressor over current
- ✿ Compressor Anti-recycle

The controller can retains up to 99 alarm histories complete with time of failure together with data stamping on critical sensor readings in an alarm condition. This tool will aid service technicians in troubleshooting tasks enabling downtime and nuisance trip-outs to be minimized.

# UNIT FEATURES

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## Remote Monitoring And Control (Option)

Dunham-Bush, as a leading HVAC solution provider understands the current trend of focusing on chiller plant performance and optimization. Several solutions as below are offered to the building owner to achieve optimized chiller plant room controls, operation and performance.

## DB-LAN Master Slave Sequencing Control (MSS)

In a chiller system with multiple Dunham-Bush chillers, Vision 2020i controller of each chiller can be connected to the DB-LAN network via a communication bus without additional controller, to enable Master-Slave Sequencing Control of this chiller system. **MSS** will stage in/out chiller in operation to match building required cooling capacity. Chiller Lead-lag, duty-standby and alarm changeover controls are come with **MSS**, as well as the chilled water pumps control. Each **MSS** DB-LAN network can be connected up to 8 numbers of chillers.

## Dunham-Bush Chiller Plant Manager (CPM)

DB Chiller Plant Manager (**CPM**) is a trustworthy and headache-free solution for building owners and users on chiller plant control and automation system. **CPM**'s advanced controllers monitor and control equipments in chiller plant such as chillers, primary and secondary

chilled water pumps, condenser water pumps, cooling towers, variable frequency drives (VFD), motorized valves, bypass modulating valves, and etc. Field devices such as flow meters, BTU meters, digital power meters, sensors & transducers can be interfaced with **CPM** via HLI or LLI. CPM controls chillers, pumps and cooling towers sequencing, as well as lead-lag, duty-standby and alarm changeover operations.

**NetVisorPRO** – Monitoring software of **CPM** system which allows system monitoring, historical trending, and alarm logging to be carry out at a PC terminal. Graphical animations on system operation, temperature and flow rate trend graphs, historical data and alarm history logs, settings changes are all available with **NetVisorPRO**.

Chiller plantroom control and automation by Dunham-Bush **CPM** provides the owners with a chiller system in stable operation, optimized performance and energy efficiency.

## Building Management System (BMS) Communication

Vision 2020i is able to communicate to BMS through an add-on communication card via various common protocols as:

- ✿ Modbus RTU RS485, ModBus TCPIP
- ✿ BACnet over IP, MS/TP, or PTP
- ✿ LONworks FTT 10

# OPTIONS AND ACCESSORIES

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- ✿ **1-pass Evaporator and Condenser** – 1-pass evaporator or condenser is suitable for applications with low temperature difference (delta T) or high fluid flow, where the evaporators or condensers are piped in series.
- ✿ **3-pass Evaporator and Condenser** – 3-pass evaporator or condenser is suitable for applications with high delta T and low fluid flow
- ✿ **Evaporator and Condenser Flanged Connection** – Flanged connection is available on request
- ✿ **Marine Water Box** – Marine water box for condenser, for ease of condenser tube cleaning without interfere with field water piping
- ✿ **250 psig Evaporator and Condenser** – Evaporator and condenser vessels with 250 psig working pressure at water side is available to suite site installation
- ✿ **Double Insulation** – Evaporator with double thick 2" [50mm] closed cell insulation, for extra resistance to condensation
- ✿ **Heat Recovery** – Heat recovery cycle that reclaim "waste" heat from the refrigerant system to produce hot water up to 140°F [60°C]. Two methods of heat recovery are available: shell-and-tube desuperheater; or double-bundle condenser
- ✿ **Condenser Insulation** – 1" thick closed cell insulation is provided to discharge piping and double-bundle condenser of heat recovery unit
- ✿ **Hotgas Bypass** – To maintain unit operation below minimum unloaded capacity
- ✿ **Flanged Semi-hermetic Compressor** – Semi hermetic compressor is available on request
- ✿ **Compressor Acoustic Jacket** – Compressor acoustic jacket is added to further reduce sound level
- ✿ **Dual Mode Operation** – The unit with dual mode operation can deliver chilled fluid temperature down to 18°F [-7.8°C] during ice making mode. Units with Dual Mode Operation is used for Ice Thermal Storage System
- ✿ **Low Temp. Operation** – The unit with Low Temp. Operation can deliver chilled fluid temperature down to 18°F [-7.8°C] for process cooling application
- ✿ **ASME / PED / JKPP Compliance** – Evaporator, condenser and desuperheater with ASME / PED / JKPP approval is available on request
- ✿ **Extended Warranty Period for Compressors** – Extended compressor warranty is available on request
- ✿ **Compact Footprint Series** – Compact footprint design is available for models 19S, 20s, 23S, 24S, 27S, 30S, 38T, 40T, 46T, 50T, 54T, 57T, 60T, 69, 73, 77, 81, 84, 87 and 90. (Compact design increases the height and may not be able to ship in a container)
- ✿ **CE Compliance** – Unit with CE compliance is available on request

# OPTIONS AND ACCESSORIES

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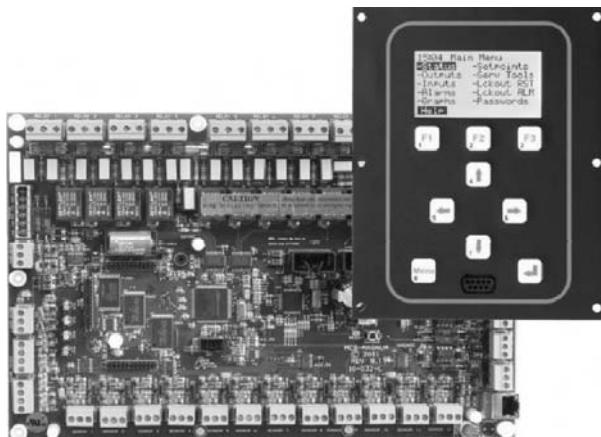
## Electrical And Controls

- ✿ **Unit Mounted Main Disconnect Switch** – Non-fused disconnect switch with external lockable handle is furnished to isolate unit main incoming power supply for servicing.
- ✿ **Soft starter For Compressor Motors** – Solid State starter comes with bypass contactor to reduced mechanical stress and inrush current during compressor start-up
- ✿ **Ground Fault Interrupt (GFI)** – Provides equipment with ground fault protection
- ✿ **Ammeter / Voltmeter** – Analog ammeter and voltmeter with 3 phase selector switch for indication; located on the control panel
- Refrigerant Leak Detector** – A refrigerant detection sensor module is connected to Vision 2020i to monitor refrigerant concentration around the unit. Alarm is triggered and unit is shut down when the refrigerant concentration has exceeded the preset safety limit.
- ✿ **Chilled Water Reset / Demand Limiting** – Low level interfacing with Building Automation System (BAS). Chilled Water Reset allows controlled temperature setpoint to be reset by a 4-20mA signal from BAS; while Demand Limiting will limit the maximum current drawn by the compressors by 4-20mA signal from BAS.
- ✿ **Chilled Water Pump Control** – Primary chilled water pump is controlled by chiller's Vision 2020i controller for enhanced safety operation
- ✿ **Condenser Water Pump Control** – Condenser water pump is controlled by chiller for enhanced stable operation
- ✿ **Condenser Water Modulating Valve Control** – A 0-10Vdc control signal is output from Vision 2020i controller to regulates the condenser water modulating valve (field supplied) to bypass portion of condenser water, to allow chiller operation at lower ambient temperature
- ✿ **Cooling Tower Fan Staging Control** – Cooling tower fans staging are controlled by chiller's Vision 2020i controller based on operating condenser pressure. This provides energy saving on cooling tower operation, while maintaining chiller operation at optimum performance.
- ✿ **Complete Temperature Monitoring** – Entering evaporator water temperature sensor, leaving and entering condenser water temperature sensors can be included for complete temperature monitoring of the unit
- ✿ **IP54 Control Panel** – IP54 rated control panel can be supplied for harsh working environment
- ✿ **System Voltage Readout** – Voltage of power supply is displayed and logged at Vision 2020i controller
- ✿ **GFCI Convenience Outlet (US Region Only)** – 115Vac convenience outlet with female receptacle
- ✿ **BMS Communication** – Various add-on communication cards provide BMS communication via common protocols: Modbus RTU RS485 / TCPIP, LONworks FTT10, BACnet over IP / MSTP / PTP

## Factory Supplied, Field Installed Accessories

- ✿ **Water Flow Switch** – Flow switch to be installed at evaporator and condenser outlet piping as safety interlock to evaporator and condenser water flow status. Three options are available: Weather tight flow switch with CE mark; NEMA 3R, and NEMA 4 rated flow switch
- ✿ **Rubber-In-Shear Isolators** – Designed for ease of installation. These one-piece molded rubber isolators are applicable for most installations.
- ✿ **Spring Isolators** – These housed spring assemblies have a neoprene friction pad at the bottom to prevent the passage of noise, and a spring locking levering bolt at the top. Neoprene inserts prevent contact between the steel upper and lower housings. Suitable for more critical application as compared to rubber-in-shear isolator.
- ✿ **DB-LAN Master Slave Sequencing Control (MSS)** – Pre-programmed at factory; field supplied and installed inter-connection wiring between chillers to provide communication bus among chillers' controllers to enable Master-Slave Sequencing Control
- ✿ **Chiller Plant Manager (CPM)** – Factory supplied control panel; field supplied and installed interconnection wiring and field devices; for complete chiller plant room automation.

## DB DIRECTOR (For US Region Only)



DB-Director control system is offered to US region as an option to Vision 2020i control system.

DB-Director is a rugged microprocessor based controller designed for the HVAC/R applications. DB-Director provides flexibility with set points and control options that can be selected prior to commissioning a system or when the unit is live and functioning. Displays, alarms and other interfaces are accomplished in a clear and simple language that informs the user the status of the chiller.

DB-Director is equipped with 128 x 64 pixels monochrome graphics LCD display with 2.8" diagonal viewing area, and 9 dedicated keys that enable user to access information, base on security level of the password. The user terminal display allows easy

# OPTIONS AND ACCESSORIES

access to the unit working conditions, compressor run time, alarm histories and to modify the parameters. Multiple messages will be displayed automatically, scrolling from each message to the next. All of these messages are spelled out in English language on the display terminal.

The display also has an automatically self-test of the controller on system start-up. For more detail operation of the DB-Director keypad, please refer to the Unit operation Manual.

## Remote Monitoring (For DB-Director)

DB-Director is equipped with RS485 and Ethernet communication ports as standard. This user friendly design allows Building Management System (BMS) to interface directly with the chiller via either of Modbus RTU, Modbus IP, or BACnet IP communication protocol.

LONworks or BACnet MSTP communication protocol can be established with installation of external adapter.

# OPERATING BENEFITS

## EFFICIENCY & RELIABILITY

### Compressor Experience

- ✿ More than 45 years of rotary screw experience and dedicated technological advancements. Compressors are CE listed
- ✿ Designed for high reliability with only two rotating parts. No gears to fail
- ✿ Insured continuous oil flow to each compressor through integral high efficiency oil separation for each compressor
- ✿ Chillers use multiple rotary screw compressors for fail-safe reliability and redundancy

### Refrigerant Compatibility

- ✿ Designed to operate with environmentally safe and economically smart HFC-134a with proven efficiency and reliability
- ✿ Consult factory for use with new HFC refrigerants

### Energy Efficiency

- ✿ Designed to provide the highest amount of cooling capacity for the least kilowatt input over the entire operating range of your building
- ✿ Delivers outstanding efficiency and offer greater energy savings through the utilization of the economizer
- ✿ Maximized performance through a wide range of matched components and multiple compressors on a single refrigerant circuit
- ✿ High efficiency oil recovery system guarantees removal of oil carried over with the refrigerant and maintains the heat exchangers at their maximum efficiency at both full and part load

### Installation And Maintenance Ease

- ✿ Side-by-side evaporator/condenser plus snug arrangement of rotary screw compressors result in an extremely compact work envelope
- ✿ Units feature optional split design to allow easy fit through any standard commercial doorway
- ✿ Dramatic payback in reduced maintenance and overhaul costs both in down time and in labor expenditures

- ✿ Ease of troubleshooting through controller retention of monitored functions

- ✿ Evaporators and condensers are designed with removable water heads which can be removed easily without dismantling the chilled water piping connections, for inspection and for mechanical tubes cleaning with brushes or auto-brush. This will enable low tube fouling factor in the evaporator and condenser to be assured, thus maintaining system efficiency

### Factory Testing

- ✿ Each chiller undergoes the factory testing prior to unit shipment. This assures consistencies of workmanship at highest quality
- ✿ Thus, all units shipped are completely factory tested; charged and adjusted according to the design parameters, for ease of installation and minimal field start-up adjustments

### Control Flexibility

- ✿ Controller-based with DDC (direct digital control) features precise touch keys control over every aspect of operation with built-in control philosophy that allow extra energy savings on start-up and throughout the life of your equipment
- ✿ Insured uniform compressor loading and optimal energy efficiency through controller controls which utilize pressure transducers to measure evaporator and condenser pressure
- ✿ Lower energy costs resulting from automatic load monitoring and increased accuracy and efficiency in compressor staging
- ✿ Various communication options for remote monitoring of the unit operation
- ✿ Proactive control by controller that anticipates problems and takes corrective action before they occur. Controls will unload compressor(s) if condenser or evaporator pressure approach limits. This will enable unit to stay on the line while warning operator of potential problems
- ✿ Stable and efficient operation with precise chilled water temperature control. Chilled water temperature is controlled at  $\pm 0.8^{\circ}\text{F}$  [ $0.5^{\circ}\text{C}$ ] range for your comfort cooling, with best energy saving

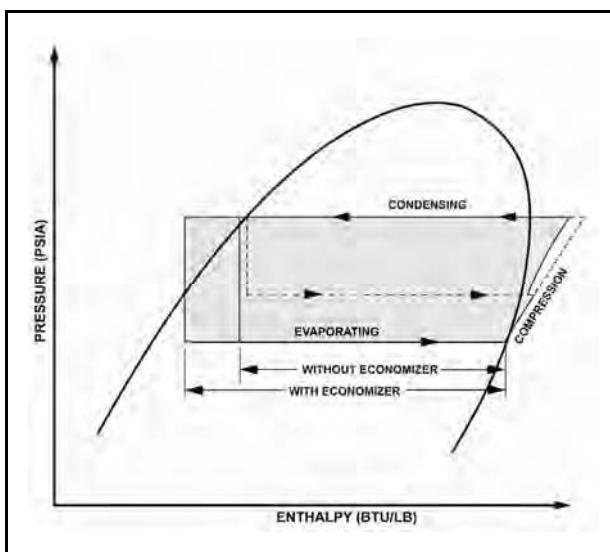
# OPERATING BENEFITS

## REFRIGERATION CYCLE

Dunham-Bush WCFX-E Chillers are designed for efficiency and reliability. The rotary screw compressor is a positive displacement, variable capacity compressor that will allow operation over a wide range of conditions.

Even at high condenser pressure and low capacity, a difficult condition for centrifugal compressors, the rotary screw compressor performs easily. It is impossible for this positive displacement compressor to surge.

The refrigerant management system is shown in the refrigerant cycle diagram below.



Liquid refrigerant enters the flooded evaporator uniformly where it absorbs heat from water flowing through the evaporator tubes, and vaporized. The vaporized refrigerant is drawn into the compressor suction port where the positive displacement compression begins.

This partially compressed refrigerant gaseous is then mixed with additional flash refrigerant from the economizer in the compression chamber. The compressed gaseous refrigerant is now discharged into the integral oil separator, to separate lubrication oil from the gaseous refrigerant, and recovers lubrication oil back to the oil sump.

The fully compressed and superheated refrigerant is discharged into the condenser, where water in the condenser tubes cools and condenses the refrigerant. Liquid refrigerant leaves the condenser is further sub-cooled by the economizer.

The gaseous refrigerant is drawn out from the economizer and is injected into compressor through the vapor injection port. The remaining liquid refrigerant shall passes through the Electronic Expansion Valve (EEV) which reduces refrigerant pressure to evaporator levels where it is then distributed evenly into the evaporator.

This delivers outstanding efficiency and total energy savings through the utilization of economizer cycle. Unit EER is improved with economizer cycle.

## PART LOAD PERFORMANCE

Through the use of economizer and multiple compressors, Dunham-Bush WCFX-E Chillers offer some of the best part-load performance characteristics in the industry when measured in accordance with AHRI Standard 550/590-2011.

In most cases, actual building system loads are significantly less than full load design conditions, therefore chillers operate at part load most of the time.

Dunham-Bush WCFX-E Chillers having multiple rotary screw compressors, economizer and advanced controller to yield the best total energy efficiency and significant operating savings at part loads.

When specifying air conditioning equipment, it is important to consider the system load characteristics of the building.

In a typical city, the air conditioning load varies according to the changes in the ambient temperature. Weather data compiled over the years could predict the number of hours that equipment operate at various load percentages.

The Air Conditioning and Refrigeration Institute (AHRI) has established a system, under AHRI Standard 550/590-2011, for measuring total chiller performance over full and part-load conditions. It defines the Integrated Part-Load Value (IPLV) as an excellent method of comparing equipment for their efficiency on equal basis. The IPLV is a single number that estimate power consumption by chiller weighted over number of hours the unit might operate at each part-load point. IPLV's are based on AHRI Standard Rating Conditions.

The formula for calculating an IPLV is:

$$IPLV = \frac{1}{\frac{0.01}{A} + \frac{0.42}{B} + \frac{0.45}{C} + \frac{0.12}{D}}$$

where: A= kW/ton at 100% load point

B= kW/ton at 75% load point

C= kW/ton at 50% load point

D= kW/ton at 25% load point



# PHYSICAL SPECIFICATIONS

## 50Hz

Model WCFX-E		10S	12S	15S	19S*	20S*	20T	22T
Nominal Capacity	TR [kW]	59.7 [210.1]	74.6 [262.4]	90.2 [317.3]	111.5 [392.2]	136.8 [481.2]	119.6 [420.5]	134.0 [471.4]
Nominal Power Input	kW	37.4	44.3	53.1	63.9	80.6	75.0	82.2
Energy Efficiency	kW/TR	0.626	0.594	0.589	0.573	0.589	0.627	0.613
	COP	5.618	5.923	5.976	6.138	5.970	5.607	5.735
Min % Unit Capacity		25%	25%	25%	25%	25%	12.5%	12.5%
Power Supply		380~415V/3Ph/50Hz						
<b>Compressor</b>								
Model(Qty.)		1210(1)	1212(1)	1215(1)	1220(1)	1222(1)	1210(2)	1210(1)/ 1212(1)
<b>Evaporator</b>								
Model		C2R	C3R	D2R	E2R	2CR	2CR	2DR
Water Flow Rate	USgpm[m³/hr]	142.6 [32.5]	178.4 [40.7]	215.0 [49.0]	266.2 [60.7]	326.5 [74.4]	284.8 [64.9]	318.0 [72.5]
Pressure Drop	ft wg[kPa]	3.7 [11.2]	4.2 [12.5]	4.1 [12.2]	4.1 [12.2]	8.8 [26.2]	7.2 [21.4]	8.3 [24.7]
Design Press. Water Side	psig[kPa]	150 [1034]						
Connection Size	inches	4	5	6	6	6	6	6
<b>Condenser</b>								
Model		B3R	B4R	B5R	C2R	E5R	E5R	4AR
Water Flow Rate	USgpm[m³/hr]	168.2 [38.3]	209.4 [47.7]	252.7 [57.6]	310.6 [70.8]	382.2 [87.1]	341.7 [77.9]	378.1 [86.2]
Pressure Drop	ft wg[kPa]	4.8 [14.2]	5.0 [15.0]	5.3 [15.8]	5.8 [17.4]	9.9 [29.7]	8.6 [25.6]	9.8 [29.3]
Design Press. Water Side	psig[kPa]	150 [1034]						
Connection Size	inches	4	5	5	6	5	5	6
<b>General Information</b>								
Length	Inches[mm]	119 [3011]	124 [3160]	124 [3160]	132 [3358]	164 [4171]	156 [3972]	157 [3977]
Width	Inches[mm]	44 [1125]	45 [1146]	48 [1231]	63 [1600]	63 [1600]	47 [1203]	50 [1280]
Height	Inches[mm]	78 [1981]	78 [1981]	85 [2159]	76 [1930]	76 [1930]	81 [2057]	81 [2057]
Shipping Weight	lbs[kg]	6,581 [2985]	6,951 [3153]	7,635 [3463]	7,981 [3620]	8,466 [3840]	7,769 [3524]	8,382 [3802]
Operating Weight	lbs[kg]	6,841 [3103]	7,269 [3297]	8,016 [3636]	8,642 [3920]	9,026 [4094]	8,885 [4030]	9,151 [4151]
Approx. R134a Charge	lbs[kg]	220 [100]	254 [115]	320 [145]	364 [165]	441 [200]	441 [200]	485 [220]
Model WCFX-E		23S*	24S*	24T	27S*	27T	30S*	30T
Nominal Capacity	TR [kW]	156.0 [548.8]	168.7 [593.3]	149.4 [525.5]	185.0 [650.5]	165.2 [580.8]	209.1 [735.5]	179.7 [631.9]
Nominal Power Input	kW	88.7	96.2	90.4	104.6	97.4	119.6	106.6
Energy Efficiency	kW/TR	0.568	0.570	0.605	0.566	0.590	0.572	0.593
	COP	6.187	6.167	5.813	6.219	5.963	6.150	5.928
Min % Unit Capacity		25%	25%	12.5%	25%	12.5%	25%	12.5%
Power Supply		380~415V/3Ph/50Hz						
<b>Compressor</b>								
Model(Qty.)		1222(1)	1227(1)	1212(2)	1227(1)	1212(1)/ 1215(1)	1230(1)	1215(2)
<b>Evaporator</b>								
Model		2DR	EAR	EAR	JAR	JAR	JBR	JBR
Water Flow Rate	USgpm[m³/hr]	369.9 [84.3]	400.5 [91.3]	356.2 [81.2]	443.2 [101.0]	395.5 [90.1]	499.2 [113.8]	427.7 [97.5]
Pressure Drop	ft wg[kPa]	10.1 [30.1]	9.8 [29.3]	8.6 [25.6]	9.2 [27.6]	7.7 [23.1]	10.3 [30.9]	8.1 [24.3]
Design Press. Water Side	psig[kPa]	150 [1034]						
Connection Size	inches	6	6	6	8	8	8	8
<b>Condenser</b>								
Model		4AR	5AR	5AR	5BR	5BR	5CR	5CR
Water Flow Rate	USgpm[m³/hr]	434.0 [98.9]	470.4 [107.2]	419.8 [95.7]	514.0 [117.1]	462.3 [105.4]	585.4 [133.4]	507.1 [115.6]
Pressure Drop	ft wg[kPa]	11.4 [34.2]	11.1 [33.2]	9.9 [29.5]	11.1 [33.3]	9.7 [28.9]	11.2 [33.6]	9.3 [27.7]
Design Press. Water Side	psig[kPa]	150 [1034]						
Connection Size	inches	6	6	6	6	6	6	6
<b>General Information</b>								
Length	Inches[mm]	164 [4171]	164 [4171]	152 [3862]	164 [4171]	152 [3866]	164 [4171]	152 [3866]
Width	Inches[mm]	63 [1600]	63 [1600]	52 [1330]	63 [1600]	54 [1381]	63 [1600]	54 [1381]
Height	Inches[mm]	76 [1930]	76 [1930]	83 [2108]	76 [1930]	88 [2235]	76 [1930]	88 [2235]
Shipping Weight	lbs[kg]	8896 [4035]	10675 [4842]	8289 [3760]	11202 [5081]	8874 [4025]	11896 [5396]	9160 [4155]
Operating Weight	lbs[kg]	9484 [4302]	11316 [5133]	9160 [4155]	11918 [5406]	9711 [4405]	12690 [5756]	9932 [4505]
Approx. R134a Charge	lbs[kg]	485 [220]	573 [260]	573 [260]	529 [240]	529 [240]	562 [255]	562 [255]

\*Optional compact footprint series is available. Unit height may be increased. Please consult factory for details.

- Notes:
- The above are rated in accordance with AHRI Standard 550/590-2011 on Superior models with following conditions:  
Inlet/outlet chilled water temperature 54/44 °F; inlet/outlet cooling water temperature 85/95 °F; evaporator fouling factor 0.0001hr.ft².°F/Btu; condenser fouling factor 0.00025hr.ft².°F/Btu; 2-pass evaporator and condenser
  - To consult nearest Dunham-Bush sales office for computer selections other than above operating conditions



# PHYSICAL SPECIFICATIONS

## 50Hz

Model WCFX-E		36S	38T*	40T*	41S	46S	46T*	50T*
Nominal Capacity	TR [kW]	245.6 [863.7]	224.5 [789.5]	275.6 [969.4]	278.8 [980.6]	314.9 [1107.3]	314.6 [1106.3]	343.2 [1206.9]
Nominal Power Input	kW	136.0	126.6	154.4	154.1	173.6	173.8	189.9
Energy Efficiency	kW/TR	0.554	0.564	0.560	0.553	0.551	0.553	0.553
	COP	6.351	6.236	6.278	6.363	6.378	6.365	6.355
Min % Unit Capacity		25%	12.5%	12.5%	25%	25.0%	12.5%	12.5%
Power Supply					380~415V/3Ph/50Hz			
<b>Compressor</b>								
Model(Qty.)		2233(1)	1220(2)	1222(2)	2236(1)	2246(1)	1222(2)	1222(1)/ 1227(1)
<b>Evaporator</b>								
Model		6AR	5BR	6CR	6CR	7DR	7DR	8BR
Water Flow Rate	USgpm[m³/hr]	586.1 [133.6]	539.2 [122.9]	656.7 [149.7]	666.4 [151.9]	751.2 [171.2]	753.5 [171.7]	818.2 [186.5]
Pressure Drop	ft wg[kPa]	11.0 [32.9]	12.6 [37.6]	10.8 [32.2]	10.9 [32.6]	13.3 [39.7]	10.9 [32.5]	11.2 [33.5]
Design Press. Water Side	psig[kPa]				150 [1034]			
Connection Size	inches	8	8	8	8	8	8	10
<b>Condenser</b>								
Model		K4R	K3R	K5R	K5R	L1R	L1R	M3R
Water Flow Rate	USgpm[m³/hr]	686.3 [156.4]	629.3 [143.4]	768.7 [175.2]	773.9 [176.4]	875.2 [199.5]	874.9 [199.4]	950.8 [216.7]
Pressure Drop	ft wg[kPa]	11.6 [34.6]	12.7 [38.1]	11.3 [33.7]	11.2 [33.6]	12.6 [37.7]	11.5 [34.3]	11.7 [35.0]
Design Press. Water Side	psig[kPa]				150 [1034]			
Connection Size	inches	8	8	8	8	8	8	10
<b>General Information</b>								
Length	Inches[mm]	174 [4425]	197 [4997]	197 [4997]	174 [4425]	174 [4425]	197 [4997]	197 [4997]
Width	Inches[mm]	70 [1778]	75 [1905]	80 [2032]	70 [1778]	70 [1778]	80 [2032]	80 [2032]
Height	Inches[mm]	96 [2438]	86 [2185]	86 [2185]	96 [2438]	97 [2463]	86 [2185]	88 [2235]
Shipping Weight	lbs[kg]	12961 [5879]	13689 [6209]	14722 [6678]	13569 [6155]	15745 [7142]	17320 [7856]	17954 [8144]
Operating Weight	lbs[kg]	14004 [6352]	14782 [6705]	15721 [7131]	14769 [6699]	17364 [7876]	18678 [8472]	19414 [8806]
Approx. R134a Charge	lbs[kg]	761 [345]	683 [310]	882 [400]	838 [380]	970 [440]	970 [440]	1014 [460]
Model WCFX-E		54T*	57T*	60T*	69*	73T	73*	75T
Nominal Capacity	TR [kW]	371.3 [1305.8]	397.3 [1397.3]	423.3 [1488.6]	475.2 [1671.3]	490.0 [1723.1]	503.7 [1771.4]	522.8 [1838.5]
Nominal Power Input	kW	206.3	220.9	235.3	267.4	273.2	283.9	292.2
Energy Efficiency	kW/TR	0.556	0.556	0.556	0.563	0.558	0.564	0.559
	COP	6.330	6.325	6.326	6.250	6.307	6.240	6.292
Min % Unit Capacity		12.5%	12.5%	12.5%	8.5%	12.5%	8.5%	12.5%
Power Supply					380~415V/3Ph/50Hz			
<b>Compressor</b>								
Model(Qty.)		1227(2)	1227(1)/ 1230(1)	1230(2)	1222(3)	2233(2)	1222(2)/ 1227 (1)	2233(1)/ 2236(1)
<b>Evaporator</b>								
Model		8CR	8DR	KBR	CER	LAR	CBR	LBR
Water Flow Rate	USgpm[m³/hr]	885.8 [201.9]	947.0 [215.8]	1010.3 [230.3]	1136.9 [259.1]	1170.0 [266.6]	1201.4 [273.8]	1245.5 [283.9]
Pressure Drop	ft wg[kPa]	11.7 [35.1]	12.4 [37.1]	11.8 [35.4]	13.6 [40.6]	13.0 [38.8]	13.7 [41.1]	13.1 [39.2]
Design Press. Water Side	psig[kPa]				150 [1034]			
Connection Size	inches[mm]	10	10	10	10	12	10	12
<b>Condenser</b>								
Model		M4R	M5R	T5R	Y5R	U1R	Y6R	U2R
Water Flow Rate	USgpm[m³/hr]	1033.4 [235.5]	1103.9 [251.6]	1174.9 [267.8]	1317.9 [300.3]	1365.6 [311.2]	1396.0 [318.1]	1459.1 [332.5]
Pressure Drop	ft wg[kPa]	11.6 [34.8]	11.9 [35.6]	12.3 [36.9]	13.3 [39.7]	13.6 [40.7]	13.7 [40.9]	12.8 [38.3]
Design Press. Water Side	psig[kPa]				150 [1034]			
Connection Size	inches[mm]	10	10	10	10	10	10	10
<b>General Information</b>								
Length	Inches[mm]	197 [4997]	197 [4997]	197 [4997]	214 [5429]	207 [5251]	214 [5429]	207 [5251]
Width	Inches[mm]	80 [2032]	80 [2032]	80 [2032]	86 [2184]	86 [2184]	86 [2184]	86 [2184]
Height	Inches[mm]	88 [2235]	88 [2235]	92 [2337]	97 [2464]	100 [2540]	97 [2464]	100 [2540]
Shipping Weight	lbs[kg]	18592 [8433]	19381 [8791]	21145 [9591]	24359 [11049]	23118 [10486]	24928 [11307]	23702 [10751]
Operating Weight	lbs[kg]	20168 [9148]	21039 [9543]	22906 [10390]	26489 [12015]	25056 [11365]	27157 [12318]	25783 [11695]
Approx. R134a Charge	lbs[kg]	1080 [490]	1113 [505]	1312 [595]	1217 [552]	1301 [590]	1299 [589]	1389 [630]

\*Optional compact footprint series is available. Unit height may be increased. Please consult factory for details.

Notes: 1. The above are rated in accordance with AHRI Standard 550/590-2011 on Superior models with following conditions:

Inlet/outlet chilled water temperature 54/44 °F; inlet/outlet cooling water temperature 85/95 °F; evaporator fouling factor 0.0001hr.ft².°F/Btu; condenser fouling factor 0.00025hr.ft².°F/Btu; 2-pass evaporator and condenser

2. To consult nearest Dunham-Bush sales office for computer selections other than above operating conditions



# PHYSICAL SPECIFICATIONS

## 50Hz

Model WCFX-E		77*	81T	81*	84*	87T	87*
Nominal Capacity	TR [kW]	532.0 [1871.1]	558.9 [1,965.7]	560.8 [1972.2]	585.5 [2059.2]	593.0 [2085.4]	610.5 [2147.0]
Nominal Power Input	kW	300.4	308.7	316.6	329.9	325.8	343.6
Energy Efficiency	kW/TR	0.565	0.552	0.565	0.563	0.549	0.563
	COP	6.229	6.368	6.229	6.242	6.401	6.249
Min % Unit Capacity		8.5%	12.5%	8.5%	8.5%	12.5%	8.5%
Power Supply		380~415V/3Ph/50Hz					
<b>Compressor</b>							
Model(Qty.)		1222(1) /1227(2)	2236(2)	1227(3)	1227(2)/ 1230(1)	2246(1)/ 2236(1)	1227(1)/ 1230(2)
<b>Evaporator</b>							
Model		CFR	MAR	CGR	DBR	DCR	DCR
Water Flow Rate	USgpm[m³/hr]	1268.5 [289.1]	1335.4 [304.3]	1338.6 [305.1]	1390.0 [316.8]	1,414.7 [322.4]	1456.4 [331.9]
Pressure Drop	ft wg[kPa]	13.9 [41.5]	11.8 [35.3]	14.0 [41.8]	12.5 [37.3]	13.4 [40.0]	12.7 [38.1]
Design Press. Water Side	psig[kPa]	150 [1034]					
Connection Size	inches	10	12	10	12	12	12
<b>Condenser</b>							
Model		Y7R	JAR	Z1R	1BR	1CR	1CR
Water Flow Rate	USgpm[m³/hr]	1470.9 [335.2]	1547.2 [352.6]	1563.8 [356.4]	1629.8 [371.4]	1647.4 [375.4]	1699.5 [387.3]
Pressure Drop	ft wg[kPa]	13.1 [39.3]	12.0 [35.9]	13.0 [38.9]	13.3 [39.7]	13.3 [39.8]	12.7 [38.1]
Design Press. Water Side	psig[kPa]	150 [1034]					
Connection Size	inches	10	12	10	10	10	10
<b>General Information</b>							
Length	Inches[mm]	214 [5429]	207 [5251]	214 [5429]	214 [5429]	214 [5429]	214 [5429]
Width	Inches[mm]	86 [2184]	86 [2184]	86 [2184]	86 [2184]	86 [2184]	86 [2184]
Height	Inches[mm]	97 [2464]	100 [2540]	99 [2515]	99 [2515]	100 [2540]	99 [2515]
Shipping Weight	lbs[kg]	25510 [11571]	27207 [12341]	27055 [12272]	30212 [13704]	26376 [11,964]	31004 [14063]
Operating Weight	lbs[kg]	27847 [12631]	29538 [13398]	29544 [13401]	32855 [14903]	29718 [13,480]	33799 [15331]
Approx. R134a Charge	lbs[kg]	1380 [626]	1455 [660]	1464 [664]	1532 [695]	1601 [726]	1601 [726]
Model WCFX-E		90T	90*	108	113	118	123
Nominal Capacity	TR [kW]	628.9 [2211.8]	633.6 [2228.3]	737.3 [2592.9]	772.0 [2715.0]	805.5 [2833.0]	841.6 [2959.8]
Nominal Power Input	kW	350.2	359.2	411.9	430.7	448.2	465.8
Energy Efficiency	kW/TR	0.557	0.567	0.559	0.558	0.556	0.553
	COP	6.316	6.204	6.295	6.304	6.321	6.354
Min % Unit Capacity		12.5%	8.5%	8.5%	8.5%	8.5%	8.5%
Power Supply		380~415V/3Ph/50Hz					
<b>Compressor</b>							
Model(Qty.)		2246(2)	1230(3)	2233(3)	2233(2)/ 2236(1)	2233(1)/ 2236(2)	2236(3)
<b>Evaporator</b>							
Model		DCR	DCR	PAR	PBR	SAR	SCR
Water Flow Rate	USgpm[m³/hr]	1500.4 [341.9]	1511.8 [344.5]	1768.5 [403.0]	1841.6 [419.7]	1915.6 [436.6]	2007.9 [457.6]
Pressure Drop	ft wg[kPa]	15.1 [45.0]	13.9 [41.4]	13.2 [39.5]	13.2 [39.4]	12.8 [38.4]	11.8 [35.4]
Design Press. Water Side	psig[kPa]	150[1034]					
Connection Size	inches[mm]	12	12	12	12	14	14
<b>Condenser</b>							
Model		1CR	1CR	8CR	8BR	9AR	9BR
Water Flow Rate	USgpm[m³/hr]	1750.5 [398.9]	1762.4 [401.7]	2044.7 [466.0]	2150.2 [490.0]	2235.9 [509.6]	2346.1 [534.7]
Pressure Drop	ft wg[kPa]	14.6 [43.7]	13.6 [40.7]	11.5 [34.4]	11.6 [34.7]	10.5 [31.4]	10.0 [30.0]
Design Press. Water Side	psig[kPa]	150[1034]					
Connection Size	inches[mm]	10	10	12	12	14	14
<b>General Information</b>							
Length	Inches[mm]	214 [5429]	214 [5429]	202 [5124]	202 [5124]	202 [5124]	202 [5124]
Width	Inches[mm]	86 [2184]	86 [2184]	97 [2464]	97 [2464]	100 [2540]	100 [2540]
Height	Inches[mm]	100 [2540]	99 [2515]	117 [2972]	117 [2972]	125 [3175]	125 [3175]
Shipping Weight	lbs[kg]	27955 [12680]	31317 [14205]	37664 [17084]	38532 [17478]	41520 [18833]	42997 [19503]
Operating Weight	lbs[kg]	30750 [13948]	34110 [15472]	39921 [18108]	40845 [18527]	44011 [19963]	45576 [20673]
Approx. R134a Charge	lbs[kg]	1669 [757]	1,601 [726]	2006 [910]	2011 [912]	2238 [1015]	2253 [1022]

\*Optional compact footprint series is available. Unit height may be increased. Please consult factory for details.

Notes: 1. The above are rated in accordance with AHRI Standard 550/590-2011 on Superior models with following conditions:  
Inlet/outlet chilled water temperature 54/44 °F; inlet/outlet cooling water temperature 85/95 °F; evaporator fouling factor 0.0001hr.ft².°F/Btu; condenser fouling factor 0.00025hr.ft².°F/Btu; 2-pass evaporator and condenser  
2. To consult nearest Dunham-Bush sales office for computer selections other than above operating conditions.



# PHYSICAL SPECIFICATIONS

## 60Hz

Model WCFX-E		10S	12S	15S	19S*	20S*	20T	22T
Nominal Capacity	TR [kW]	71.1 [249.9]	89.1 [313.2]	108.0 [379.7]	132.9 [467.3]	164.0 [576.8]	142.2 [500.1]	160.1 [562.9]
Nominal Power Input	kW	44.6	52.7	63.0	77.1	96.7	89.4	97.8
Energy Efficiency	kW/TR	0.628	0.592	0.584	0.580	0.590	0.629	0.611
	COP	5.603	5.943	6.027	6.061	5.965	5.594	5.756
Min % Unit Capacity		25%	25%	25%	25%	25%	12.5%	12.5%
Power Supply		208~230V/3Ph/60Hz, 380V/3Ph/60Hz, 460V/3Ph/60Hz, 575V/3Ph/60Hz						
Compressor								
Model (Qty)		1210(1)	1212(1)	1215(1)	1220(1)	1222(1)	1210(2)	1210(1) / 1212(1)
Evaporator								
Model		C3R	D2R	E2R	FAR	EAR	EAR	JAR
Water Flow Rate	USgpm[m³/hr]	170.3 [38.8]	212.2 [48.4]	258.3 [58.9]	317.7 [72.4]	389.0 [88.7]	339.8 [77.4]	383.8 [87.5]
Evap. Pressure Drop	ft wg[kPa]	3.7 [11.2]	3.9 [11.8]	3.6 [10.8]	4.5 [13.6]	9.1 [27.3]	7.5 [22.3]	7.8 [23.3]
Design Press. Water Side	psig[kPa]				150 [1034]			
Connection Size	inches	5	6	6	8	6	6	8
Condenser								
Model		B4R	B5R	C2R	D2R	5BR	5BR	5BR
Water Flow Rate	USgpm[m³/hr]	201.1 [45.8]	250.0 [57.0]	302.3 [68.9]	370.6 [84.5]	459.6 [104.7]	402.2 [91.7]	451.7 [102.9]
Cond. Pressure Drop	ft wg[kPa]	4.5 [13.6]	5.1 [15.1]	5.4 [16.0]	5.9 [17.5]	9.3 [27.8]	7.7 [23.2]	9.8 [29.3]
Design Press. Water Side	psig[kPa]				150 [1034]			
Connection Size	inches	5	5	6	6	6	6	6
General Information								
Length	inches[mm]	124 [3160]	124 [3160]	125 [3171]	132 [3358]	164 [4171]	152 [3862]	152 [3866]
Width	inches[mm]	45 [1146]	47 [1195]	52 [1326]	70 [1778]	70 [1778]	52 [1330]	54 [1363]
Height	inches[mm]	78 [1981]	81 [2057]	87 [2210]	76 [1930]	76 [1930]	83 [2108]	85 [2159]
Shipping Weight	lbs[kg]	6898 [3129]	7357 [3337]	8682 [3938]	8576 [3894]	10496 [4761]	7987 [3623]	8869 [4023]
Operating Weight	lbs[kg]	7216 [3273]	7738 [3510]	9149 [4150]	9370 [4254]	11173 [5073]	8938 [4054]	9709 [4404]
Approx. R134a Charge	lbs[kg]	254 [115]	320 [145]	364 [165]	419 [190]	529 [240]	529 [240]	558 [253]
Model WCFX-E		23S*	24S*	24T	27S*	27T	30S*	30T
Nominal Capacity	TR [kW]	186.4 [655.6]	202.0 [710.3]	177.4 [624.0]	220.6 [775.7]	196.9 [692.5]	248.5 [873.9]	213.3 [750.2]
Nominal Power Input	kW	105.6	115.6	108.0	124.7	115.9	142.9	127.4
Energy Efficiency	kW/TR	0.566	0.572	0.609	0.565	0.589	0.575	0.597
	COP	6.208	6.144	5.778	6.221	5.975	6.115	5.889
Min % Unit Capacity		25%	25%	12.5%	25%	12.5%	25%	12.5%
Power Supply		208~230V/3Ph/60Hz, 380V/3Ph/60Hz, 460V/3Ph/60Hz, 575V/3Ph/60Hz						
Compressor								
Model (Qty)		1222(1)	1227(1)	1212 (2)	1227(1)	1212(1)/1215(1)	1230(1)	1215(2)
Evaporator								
Model		JAR	JBR	JBR	6DR	6DR	6ER	6ER
Water Flow Rate	USgpm[m³/hr]	442.4 [100.8]	479.7 [109.3]	420.6 [95.8]	524.9 [119.6]	470.3 [107.2]	589.4 [134.3]	507.5 [115.7]
Evap. Press. Drop	ft wg[kPa]	9.4 [28.0]	9.8 [29.3]	8.33 [24.9]	8.6 [25.8]	7.3 [21.7]	9.6 [28.8]	7.6 [22.8]
Design Press. Water Side	psig[kPa]				150 [1034]			
Connection Size	inches	8	8	8	8	8	8	8
Condenser								
Model		5BR	5CR	5CR	6CR	6CR	1KR	1KR
Water Flow Rate	USgpm[m³/hr]	521.7 [118.9]	563.1 [128.3]	500.0 [114.0]	617.9 [140.8]	552.0 [125.8]	694.9 [158.4]	598.0 [136.3]
Cond. Press. Drop	ft wg[kPa]	11.6 [34.6]	10.3 [30.9]	9.1 [27.2]	11.1 [33.2]	9.6 [28.6]	10.5 [31.5]	8.6 [25.7]
Design Press. Water Side	psig[kPa]				150 [1034]			
Connection Size	inches	6	6	6	6	6	8	8
General Information								
Length	inches[mm]	164 [4171]	164 [4171]	152 [3866]	164 [4171]	153 [3879]	164 [4171]	158 [4024]
Width	inches[mm]	70 [1778]	70 [1778]	54 [1364]	70 [1778]	55 [1386]	70 [1778]	56 [1412]
Height	inches[mm]	76 [1930]	76 [1930]	85 [2159]	78 [1980]	88 [2235]	80 [2031]	88 [2235]
Shipping Weight	lbs[kg]	10915 [4951]	11325 [5137]	9678 [4390]	11962 [5426]	10315 [4679]	13087 [5936]	11429 [5184]
Operating Weight	lbs[kg]	11632 [5276]	12119 [5497]	10474 [4751]	12833 [5821]	11191 [5076]	14065 [6380]	12410 [5629]
Approx. R134a Charge	lbs[kg]	558 [253]	584 [265]	584 [265]	705 [320]	705 [320]	750 [340]	750 [340]

\*Optional compact footprint series is available. Unit height may be increased. Please consult factory for details.

Notes: 1. The above are rated in accordance with AHRI Standard 550/590-2011 on Superior models with following conditions:

Inlet/outlet chilled water temperature 54/44 °F; inlet/outlet cooling water temperature 85/95 °F; evaporator fouling factor 0.0001hr.ft².°F/Btu; condenser fouling factor 0.00025hr.ft².°F/Btu; 2-pass evaporator and condenser

2. To consult nearest Dunham-Bush sales office for computer selections other than above operating conditions



# PHYSICAL SPECIFICATIONS

## 60Hz

Model WCFX-E		36S	38T*	40T*	41S	46S	46T*	50T*
Nominal Capacity	TR [kW]	292.2 [1027.5]	270.3 [950.7]	330.1 [1160.9]	332.0 [1167.4]	376.0 [1322.4]	375.3 [1319.8]	409.8 [1441.4]
Nominal Power Input	kW	162.5	151.5	185.8	184.2	207.7	207.5	226.8
Energy Efficiency	kW/TR	0.556	0.560	0.563	0.555	0.552	0.553	0.553
	COP	6.323	6.275	6.248	6.338	6.367	6.360	6.355
Min % Unit Capacity		25%	12.5%	12.5%	25%	25%	12.5%	12.5%
Power Supply		208~230V/3Ph/60Hz, 380V/3Ph/60Hz, 460V/3Ph/60Hz, 575V/3Ph/60Hz						
<b>Compressor</b>								
Model (Qty)		2233(1)	1220(2)	1222(2)	2236(1)	2246(1)	1222(2)	1222(1)/ 1227(1)
<b>Evaporator</b>								
Model		7CR	6CR	8BR	7BR	8DR	8DR	KBR
Water Flow Rate	USgpm[m³/hr]	697.1 [158.9]	644.8 [147.0]	786.7 [179.3]	795.5 [181.3]	897.1 [204.4]	902.4 [205.7]	985.3 [224.5]
Evap. Press. Drop	ft wg[kPa]	10.3 [30.9]	11.5 [34.4]	10.5 [31.4]	10.8 [32.2]	13.6 [40.6]	11.3 [33.7]	11.2 [33.5]
Design Press. Water Side	psig[kPa]				150 [1034]			
Connection Size	inches	8	8	10	10	10	10	10
<b>Condenser</b>								
Model		RAR	K5R	M3R	M1R	M5R	M5R	T5R
Water Flow Rate	USgpm[m³/hr]	812.6 [185.2]	754.4 [171.9]	913.6 [208.2]	917.1 [209.0]	1045.4 [238.2]	1039.3 [236.8]	1137.6 [259.3]
Cond. Press. Drop	ft wg[kPa]	11.4 [34.0]	12.1 [36.1]	11.0 [32.8]	10.8 [32.3]	11.8 [35.3]	10.6 [31.8]	11.5 [34.5]
Design Press. Water Side	psig[kPa]				150 [1034]			
Connection Size	inches	8	8	10	10	10	10	10
<b>General Information</b>								
Length	inches[mm]	174 [4425]	197 [4997]	197 [4997]	174 [4425]	174 [4425]	197 [4997]	197 [4997]
Width	inches[mm]	70 [1778]	75 [1905]	80 [2032]	70 [1778]	75 [1905]	80 [2032]	80 [2032]
Height	inches[mm]	96 [2438]	86 [2185]	88 [2235]	97 [2464]	100 [2540]	88 [2235]	92 [2337]
Shipping Weight	lbs[kg]	15205 [6897]	14103 [6397]	17414 [7899]	16180 [7339]	17505 [7940]	18210 [8260]	19928 [9039]
Operating Weight	lbs[kg]	16473 [7472]	15393 [6982]	18673 [8470]	17633 [7998]	19255 [8734]	19864 [9010]	21689 [9838]
Approx. R134a Charge	lbs[kg]	981 [445]	882 [400]	1014 [460]	1102 [500]	1113 [505]	1113 [505]	1312 [595]
<b>Model WCFX-E</b>								
Nominal Capacity	TR [kW]	444.6 [1563.7]	474.5 [1668.7]	503.8 [1771.9]	563.7 [1982.5]	582.1 [2047.1]	600.3 [2111.1]	621.8 [2186.7]
Nominal Power Input	kW	245.8	263.3	281.1	319.8	327.4	338.3	349.3
Energy Efficiency	kW/TR	0.553	0.555	0.558	0.567	0.562	0.564	0.562
	COP	6.362	6.338	6.303	6.199	6.253	6.240	6.260
Min % Unit Capacity		12.5%	12.5%	12.5%	8.5%	8.5%	12.5%	12.5%
Power Supply		208~230V/3Ph/60Hz, 380V/3Ph/60Hz, 460V/3Ph/60Hz, 575V/3Ph/60Hz						
<b>Compressor</b>								
Model (Qty)		1227(2)	1227(1)/ 1230(1)	1230(2)	1222(3)	2233(2)	1222(2)/ 1227(1)	2233(1)/ 2236(1)
<b>Evaporator</b>								
Model		YAR	YBR	YCR	CGR	MAR	DBR	MBR
Water Flow Rate	USgpm[m³/hr]	1060.7 [241.7]	1131.7 [257.9]	1202.0 [273.9]	1343.9 [306.3]	1386.6 [316.0]	1422.8 [324.3]	1483.4 [338.1]
Evap. Press. Drop	ft wg[kPa]	11.1 [33.3]	11.6 [34.6]	11.9 [35.6]	14.4 [43.1]	12.7 [38.0]	13.3 [39.7]	13.0 [39.0]
Design Press. Water Side	psig[kPa]				150 [1034]			
Connection Size	inches	10	10	10	10	12	12	12
<b>Condenser</b>								
Model		YAR	YBR	YCR	1BR	JAR	1CR	JBR
Water Flow Rate	USgpm[m³/hr]	1232.7 [280.9]	1321.3 [301.1]	1405.4 [320.3]	1580.8 [360.3]	1619.4 [369.1]	1671.0 [380.8]	1731.9 [394.7]
Cond. Press. Drop	ft wg[kPa]	11.0 [33.0]	11.6 [34.5]	11.8 [35.2]	13.0 [38.9]	13.4 [40.1]	12.8 [38.2]	12.3 [36.8]
Design Press. Water Side	psig[kPa]				150 [1034]			
Connection Size	inches	10	10	10	10	12	10	12
<b>General Information</b>								
Length	inches[mm]	197 [4997]	197 [4997]	197 [4997]	214 [5429]	207 [5251]	214 [5429]	207 [5251]
Width	inches[mm]	80 [2032]	80 [2032]	80 [2032]	88 [2235]	88 [2235]	88 [2235]	88 [2235]
Height	inches[mm]	97 [2464]	97 [2464]	97 [2464]	95 [2413]	100 [2540]	95 [2413]	100 [2540]
Shipping Weight	lbs[kg]	21645 [9818]	22476 [10195]	23091 [10474]	26279 [11920]	26819 [12165]	29202 [13246]	27597 [12518]
Operating Weight	lbs[kg]	23587 [10699]	24509 [11117]	25230 [11444]	28808 [13067]	29145 [13220]	31949 [14492]	30111 [13658]
Approx. R134a Charge	lbs[kg]	1356 [615]	1422 [645]	1477 [670]	1532 [695]	1455 [660]	1940 [880]	1543 [700]

\*Optional compact footprint series is available. Unit height may be increased. Please consult factory for details.

Notes: 1. The above are rated in accordance with AHRI Standard 550/590-2011 on Superior models with following conditions:

Inlet/outlet chilled water temperature 54/44 °F; inlet/outlet cooling water temperature 85/95 °F; evaporator fouling factor 0.0001hr.ft<sup>2</sup>.°F/Btu; condenser fouling factor 0.00025hr.ft<sup>2</sup>.°F/Btu; 2-pass evaporator and condenser

2. To consult nearest Dunham-Bush sales office for computer selections other than above operating conditions



# PHYSICAL SPECIFICATIONS

## 60Hz

Model WCFX-E		77*	81T	81*	84*	87T	87*
Nominal Capacity	TR [kW]	634.0 [2229.6]	664.9 [2338.4]	667.2 [2346.6]	696.4 [2449.0]	705.3 [2480.5]	725.5 [2551.5]
Nominal Power Input	kW	358.7	368.9	377.7	394.3	390.8	411.8
Energy Efficiency	kW/TR	0.566	0.555	0.566	0.566	0.554	0.568
	COP	6.216	6.339	6.213	6.211	6.348	6.196
Min % Unit Capacity		8.5%	12.5%	8.5%	8.5%	12.5%	8.5%
Power Supply		208~230V/3Ph/60Hz, 380V/3Ph/60Hz, 460V/3Ph/60Hz, 575V/3Ph/60Hz					
<b>Compressor</b>							
Model (Qty)		1222(1)/ 1227(2)	2236(2)	1227(3)	1227(2)/ 1230(1)	2236(1), 2246(1)	1227(1)/ 1230(2)
<b>Evaporator</b>							
Model		DCR	NAR	N1R	PCR	PAR	PAR
Water Flow Rate	USgpm[m³/hr]	1512.3 [344.7]	1581.1 [360.3]	1590.8 [362.5]	1663.1 [379.0]	1682.6 [382.0]	1722.2 [392.5]
Evap. Press. Drop	ft wg[kPa]	13.6 [40.7]	11.8 [35.2]	13.8 [41.2]	12.4 [37.2]	13.4 [40.0]	12.7 [38.1]
Design Press. Water Side	psig[kPa]			150 [1034]			
Connection Size	inches	12	12	12	12	12	12
<b>Condenser</b>							
Model		1CR	KAR	7BR	7BR	7CR	7CR
Water Flow Rate	USgpm[m³/hr]	1765.9 [402.5]	1846.8 [420.9]	1870.5 [426.3]	1942.8 [442.8]	1961.7 [445.3]	2020.1 [460.4]
Cond. Press. Drop	ft wg[kPa]	13.4 [40.1]	11.4 [34.1]	12.4 [37.1]	13.1 [39.3]	15.7 [46.9]	13.3 [39.7]
Design Press. Water Side	psig[kPa]			150 [1034]			
Connection Size	inches	10	12	12	12	12	12
<b>General Information</b>							
Length	inches[mm]	214 [5429]	207 [5251]	214 [5429]	214 [5429]	214 [5429]	214 [5429]
Width	inches[mm]	88 [2235]	88 [2235]	88 [2235]	88 [2235]	90 [2286]	88 [2235]
Height	inches[mm]	95 [2413]	100 [2540]	95 [2413]	95 [2413]	108 [2743]	95 [2413]
Shipping Weight	lbs[kg]	29665 [13456]	29952 [13586]	31857 [14450]	33735 [15302]	29729 [13485]	34370 [15590]
Operating Weight	lbs[kg]	32459 [14723]	32774 [14866]	34888 [15825]	36905 [16740]	33687 [15280]	37642 [17074]
Approx. R134a Charge	lbs[kg]	2017 [915]	1808 [820]	2260 [1025]	2635 [1195]	2701 [1225]	2701 [1225]
Model WCFX-E		90T	90*	108	113	118	123
Nominal Capacity	TR [kW]	748.3 [2631.5]	753.2 [2649.0]	875.2 [3078.1]	915.9 [3221.1]	955.9 [3361.6]	997.5 [3507.9]
Nominal Power Input	kW	418.8	429.2	494.6	516.7	537.8	559.8
Energy Efficiency	kW/TR	0.560	0.570	0.565	0.564	0.563	0.561
	COP	6.283	6.172	6.223	6.234	6.251	6.266
Min % Unit Capacity		12.5%	8.5%	8.5%	8.5%	8.5%	8.5%
Power Supply		208~230V/3Ph/60Hz, 380V/3Ph/60Hz, 460V/3Ph/60Hz, 575V/3Ph/60Hz					
<b>Compressor</b>							
Model (Qty)		2246(2)	1230(3)	2233(3)	2233(2)/ 2236(1)	2233(1)/ 2236(2)	2236(3)
<b>Evaporator</b>							
Model		PAR	PAR	SCR	SDR	TAR	TBR
Water Flow Rate	USgpm[m³/hr]	1785.2 [406.8]	1797.9 [409.7]	2073.0 [472.4]	2187.1 [498.4]	2279.3 [519.5]	2385.7 [543.7]
Evap. Press. Drop	ft wg[kPa]	15.3 [45.8]	14.0 [41.9]	12.7 [38.1]	13.1 [39.1]	12.8 [38.2]	11.8 [35.2]
Design Press. Water Side	psig[kPa]			150 [1034]			
Connection Size	inches	12	12	14	14	14	14
<b>Condenser</b>							
Model		8AR	8AR	9AR	9BR	WAR	WBR
Water Flow Rate	USgpm[m³/hr]	2084.1 [475.0]	2108.3 [480.5]	2441.7 [556.5]	2549.2 [581.0]	2652.6 [604.5]	2790.9 [636.0]
Cond. Press. Drop	ft wg[kPa]	13.9 [41.5]	13.0 [38.9]	12.1 [36.3]	11.5 [34.4]	10.3 [30.9]	10.0 [29.8]
Design Press. Water Side	psig[kPa]			150 [1034]			
Connection Size	inches	12	12	14	14	14	14
<b>General Information</b>							
Length	inches[mm]	214 [5429]	214 [5429]	202 [5124]	202 [5124]	202 [5124]	202 [5124]
Width	inches[mm]	90 [2286]	88 [2235]	100 [2540]	100 [2540]	100 [2540]	100 [2540]
Height	inches[mm]	112 [2840]	99 [2515]	125 [3175]	125 [3175]	129 [3277]	129 [3277]
Shipping Weight	lbs[kg]	32915 [14930]	35569 [16134]	41833 [18975]	43085 [19543]	47673 [21624]	49161 [22299]
Operating Weight	lbs[kg]	36207 [16423]	38956 [17670]	44342 [20113]	45669 [20715]	50532 [22921]	52108 23636
Approx. R134a Charge	lbs[kg]	2701 [1225]	2701 [1225]	2253 [1022]	2392 [1085]	2601 [1180]	2833 [1285]

\*Optional compact footprint series is available. Unit height may be increased. Please consult factory for details.

Notes: 1. The above are rated in accordance with AHRI Standard 550/590-2011 on Superior models with following conditions:  
 Inlet/outlet chilled water temperature 54/44 °F; inlet/outlet cooling water temperature 85/95 °F; evaporator fouling factor 0.0001hr.ft².°F/Btu; condenser fouling factor 0.00025hr.ft².°F/Btu; 2-pass evaporator and condenser  
 2. To consult nearest Dunham-Bush sales office for computer selections other than above operating conditions

# SOUND PRESSURE DATA

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## 50Hz

Model WCFX-E	Octave Band (Hz)								Total dB (A)
	63	125	250	500	1K	2K	4K	8K	
10S	70	55	59	67	75	72	62	53	78
12S	71	56	60	68	76	73	63	54	79
15S	71	59	63	71	79	76	66	57	81
19S	68	57	63	68	75	72	72	54	79
20S	68	57	63	68	75	72	72	54	79
20T	72	57	61	69	77	74	64	55	80
22T	73	58	62	70	78	75	65	56	81
23S	68	57	63	68	75	72	72	54	79
24S	69	59	64	68	76	73	74	56	80
24T	73	58	62	70	78	75	65	56	81
27S	69	59	64	68	76	73	74	56	80
27T	73	59	63	71	79	76	66	57	82
30S	70	61	65	69	78	75	74	59	82
30T	73	61	65	73	81	78	68	59	84
36S	71	62	66	70	79	76	75	60	83
38T	70	59	65	70	77	74	74	56	81
40T	70	59	65	70	77	74	74	56	81
41S	71	62	66	70	79	76	75	60	83
46S	73	64	68	72	81	78	77	62	85
46T	70	59	65	70	77	74	74	56	81
50T	71	60	66	70	78	75	75	57	82
54T	71	61	66	70	78	75	76	58	82
57T	72	62	67	71	79	76	76	60	83
60T	72	63	67	71	80	77	76	61	84
69	71	60	66	71	78	75	75	57	82
73T	74	65	69	73	82	79	78	63	85
73	68	58	63	67	75	72	73	55	79
75T	74	65	69	73	82	79	78	63	85
77	72	62	67	71	79	76	77	59	83
81T	74	65	69	73	82	79	78	63	85
81	72	62	67	71	79	76	77	59	84
84	73	63	68	72	80	77	77	61	84
87T	76	67	71	75	84	81	80	65	87
87	73	64	68	72	81	78	77	62	85
90T	76	67	71	75	84	81	80	65	87
90	73	64	68	72	81	78	77	62	85
108	75	66	70	74	83	80	79	64	86
113	75	66	70	74	83	80	79	64	86
118	75	66	70	74	83	80	79	64	86
123	75	66	70	74	83	80	79	64	86

## 60Hz

10S	70	55	59	67	75	72	62	53	78
12S	71	56	60	68	76	73	63	54	79
15S	71	59	63	71	79	76	66	57	82
19S	68	57	63	68	75	72	72	54	79
20S	68	57	63	68	75	72	72	54	79
20T	72	57	61	69	77	74	64	55	80
22T	73	58	62	70	78	75	65	56	81
23S	68	57	63	68	75	72	72	54	79
24S	69	59	64	68	76	73	74	56	80
24T	73	58	62	70	78	75	65	56	81
27S	69	59	64	68	76	73	74	56	80
27T	73	60	64	72	80	77	67	58	83
30S	70	61	65	69	78	75	74	59	81
30T	73	61	65	73	81	78	68	59	84
36S	72	63	67	71	80	77	76	61	83
38T	70	59	65	70	77	74	74	56	81
40T	70	59	65	70	77	74	74	56	81
41S	72	63	67	71	80	77	76	61	83
46S	73	64	68	72	81	78	77	62	85
46T	70	59	65	70	77	74	74	56	81
50T	71	60	66	70	78	75	75	57	82
54T	71	61	66	70	78	75	76	58	82
57T	71	62	66	70	79	76	76	60	83
60T	72	63	67	71	80	77	76	61	83
69	71	60	66	71	78	75	75	57	82
73T	74	65	69	73	82	79	78	63	85
73	72	61	67	71	79	76	76	58	83
75T	74	65	69	73	82	79	78	63	85
77	72	62	67	71	79	76	77	59	83
81T	74	65	69	73	82	79	78	63	85
81	72	62	67	71	79	76	77	59	84
84	73	63	68	72	80	77	77	61	84
87T	74	65	69	73	82	79	78	63	86
87	73	64	68	72	81	78	77	62	85
90T	75	66	70	74	83	80	79	64	86
90	73	64	68	72	81	78	77	62	85
108	75	66	70	74	83	80	79	64	86
113	75	66	70	74	83	80	79	64	86
118	75	66	70	74	83	80	79	64	86
123	75	66	70	74	83	80	79	64	86

Note: Sound Pressure Level dB(A) @ 3.3ft [1m] (free field) ± 2dBA.

# ELECTRICAL DATA

## 50Hz

Model WCFX-E	Unit			Compressor			
	Power Supply	Max. Fuse Size	Min. Circuit Ampacity	Model (Qty)	RLA (Qty)	Inrush Amps (Qty)	LRA (Qty)
10S	400VAC±10%	200	100	1210(1)	74(1)	269(1)	403(1)
12S		300	100	1212(1)	99(1)	372(1)	559(1)
15S		400	200	1215(1)	123(1)	408(1)	611(1)
19S		300	200	1220(1)	120(1)	388(1)	582(1)
20S		400	200	1222(1)	146(1)	474(1)	711(1)
20T		300	200	1210(2)	74(1)/ 74(1)	269(1)/ 269(1)	403(1)/ 403(1)
22T		400	200	1212(1)/ 1210(1)	99(1)/ 74(1)	372(1)/ 269(1)	559(1)/ 403(1)
23S		400	200	1222(1)	146(1)	474(1)	711(1)
24S		500	200	1227(1)	183(1)	584(1)	876(1)
24T		400	300	1212(2)	99(1)/ 99(1)	372(1)/ 372(1)	559(1)/ 559(1)
27S		500	200	1227(1)	183(1)	584(1)	876(1)
27T		500	300	1215(1)/ 1212(1)	123(1)/ 99(1)	408(1)/ 372(1)	611(1)/ 559(1)
30S		600	300	1230(1)	213(1)	645(1)	968(1)
30T		500	300	1215 (2)	123(1)/ 123(1)	408(1)/ 408(1)	611(1)/ 611(1)
36S		700	300	2233(1)	246(1)	874(1)	1311(1)
38T		500	300	1220(2)	119.7(2)	387.9(2)	581.8(2)
40T		600	400	1222(2)	146.3(2)	474.0(2)	711.7(2)
41S		800	400	2236(1)	294(1)	1153(1)	1730(1)
46S		800	443	2246(1)	354(1)	794(1)	2016(1)
46T		600	400	1222(2)	146(2)	474(2)	711(2)
50T		700	400	1227(1)/ 1222(1)	183(1)/ 146(1)	584(1)/ 474(1)	876(1)/ 711(1)
54T		800	500	1227(2)	183(2)	584(2)	876(2)
57T		900	500	1230(1)/ 1227(1)	213(1)/ 183(1)	645(1)/ 584(1)	968(1)/ 876(1)
60T		900	600	1230(2)	213(2)	645(2)	968(2)
69		800	600	1222(3)	146(3)	474(3)	711(3)
73		900	600	1227(1)/ 1222(2)	183(1)/ 146(2)	584(1)/ 474(2)	876(1)/ 711(2)
73T		1000	600	2233(2)	246(2)	874(2)	1311(2)
75T		1200	700	2236(1)/ 2233(1)	294(1)/ 246(1)	1153(1)/ 874(1)	1730(1)/ 1311(1)
77		1000	700	1227(2)/ 1222(1)	183(2)/ 146(1)	584(2)/ 474(1)	876(2)/ 711(1)
81		1000	700	1227(3)	183(3)	584(3)	876(3)
81T		1200	700	2236(2)	294(2)	1153(2)	1730(2)
84		1100	800	1230(1)/ 1227(2)	213(1)/ 183(2)	645(1)/ 584(2)	967(1)/ 876(2)
87T		1200	900	2246(2)	385(2)	1343(2)	2016(2)
87		1100	800	1230(2)/ 1227(1)	213(2)/ 183(1)	645(2)/ 584(1)	968(2)/ 876(1)
90T		800	649	2246(2)	288(2)	956(2)	2122(2)
90		1200	800	1230(3)	213(3)	645(3)	968(3)
108		1300	900	2233(3)	246(3)	874(3)	1311(3)
113		1400	1000	2236(1)/ 2233(2)	294(1)/ 246(2)	1153(1)/ 874(2)	1730(1)/ 1311(2)
118		1500	1000	2236(2)/ 2233(1)	294(2)/ 246(1)	1153(2)/ 874(1)	1730(2)/ 1311(1)
123		1600	1100	2236(3)	294(3)	1153(3)	1730(3)

Note: RLA – Rated Load Amps

LRA – Locked Rotor Amps

# ELECTRICAL DATA

## 60Hz

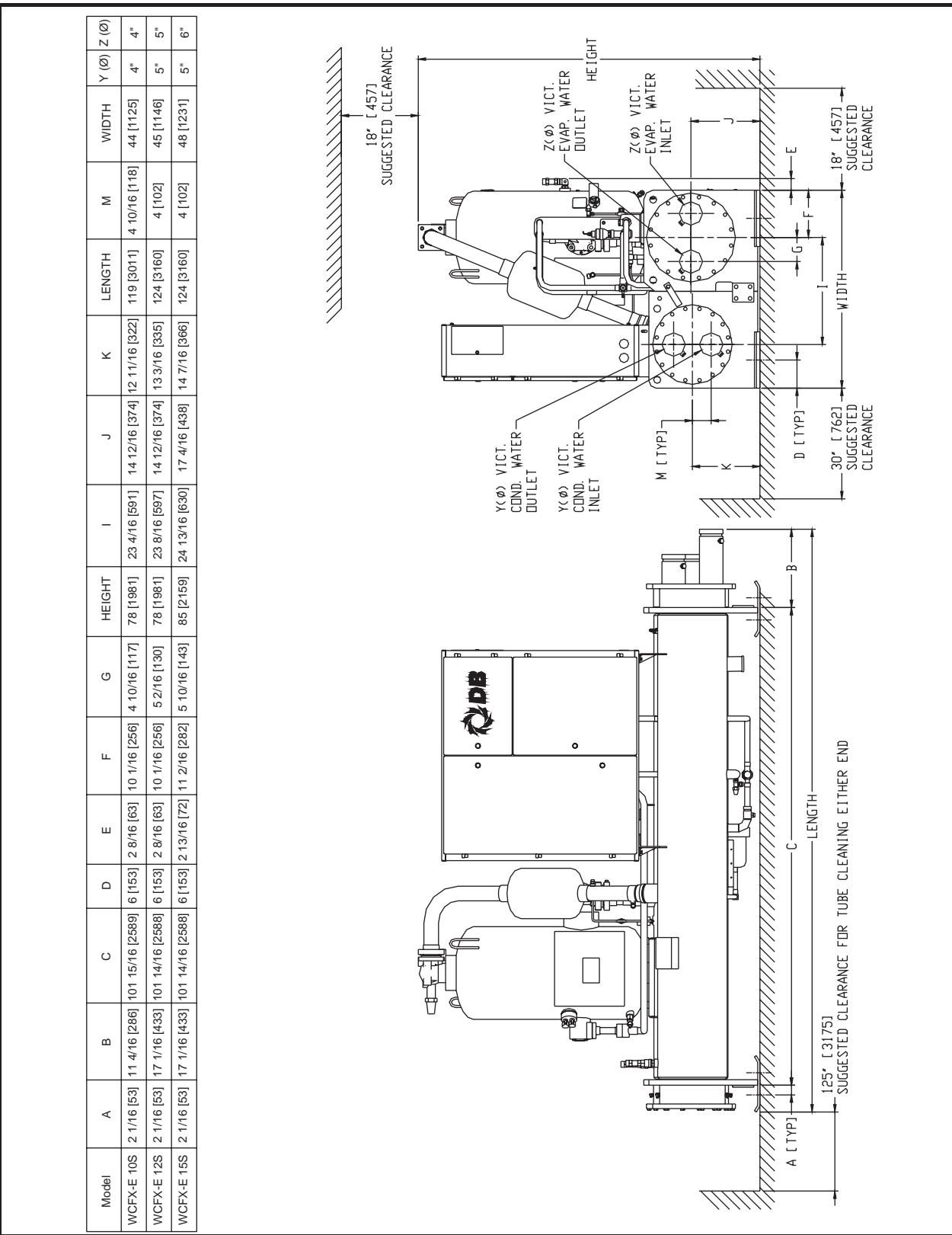
Model WCFX-E	Unit			Compressor			
	Power Supply	Max. Fuse Size	Min. Circuit Ampacity	Model (Qty)	RLA (Qty)	Inrush Amps (Qty)	LRA (Qty)
10S	460VAC±10%	175	99	1210(1)	79(1)	200(1)	435(1)
12S		225	124	1212(1)	99(1)	252(1)	603(1)
15S		250	149	1215(1)	119(1)	325(1)	661(1)
19S		350	184	1220(1)	147(1)	302(1)	733(1)
20S		400	225	1222(1)	180(1)	302(1)	733(1)
20T		250	178	1210(2)	79(2)	200(2)	435(2)
22T		300	203	1210(1)/ 1212(1)	79(1)/ 99(1)	200(1)/ 252(1)	435(1)/ 603(1)
23S		400	225	1222(1)	180(1)	302(1)	733(1)
24S		450	264	1227(1)	211(1)	394(1)	904(1)
24T		300	223	1212(2)	99(2)	252(2)	603(2)
27S		450	264	1227(1)	211(1)	394(1)	904(1)
27T		350	248	1212(1)/ 1215(1)	99(1)/ 119(1)	252(1)/ 325(1)	603(1)/ 661(1)
30S		500	295	1230(1)	236(1)	476(1)	999(1)
30T		400	268	1215(2)	119(2)	325(2)	661(2)
36S		600	343	2233(1)	274(1)	610(1)	1334(1)
38T		500	331	1220(2)	147(2)	302(2)	733(2)
40T		600	405	1222(2)	180(2)	302(2)	733(2)
41S		700	393	2236(1)	314(1)	719(1)	1760(1)
46S		800	466	2246(1)	373(1)	836(1)	2122(1)
46T		600	405	1222(2)	180(2)	302(2)	733(2)
50T		700	444	1222(1)/ 1227(1)	180(1)/ 211	302(1)/ 394(1)	733(1)/ 904(1)
54T		700	475	1227(2)	211(2)	394(2)	904(2)
57T		700	506	1227(1)/ 1230(1)	211(1)/ 236(1)	394(1)/ 476(1)	904(1)/ 999(1)
60T		800	531	1230(2)	236(2)	476( 2)	999(2)
69		800	585	1222(3)	180(3)	302(3)	733(3)
73T		1000	617	2233(2)	274(2)	610(2)	1334(2)
73		800	624	1222(2)/ 1227(1)	180(2)/ 211(1)	302(2)/ 394(1)	733(2)/ 904(1)
75T		1000	667	2233(1)/ 2236(1)	274(1)/ 314(1)	610(1)/ 718(1)	1334(1)/ 1760(1)
77		800	655	1222(1)/ 1227(2)	180/ 211(2)	302(1)/ 394(2)	733/ 904(2)
81T		1000	707	2236(2)	314(2)	718(2)	1760(2)
81		1000	686	1227(3)	211(3)	394(3)	904(3)
84		1000	717	1227(2)/ 1230(1)	211(2)/ 236(1)	394(2)/ 476(1)	904(2)/ 999(1)
87T		800	634	2236(1), 2246(1)	261(1)/ 298(1)	701(1)/ 835(1)	1266(1)/ 2122(1)
87		1000	742	1227(1)/ 1230(2)	211(1)/ 236(2)	394(1)/ 476(2)	904(1)/ 999(2)
90T		1000	767	1230(3)	236(3)	476(3)	999(3)
90		1200	839	2246(2)	373(2)	836(2)	2122(2)
108		1200	891	2233(3)	274(3)	610(3)	1334(3)
113		1200	941	2233(2)/ 2236(1)	274(2)/ 314(1)	610(2)/ 718(1)	1334(2)/ 1760(1)
118		1200	981	2233(1)/ 2236(2)	274(1)/ 314(2)	610(1)/ 718(2)	1334(1)/ 1760(2)
123		1200	1021	2236(3)	314(3)	718(3)	1760(3)

Note: RLA – Rated Load Amps

LRA – Locked Rotor Amps

# DIMENSIONAL DATA

## 50Hz: WCFX-E 10S, 12S, 15S



\*Optional compact footprint series is available. Unit height may be increased. Please consult factory for details.

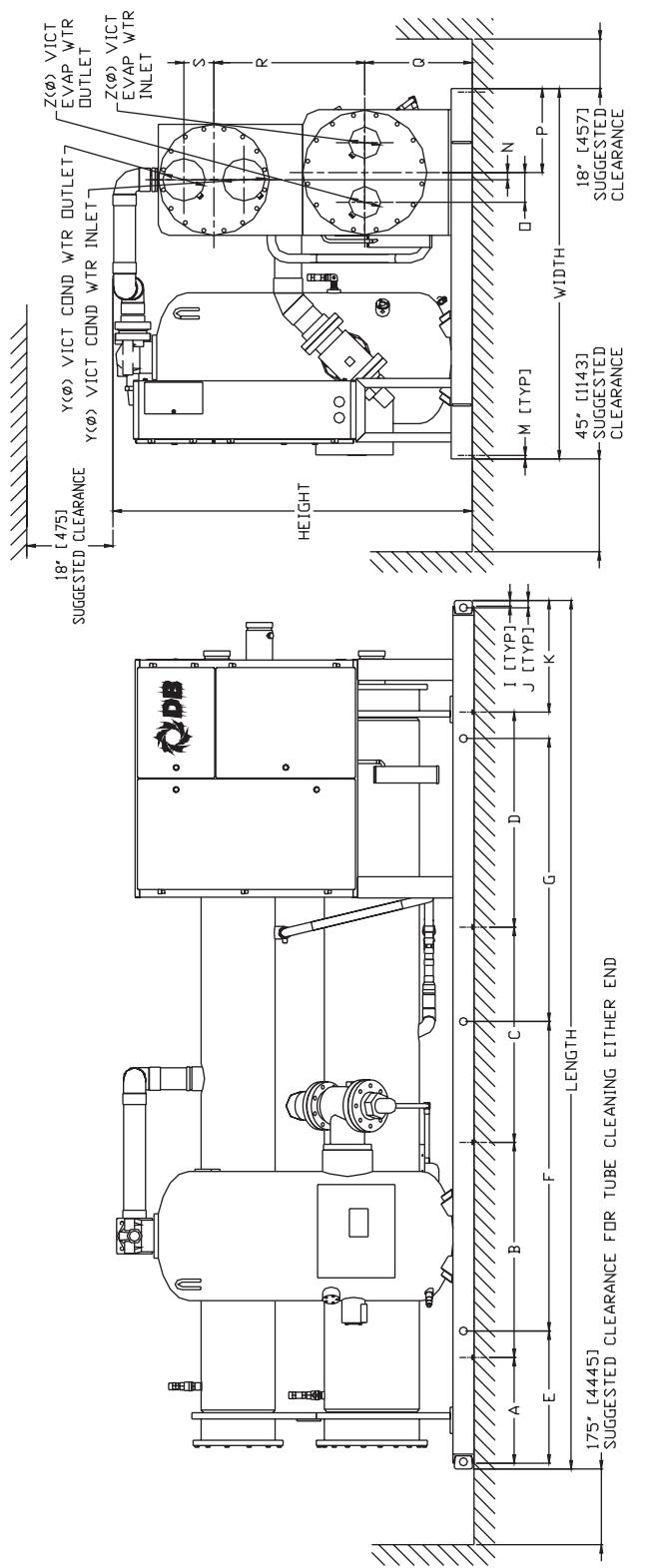
Notes : 1.) All dimensions are in inches[mm].

2.) Above drawing is for Superior model. Consult factory for Standard and Premium model dimension.

# DIMENSIONAL DATA

## 50Hz: WCFX-E 19S\*, 20S\*, 23S\*, 24S\*, 27S\*, 30S\*, 36S, 41S, 46S

Model	A	B	C	D	E	F	G	HEIGHT	I	J	K	LENGTH	M	N	O	P	Q	R	S	WIDTH	Y (Ø)	Z (Ø)
WCFX-E 19S*	15 [381]	33 3/16 [843]	33 3/16 [843]	16 [445]	37 3/16 [945]	51 3/16 [945]	16 [445]	40 11/16 [1033]	1 2/16 [29] 1 6/16 [35]	15 7/16 [392]	1 1/16 [17]	2 [51]	5 10/16 [143]	14 14/16 [378]	22 8/16 [699]	4 8/16 [14]	63 [1600]	6"	6"			
WCFX-E 20S*	20 [508]	40 11/16 [1033]	40 11/16 [1033]	16 [446]	58 8/16 [635]	53 8/16 [1359]	16 [446]	40 11/16 [1033]	1 2/16 [28] 1 6/16 [35]	24 2/16 [536]	1 1/16 [17]	1 1/16 [44]	5 10/16 [143]	14 13/16 [377]	25 4/16 [642]	4 8/16 [102]	63 [1600]	5"	6"			
WCFX-E 23S*	20 [508]	40 11/16 [1033]	40 11/16 [1033]	25 [635]	58 8/16 [1359]	53 8/16 [1359]	16 [446]	40 11/16 [1033]	1 2/16 [28] 1 6/16 [35]	20 14/16 [530]	1 1/16 [17]	1 2/16 [19]	5 10/16 [143]	14 13/16 [377]	26 5/16 [668]	4 8/16 [115]	63 [1600]	6"	6"			
WCFX-E 24S*	20 [508]	40 11/16 [1033]	40 11/16 [1033]	25 [635]	58 8/16 [1359]	53 8/16 [1359]	16 [446]	40 11/16 [1033]	1 2/16 [28] 1 6/16 [35]	21 2/16 [536]	1 1/16 [17]	1 4/16 [32]	5 10/16 [143]	14 13/16 [377]	28 9/16 [546]	5 10/16 [143]	63 [1600]	6"	6"			
WCFX-E 27S*	20 [508]	40 11/16 [1033]	40 11/16 [1033]	25 [635]	58 8/16 [1359]	53 8/16 [1359]	16 [446]	40 11/16 [1033]	1 2/16 [28] 1 6/16 [35]	20 14/16 [530]	1 1/16 [17]	2 8/16 [64]	6 14/16 [175]	14 13/16 [377]	29 12/16 [756]	5 10/16 [143]	63 [1600]	6"	8"			
WCFX-E 30S*	20 [508]	40 11/16 [1033]	40 11/16 [1033]	25 [635]	58 8/16 [1359]	53 8/16 [1359]	16 [446]	40 11/16 [1033]	1 2/16 [28] 1 6/16 [35]	20 14/16 [530]	1 1/16 [17]	2 8/16 [64]	6 14/16 [175]	14 13/16 [377]	29 12/16 [756]	5 10/16 [143]	63 [1600]	6"	8"			
WCFX-E 36S	20 [508]	40 11/16 [1033]	40 11/16 [1033]	30 11/16 [1287]	60 [780]	96 [1524]	16 [445]	40 11/16 [1033]	1 2/16 [28] 1 6/16 [35]	21 2/16 [536]	1 1/16 [17]	2 2/16 [54]	6 14/16 [175]	14 13/16 [4425]	23 5/16 [592]	3 4/16 [154]	6 1/16 [175]	70 [1778]	8"	8"		
WCFX-E 41S	20 [508]	40 11/16 [1033]	40 11/16 [1033]	30 11/16 [1287]	60 [780]	96 [1524]	16 [445]	40 11/16 [1033]	1 2/16 [28] 1 6/16 [35]	21 2/16 [536]	1 1/16 [17]	2 2/16 [54]	6 14/16 [175]	14 13/16 [4425]	23 5/16 [592]	3 4/16 [154]	6 1/16 [175]	70 [1778]	8"	8"		
WCFX-E 46S	20 [508]	40 11/16 [1033]	40 11/16 [1033]	30 11/16 [1287]	60 [780]	97 [1524]	16 [445]	40 11/16 [1033]	1 2/16 [28] 1 6/16 [35]	21 2/16 [536]	1 1/16 [17]	2 [51]	8 2/16 [206]	24 5/16 [508]	35 4/16 [896]	6 14/16 [617]	70 [1778]	8"	8"			



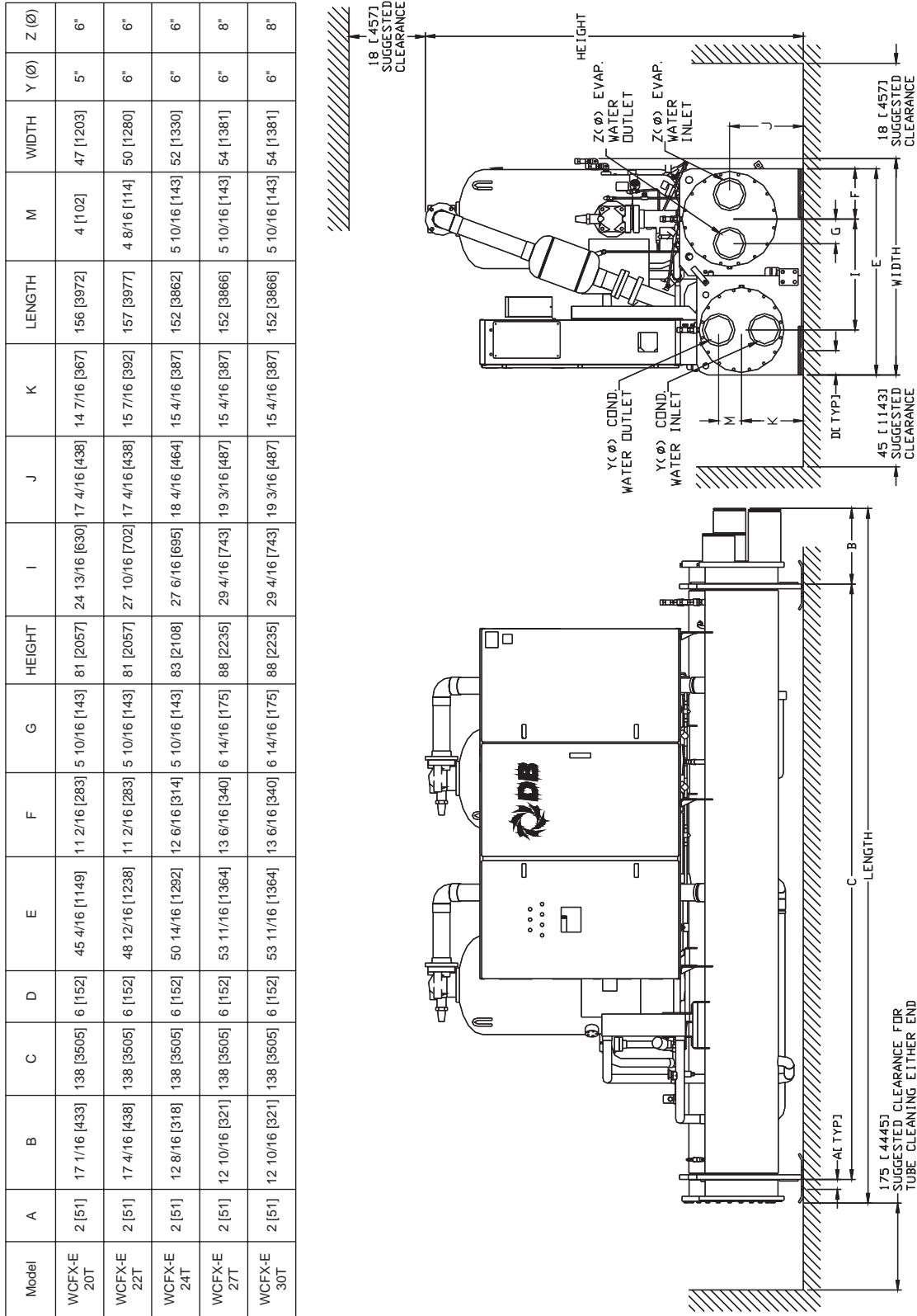
\*Optional compact footprint series is available. Unit height may be increased. Please consult factory for details.

Notes : 1.) All dimensions are in inches[mm].

2.) Above drawing is for Superior model. Consult factory for Standard and Premium model dimension.

# DIMENSIONAL DATA

## 50Hz: WCFX-E 20T, 22T, 24T, 27T, 30T



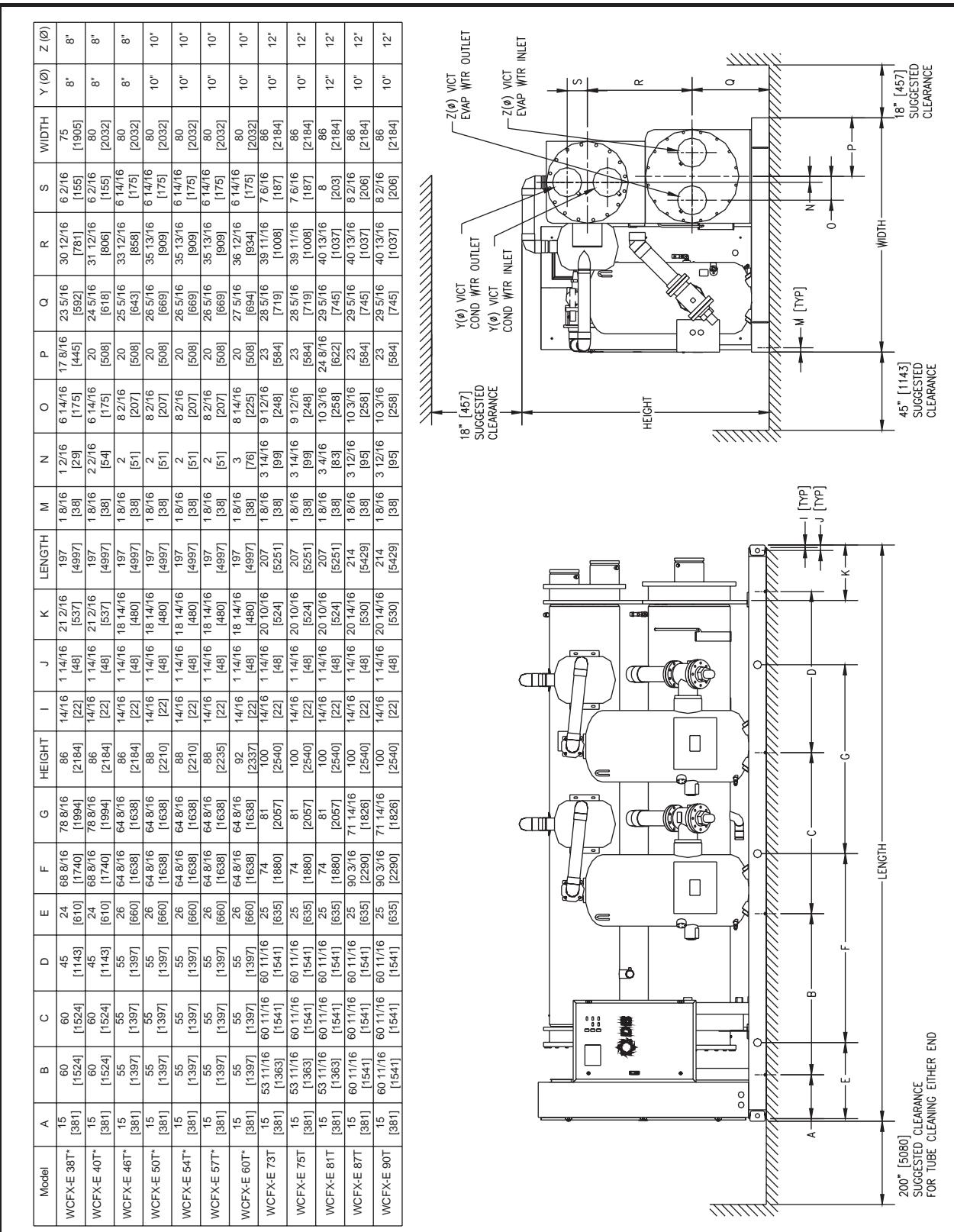
\*Optional compact footprint series is available. Unit height may be increased. Please consult factory for details.

Notes : 1.) All dimensions are in inches[mm].

2.) Above drawing is for Superior model. Consult factory for Standard and Premium model dimension.

# DIMENSIONAL DATA

**50Hz: WCFX-E 38T\*, 40T\*, 46T\*, 50T\*, 54T\*, 57T\*, 60T\*, 73T, 75T, 81T, 87T, 90T**



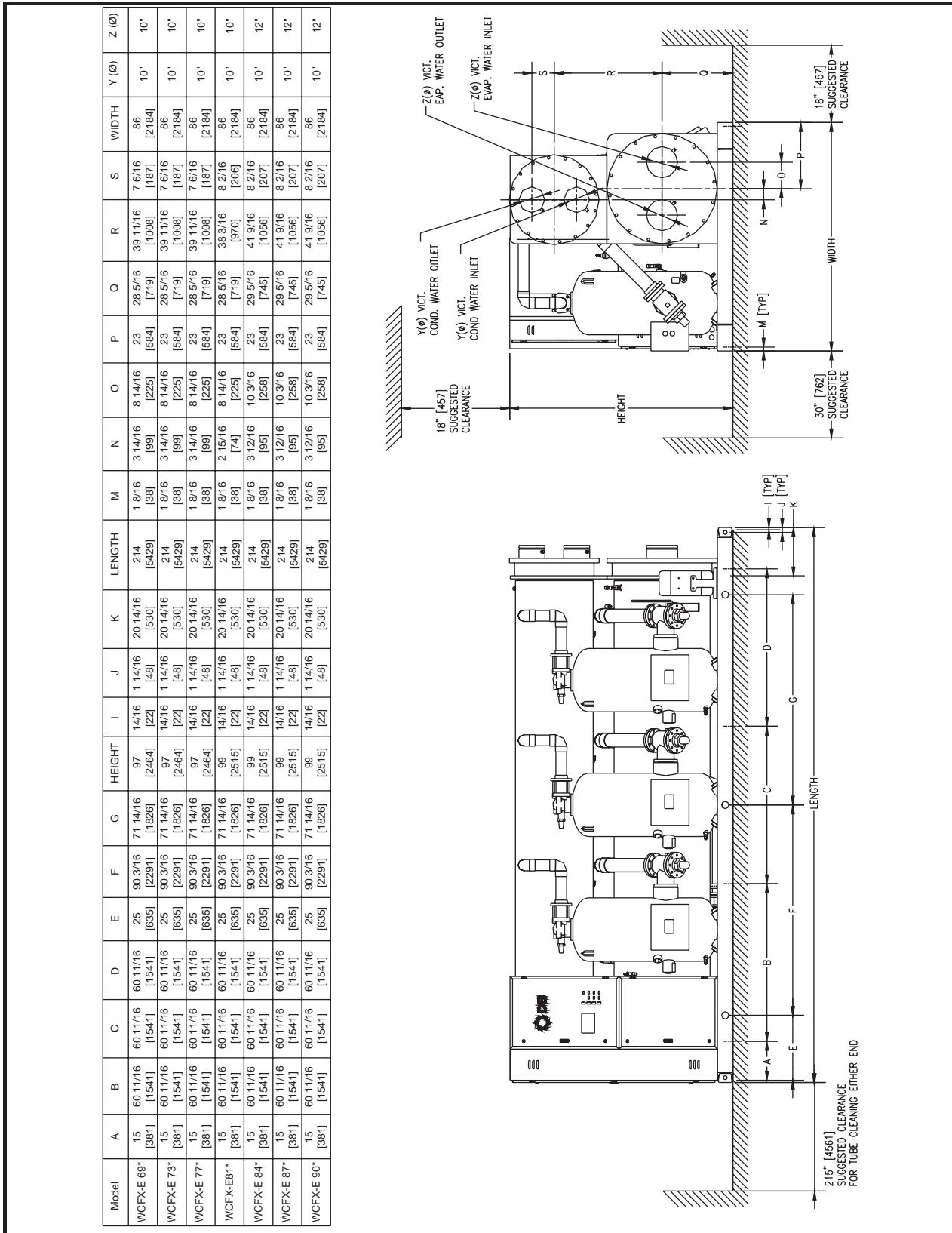
\*Optional compact footprint series is available. Unit height may be increased. Please consult factory for details.

Notes : 1.) All dimensions are in inches[mm].

2.) Above drawing is for Superior model. Consult factory for Standard and Premium model dimension.

# DIMENSIONAL DATA

**50Hz: WCFX-E 69\*, 73\*, 77\*, 81\*, 84\*, 87\*, 90\***



\*Optional compact footprint series is available. Unit height may be increased. Please consult factory for details.

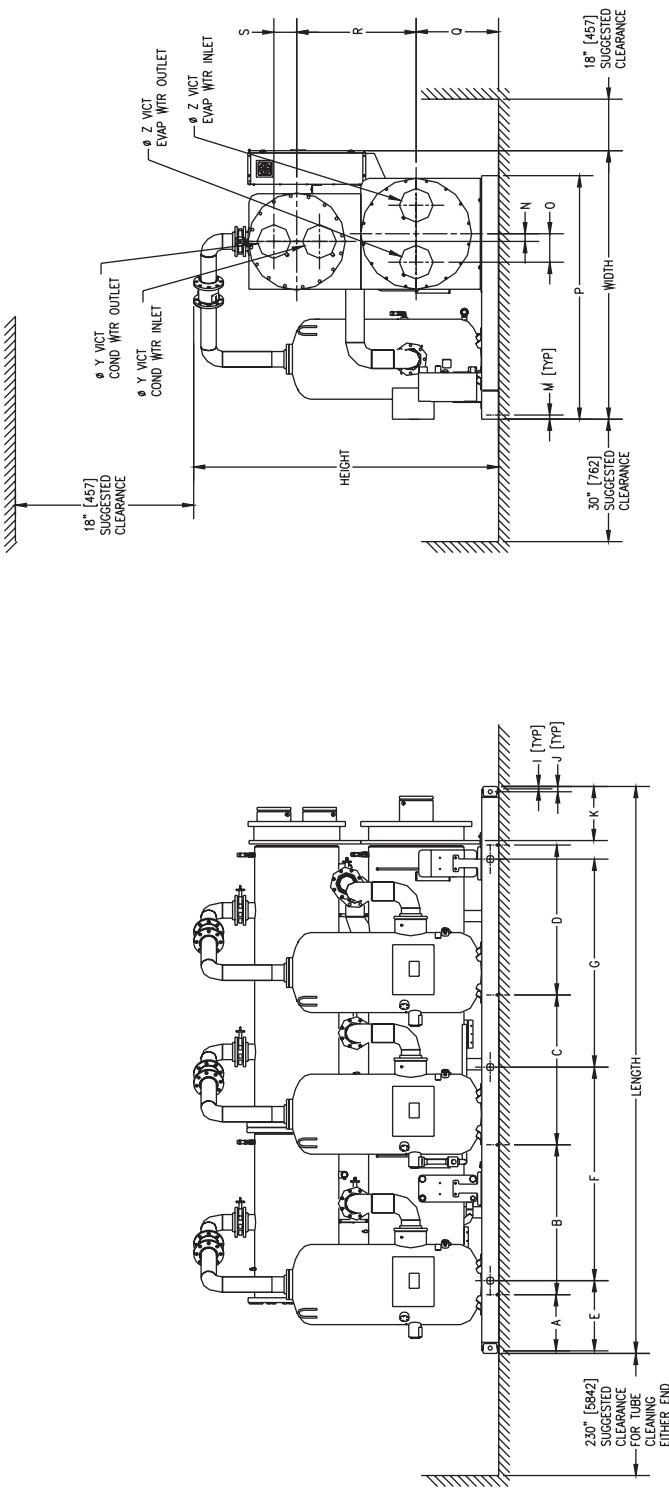
Notes : 1.) All dimensions are in inches/mm].

2.) Above drawing is for Superior model. Consult factory for Standard and Premium model dimension.

# DIMENSIONAL DATA

**50Hz: WCFX-E 108, 113, 118, 123**

Model	A	B	C	E	F	G	HEIGHT	I	J	K	LENGTH	M	N	O	Q	R	S	WIDTH	Y (Ø)	Z (Ø)
WCFX-E 108	29	71	71	25	76	74	117	14/16	114/16	202	18/16	36/16	103/16	325/16	4412/16	912/16	97	12"	12"	
	[737]	[1803]	[1803]	[635]	[1930]	[1880]	[2972]	[48]	[48]	[5124]	[38]	[85]	[259]	[821]	[1137]	[2464]	[248]	[2464]	[248]	
WCFX-E 113	29	71	71	25	76	74	117	14/16	114/16	202	18/16	36/16	103/16	325/16	4412/16	912/16	97	12"	12"	
	[737]	[1803]	[1803]	[635]	[1930]	[1880]	[2972]	[48]	[48]	[5124]	[38]	[85]	[259]	[821]	[1137]	[2464]	[248]	[2464]	[248]	
WCFX-E 118	29	71	71	25	76	74	125	14/16	114/16	202	18/16	311/16	1012/16	345/16	4814/16	1010/16	100	14"	14"	
	[737]	[1803]	[1803]	[635]	[1930]	[1880]	[3175]	[48]	[48]	[5124]	[38]	[94]	[273]	[872]	[1241]	[2540]	[270]	[270]	[270]	
WCFX-E 123	29	71	71	25	76	74	125	14/16	114/16	202	18/16	311/16	1012/16	345/16	4814/16	1010/16	100	14"	14"	
	[737]	[1803]	[1803]	[635]	[1930]	[1880]	[3175]	[48]	[48]	[5124]	[38]	[94]	[273]	[872]	[1241]	[2540]	[270]	[270]	[270]	



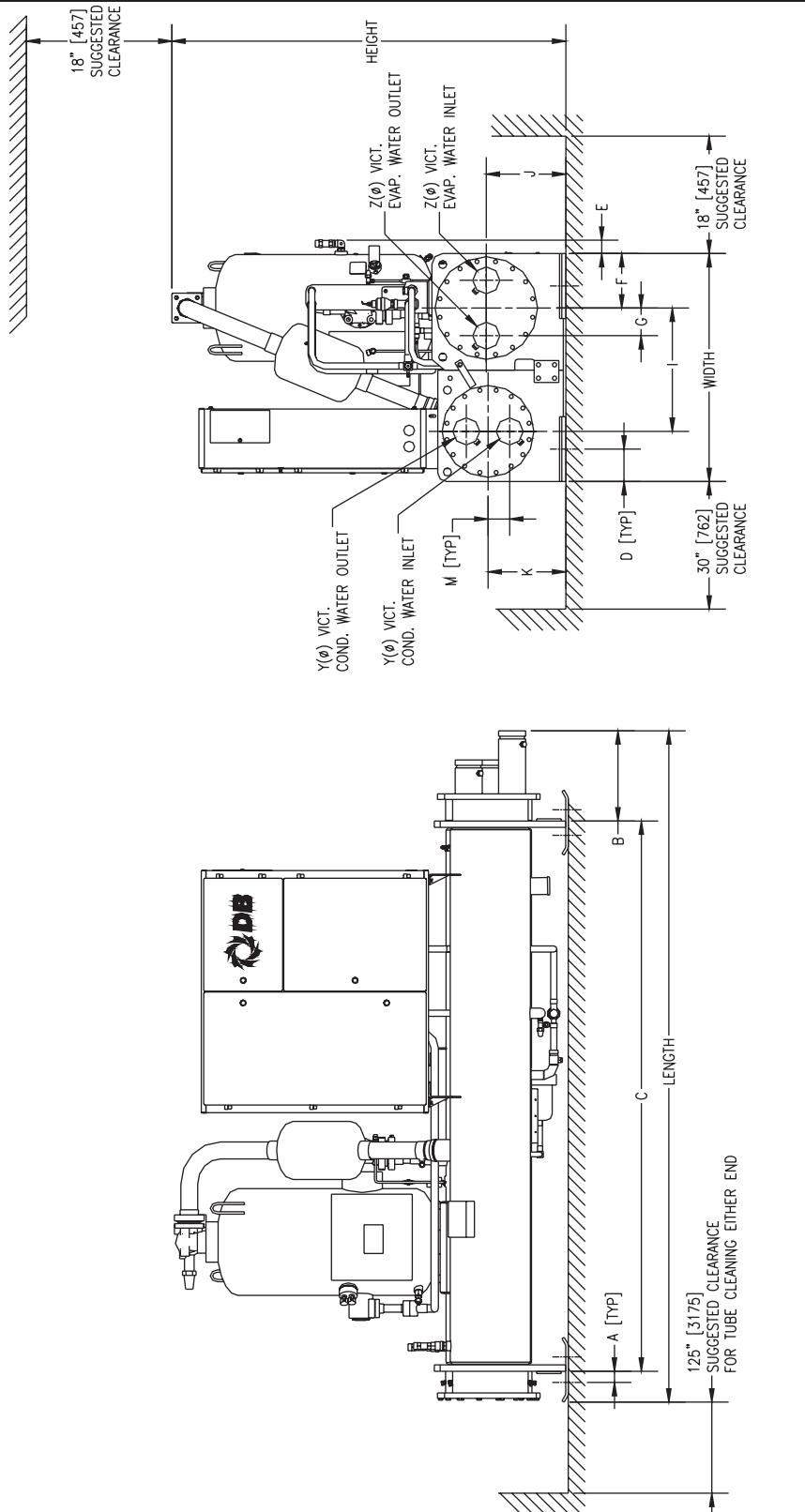
Notes : 1.) All dimensions are in inches[mm].

2.) Above drawing is for Superior model. Consult factory for Standard and Premium model dimension.

# DIMENSIONAL DATA

## 60Hz: WCFX-E 10S, 12S, 15S

Model	A	B	C	D	E	F	G	HEIGHT	I	J	K	LENGTH	M	WIDTH	Y (Ø)	Z (Ø)
WCFX-E 10S [53]	2 1/16 [53]	17 1/16 [433]	101 14/16 [2588]	6 [153]	2 8/16 [63]	10 1/16 [256]	5 2/16 [130]	78 [1981]	23 8/16 [597]	14 12/16 [374]	13 3/16 [335]	124 [3160]	4 [102]	45 [1146]	5' [102]	5" [1146]
WCFX-E 12S [53]	2 1/16 [53]	17 1/16 [433]	101 14/16 [2588]	6 [153]	1 7/16 [37]	11 2/16 [282]	5 10/16 [143]	81 [2057]	24 13/16 [630]	17 4/16 [438]	14 7/16 [366]	124 [3160]	4 [102]	47 [1195]	5' [102]	6" [1195]
WCFX-E 15S [53]	2 1/16 [53]	17 4/16 [438]	101 14/16 [2588]	6 [153]	1 9/16 [39]	12 6/16 [143]	5 10/16 [143]	87 [2210]	28 2/16 [715]	18 3/16 [462]	15 7/16 [392]	125 [3171]	4 8/16 [115]	52 [1326]	6' [1326]	6" [1326]



\*Optional compact footprint series is available. Unit height may be increased. Please consult factory for details.

Notes : 1.) All dimensions are in inches[mm].  
2.) Above drawing is for Superior model. Consult factory for Standard and Premium model dimension.

# DIMENSIONAL DATA

## 60Hz: WCFX-E 19S\*, 20S\*, 23S\*, 24S\*, 27S\*, 30S\*, 36S, 41S, 46S

Model	A	B	C	D	E	F	G	H HEIGHT	I	J	K	LENGTH	M	N	O	P	Q	R	S	WIDTH	Y (Ø)	Z (Ø)			
WCFX-E 19S* [381]	15	33 3/16	33 3/16	33 3/16	17 8/16	37 13/16	51 3/16	76	1 2/16	1 6/16	20 14/16	132	1 1/16	2 8/16	6 14/16	15 14/16	21 5/16	5 10/16	70	6"	8"				
WCFX-E 20S* [508]	20	40 11/16	40 11/16	40 11/16	25	58 8/16	53 8/16	76	1 2/16	1 6/16	20 14/16	[35] [530] [1930]	[29] [35] [1300]	[17] [64] [1403]	[175] [64] [1403]	[17] [64] [1403]	[175] [64] [1403]	[17] [64] [1403]	[175] [64] [1403]	[17] [64] [1403]	[175] [64] [1403]	[17] [64] [1403]	[175] [64] [1403]	[17] [64] [1403]	[175] [64] [1403]
WCFX-E 23S* [508]	20	40 11/16	40 11/16	40 11/16	25	58 8/16	53 8/16	76	1 2/16	1 6/16	20 14/16	[35] [530] [1930]	[28] [35] [1359]	[17] [64] [1403]	[175] [64] [1403]	[17] [64] [1403]	[175] [64] [1403]	[17] [64] [1403]	[175] [64] [1403]	[17] [64] [1403]	[175] [64] [1403]	[17] [64] [1403]	[175] [64] [1403]	[17] [64] [1403]	[175] [64] [1403]
WCFX-E 24S* [508]	20	40 11/16	40 11/16	40 11/16	25	58 8/16	53 8/16	76	1 2/16	1 6/16	20 14/16	[35] [530] [1930]	[28] [35] [1359]	[17] [64] [1403]	[175] [64] [1403]	[17] [64] [1403]	[175] [64] [1403]	[17] [64] [1403]	[175] [64] [1403]	[17] [64] [1403]	[175] [64] [1403]	[17] [64] [1403]	[175] [64] [1403]	[17] [64] [1403]	[175] [64] [1403]
WCFX-E 27S* [508]	20	40 11/16	40 11/16	40 11/16	25	58 8/16	53 8/16	78	1 2/16	1 6/16	20 14/16	[35] [530] [1930]	[28] [35] [1359]	[17] [64] [1403]	[175] [64] [1403]	[17] [64] [1403]	[175] [64] [1403]	[17] [64] [1403]	[175] [64] [1403]	[17] [64] [1403]	[175] [64] [1403]	[17] [64] [1403]	[175] [64] [1403]	[17] [64] [1403]	[175] [64] [1403]
WCFX-E 30S* [508]	20	40 11/16	40 11/16	40 11/16	25	58 8/16	53 8/16	80	1 2/16	1 6/16	21 2/16	[35] [536] [1930]	[28] [35] [1359]	[17] [64] [1403]	[175] [64] [1403]	[17] [64] [1403]	[175] [64] [1403]	[17] [64] [1403]	[175] [64] [1403]	[17] [64] [1403]	[175] [64] [1403]	[17] [64] [1403]	[175] [64] [1403]	[17] [64] [1403]	[175] [64] [1403]
WCFX-E 36S [508]	20	40 11/16	40 11/16	40 11/16	60	60	96	1 2/16	1 6/16	21 2/16	[35] [536] [1930]	[28] [35] [1524]	[17] [64] [1403]	[175] [64] [1403]	[17] [64] [1403]	[175] [64] [1403]	[17] [64] [1403]	[175] [64] [1403]	[17] [64] [1403]	[175] [64] [1403]	[17] [64] [1403]	[175] [64] [1403]	[17] [64] [1403]	[175] [64] [1403]	
WCFX-E 41S [508]	20	40 11/16	40 11/16	50 11/16	60	60	97	1 2/16	1 6/16	21 2/16	[35] [536] [1930]	[28] [35] [1524]	[17] [64] [1403]	[175] [64] [1403]	[17] [64] [1403]	[175] [64] [1403]	[17] [64] [1403]	[175] [64] [1403]	[17] [64] [1403]	[175] [64] [1403]	[17] [64] [1403]	[175] [64] [1403]	[17] [64] [1403]	[175] [64] [1403]	
WCFX-E 46S [508]	20	40 11/16	40 11/16	50 11/16	60	60	100	1 2/16	1 6/16	21 2/16	[35] [536] [1930]	[28] [35] [1524]	[17] [64] [1403]	[175] [64] [1403]	[17] [64] [1403]	[175] [64] [1403]	[17] [64] [1403]	[175] [64] [1403]	[17] [64] [1403]	[175] [64] [1403]	[17] [64] [1403]	[175] [64] [1403]	[17] [64] [1403]	[175] [64] [1403]	

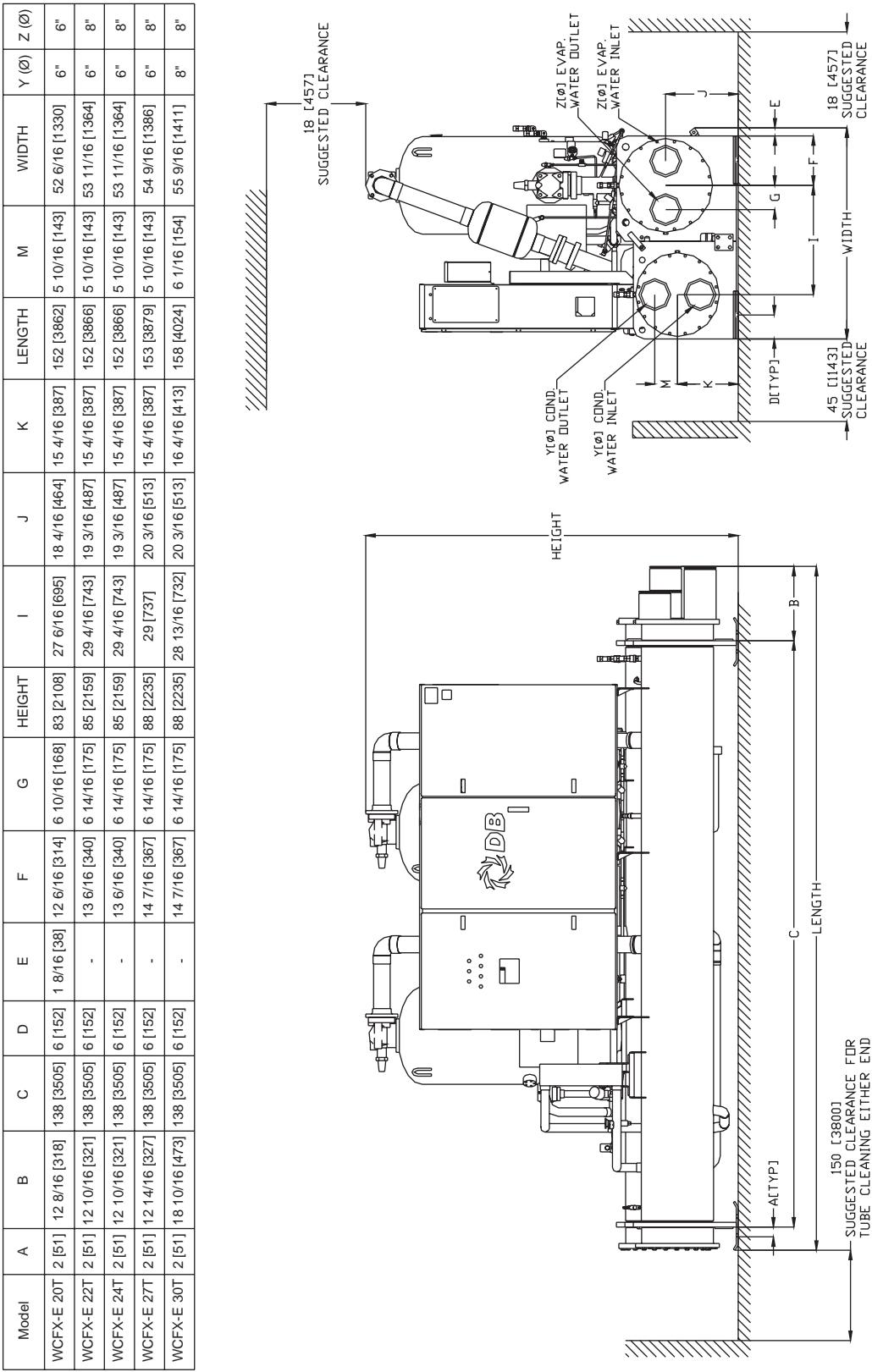
\*Optional compact footprint series is available. Unit height may be increased. Please consult factory for details.

Notes : 1.) All dimensions are in inches[mm].

2.) Above drawing is for Superior model. Consult factory for Standard and Premium model dimension.

# DIMENSIONAL DATA

**60Hz: WCFX-E 20T, 22T, 24T, 27T, 30T**

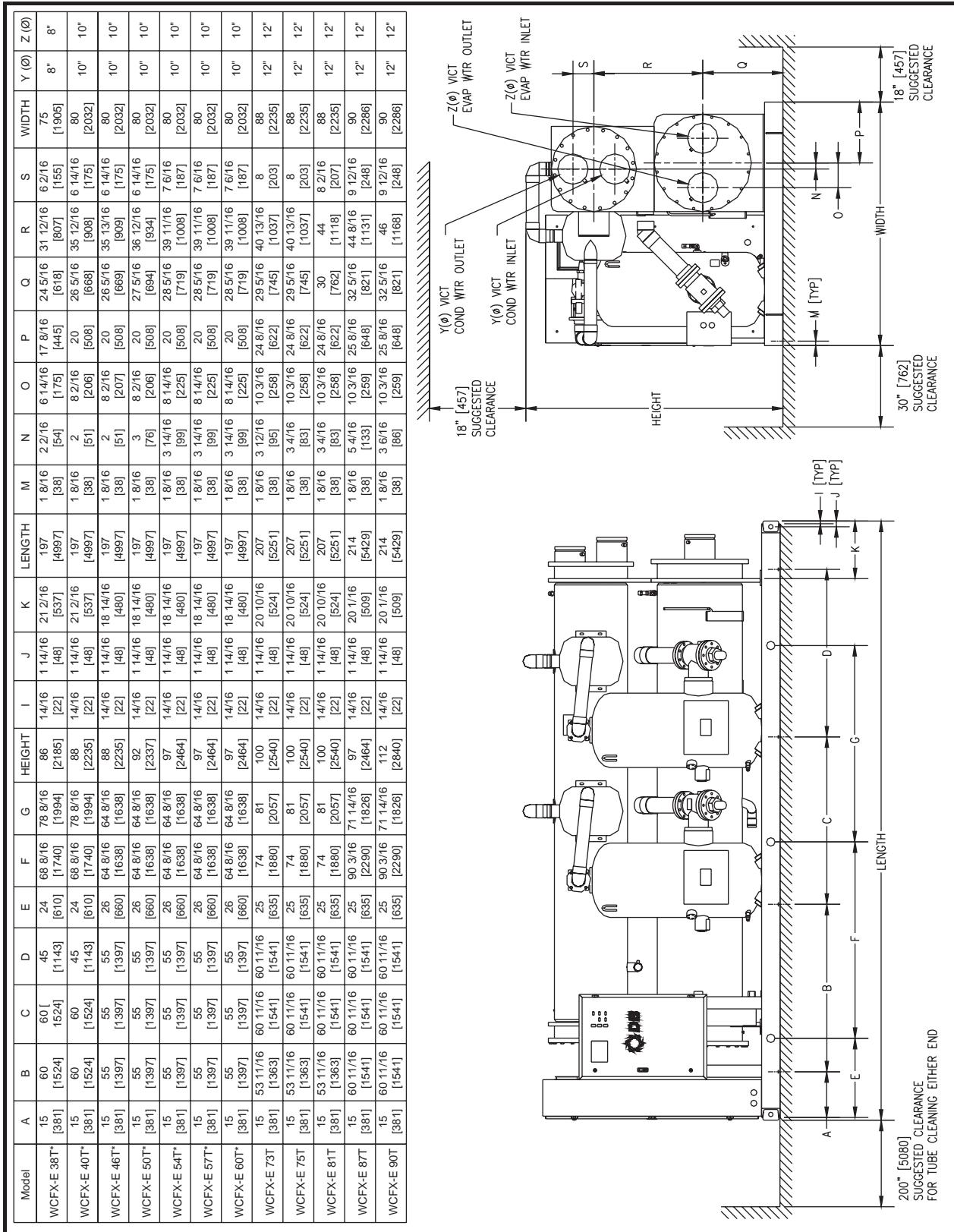


Notes : 1.) All dimensions are in inches[mm].

2.) Above drawing is for Superior model. Consult factory for Standard and Premium model dimension.

# DIMENSIONAL DATA

**60Hz: WCFX-E 38T\*, 40T\*, 46T\*, 50T\*, 54T\*, 57T\*, 60T\*, 73T, 75T, 81T, 87T, 90T**



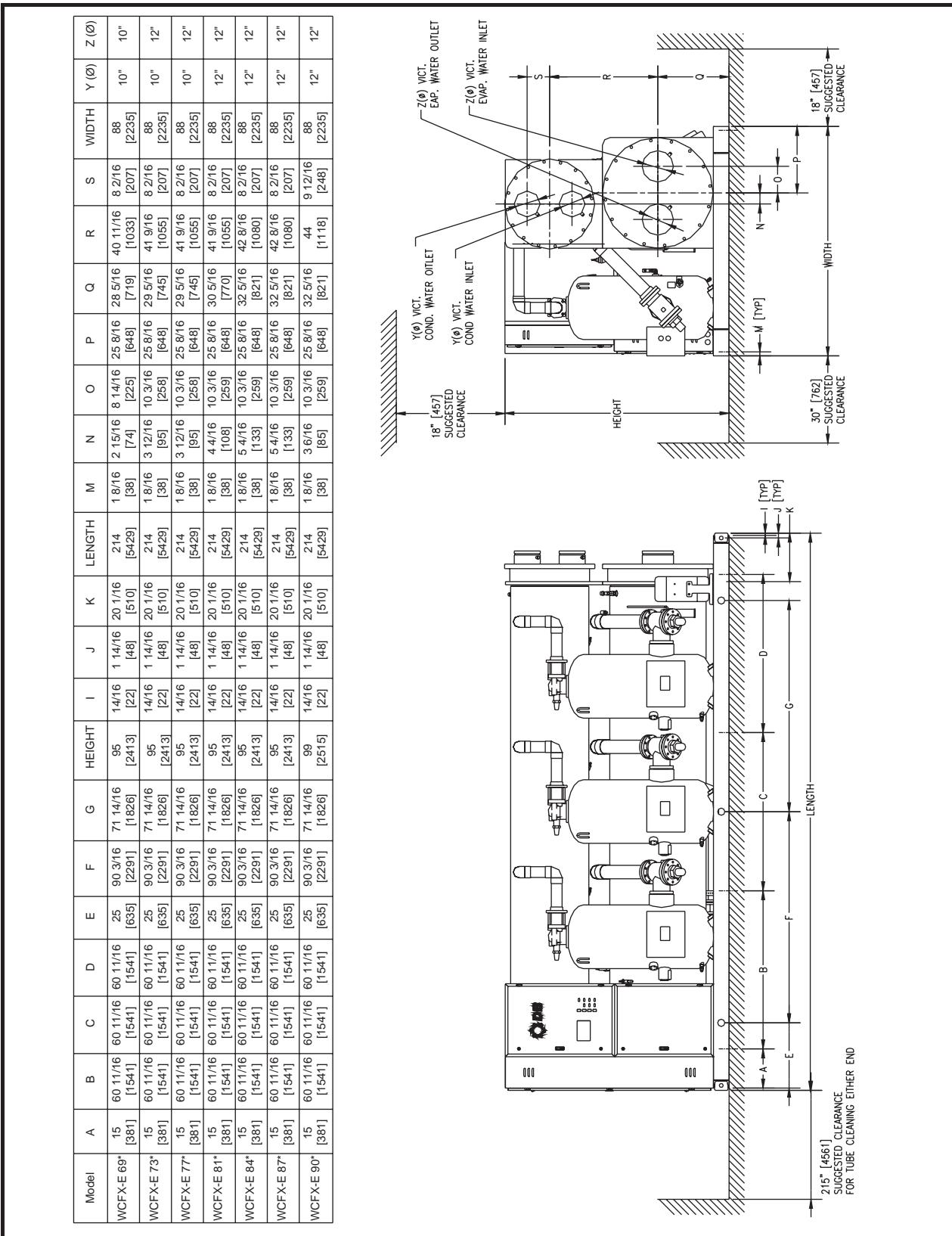
\*Optional compact footprint series is available. Unit height may be increased. Please consult factory for details.

Notes : 1.) All dimensions are in inches[mm].

2.) Above drawing is for Superior model. Consult factory for Standard and Premium model dimension.

# DIMENSIONAL DATA

**60Hz: WCFX-E 69\*, 73\*, 77\*, 81\*, 84\*, 87\*, 90\***



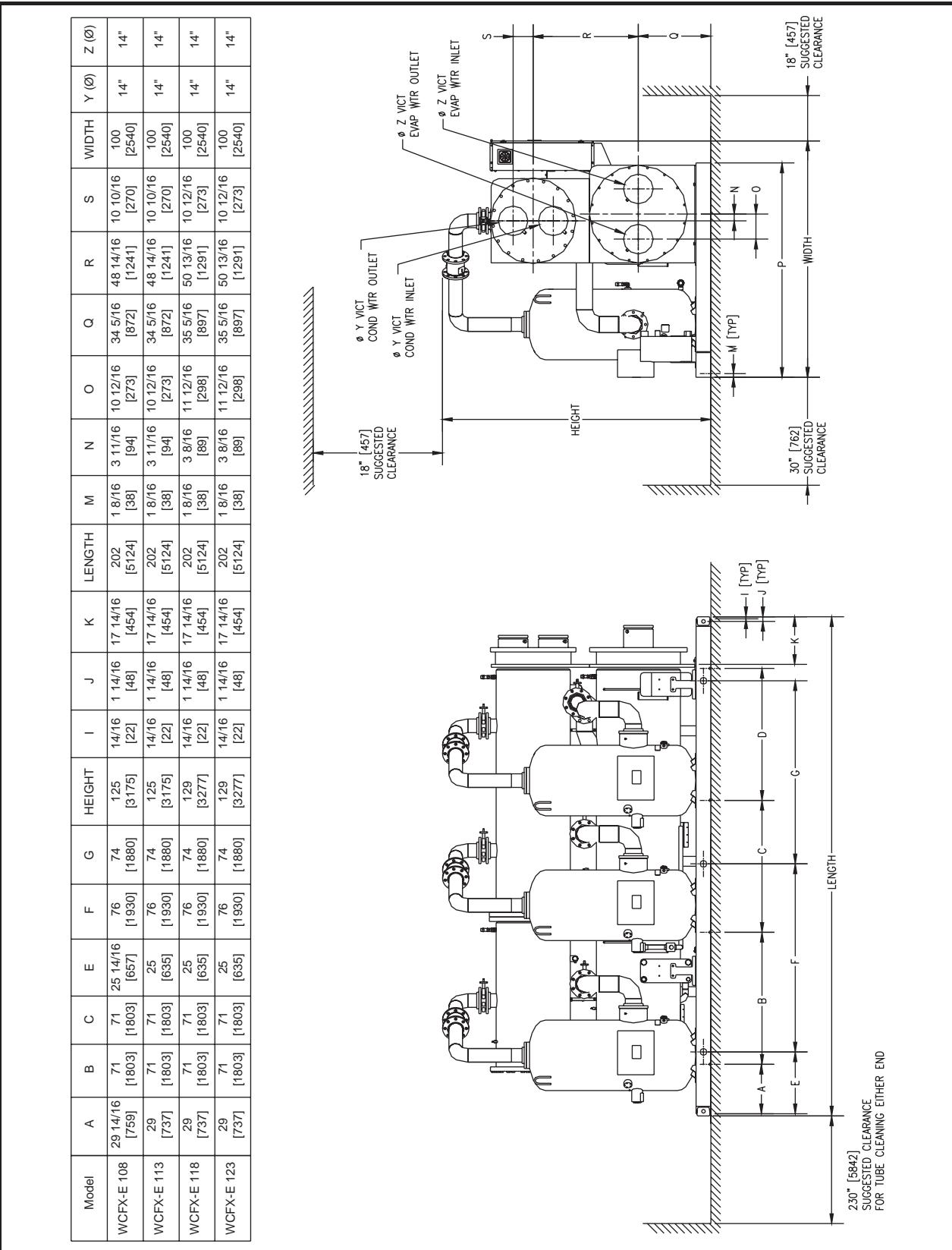
\*Optional compact footprint series is available. Unit height may be increased. Please consult factory for details.

Notes : 1.) All dimensions are in inches/mm.

2.) Above drawing is for Superior model. Consult factory for Standard and Premium model dimension.

# DIMENSIONAL DATA

## 60Hz: WCFX-E 108, 113, 118, 123

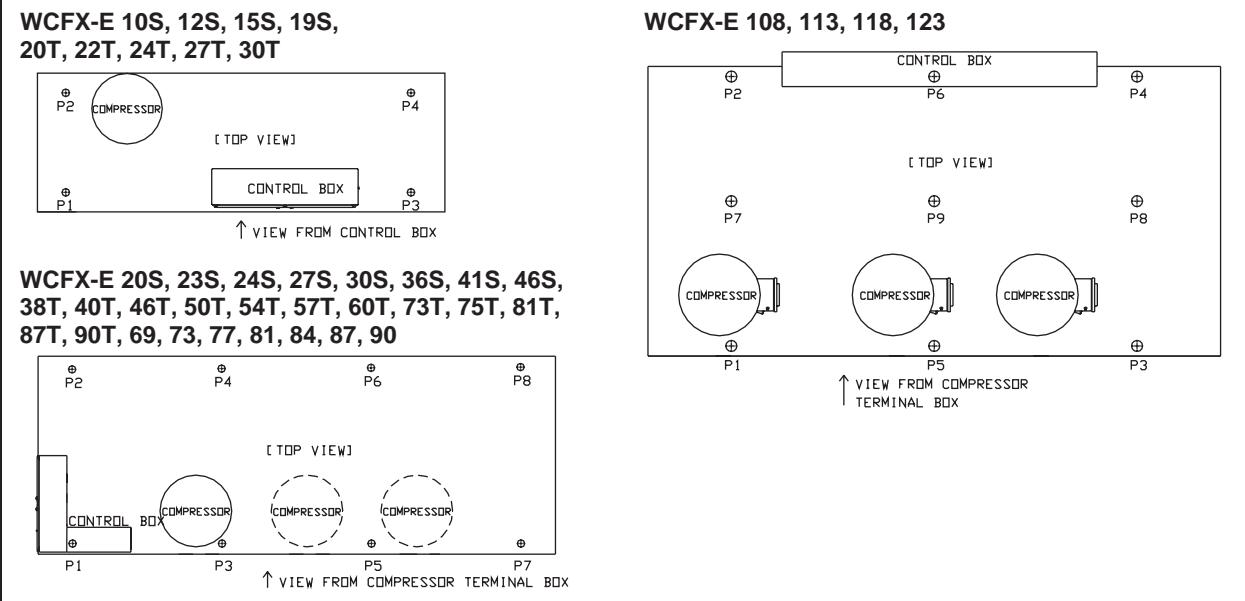


Notes : 1.) All dimensions are in inches[mm].

2.) Above drawing is for Superior model. Consult factory for Standard and Premium model dimension.

# FLOOR LOADING DIAGRAM

50Hz



## POINT LOAD DATA -LBS[KG]

Model WCFX-E	P1	P2	P3	P4	P5	P6	P7	P8	P9	Operating Weight
10S	3262 [1480]	1369 [621]	1043 [473]	1166 [529]	-	-	-	-	-	6841 [3103]
12S	3335 [1513]	1529 [694]	1116 [506]	1289 [585]	-	-	-	-	-	7269 [3293]
15S	3534 [1603]	1787 [810]	1264 [573]	1431 [650]	-	-	-	-	-	8016 [3636]
19S	1043 [473]	1426 [647]	952 [432]	1310 [594]	862 [391]	1195 [542]	774 [351]	1080 [490]	-	8642 [3920]
20S	1147 [520]	1456 [660]	1041 [472]	1331 [604]	934 [424]	1206 [547]	828 [375]	1082 [491]	-	9026 [4094]
20T	1777 [806]	2877 [1305]	1728 [784]	2502 [1135]	-	-	-	-	-	8885 [4030]
22T	1830 [830]	2963 [1344]	1782 [808]	2576 [1169]	-	-	-	-	-	9151 [4151]
23S	1184 [537]	1547 [702]	1077 [488]	1414 [642]	969 [440]	1282 [582]	862 [391]	1149 [520]	-	9484 [4302]
24S	1350 [612]	1939 [879]	1217 [552]	1766 [801]	1083 [491]	1593 [722]	950 [431]	1419 [644]	-	11316 [5133]
24T	1832 [831]	2965 [1345]	1781 [808]	2582 [1171]	-	-	-	-	-	9160 [4155]
27S	1399 [635]	2055 [932]	1265 [574]	1873 [850]	1131 [513]	1691 [767]	996 [452]	1508 [684]	-	11918 [5406]
27T	1942 [881]	3144 [1426]	1889 [857]	2736 [1241]	-	-	-	-	-	9711 [4405]
30S	1521 [690]	2163 [981]	1371 [622]	1970 [894]	1220 [553]	1778 [807]	1069 [485]	1598 [724]	-	12690 [5756]
30T	1986 [901]	3217 [1459]	1931 [876]	2798 [1269]	-	-	-	-	-	9932 [4505]
36S	1546 [701]	2316 [1051]	1454 [660]	2167 [983]	1363 [618]	2018 [915]	1272 [577]	1868 [848]	-	14004 [6352]
38T	1858 [843]	2264 [1027]	1722 [781]	2114 [959]	1585 [719]	1967 [892]	1451 [658]	1821 [826]	-	14782 [6705]
40T	1978 [897]	2407 [1092]	1832 [831]	2249 [1020]	1687 [765]	2092 [949]	1541 [699]	1936 [878]	-	15721 [7131]
41S	1624 [736]	2449 [1111]	1527 [693]	2292 [1040]	1430 [649]	2135 [968]	1334 [605]	1978 [897]	-	14769 [6699]
46S	1893 [859]	2628 [1192]	1825 [828]	2576 [1168]	1757 [797]	2524 [1145]	1690 [767]	2472 [1121]	-	17364 [7876]
46T	2232 [1012]	2839 [1288]	2133 [967]	2671 [1211]	2034 [922]	2502 [1135]	1934 [877]	2334 [1059]	-	18678 [8472]
50T	2332 [1058]	2945 [1336]	2224 [1009]	2770 [1256]	2117 [960]	2595 [1177]	2010 [912]	2421 [1098]	-	19414 [8806]
54T	2415 [1096]	3043 [1380]	2315 [1050]	2866 [1300]	2215 [1005]	2688 [1219]	2114 [959]	2511 [1139]	-	20168 [9148]
57T	2526 [1146]	3130 [1420]	2431 [1103]	2958 [1342]	2335 [1059]	2786 [1264]	2240 [1016]	2633 [1194]	-	21039 [9543]
60T	2691 [1221]	3453 [1566]	2600 [1180]	3262 [1480]	2509 [138]	3071 [1393]	2418 [1097]	2900 [1315]	-	22886 [10390]
69	3388 [1537]	3964 [1798]	3139 [1424]	3726 [1690]	2891 [1311]	3488 [1582]	2642 [1198]	3251 [1474]	-	26489 [12015]
73T	3399 [1542]	4055 [1840]	2940 [1334]	3721 [1688]	2481 [1126]	3386 [1536]	2023 [917]	3052 [1384]	-	25056 [11365]
73	3509 [1592]	4057 [1840]	3237 [1469]	3810 [1728]	2966 [1345]	3564 [1617]	2695 [1222]	3319 [1505]	-	27157 [12318]
75T	3484 [1580]	4173 [1893]	3019 [1369]	3831 [1738]	2554 [1158]	3488 [1582]	2089 [947]	3145 [1427]	-	25783 [11696]
77	3599 [1632]	4148 [1882]	3226 [1509]	3898 [1768]	3053 [1385]	3647 [1654]	2779 [1261]	3397 [1541]	-	27847 [12631]
81T	3808 [1727]	4890 [2218]	3322 [1507]	4500 [2041]	2837 [1287]	4109 [1864]	2351 [1066]	3720 [1687]	-	29538 [13398]
81	3759 [1705]	4430 [2009]	3489 [1583]	4165 [1889]	3218 [1460]	3900 [1769]	2948 [1337]	3635 [1649]	-	29544 [13401]
84	4097 [1859]	4983 [2260]	3807 [1727]	4691 [2128]	3516 [1595]	4399 [1995]	3226 [1463]	4136 [1876]	-	32826 [14903]
87T	2812 [1276]	2088 [947]	3118 [1414]	3468 [1573]	3425 [1554]	4849 [2200]	3731 [1692]	6228 [2824]	-	29718 [13480]
87	4214 [1911]	5116 [2321]	3921 [1778]	4817 [2185]	3628 [1645]	4519 [2050]	3334 [1512]	4250 [1928]	-	33769 [15331]
90T	2377 [1078]	1726 [783]	2861 [1298]	3632 [1647]	3345 [1517]	5538 [2512]	3829 [1737]	7444 [3377]	-	30750 [13948]
90	4250 [1928]	5130 [2327]	3972 [1802]	4834 [2193]	3694 [1676]	4539 [2059]	3416 [1550]	4274 [1938]	-	34110 [15459]
108	4182 [1897]	4476 [2030]	4337 [1967]	4769 [2163]	4260 [1932]	4623 [2097]	4313 [1957]	4536 [2057]	4424 [2006]	39921 [18108]
113	4261 [1933]	4577 [2076]	4446 [2017]	4892 [2219]	4354 [1975]	4735 [2148]	4402 [1997]	4651 [2110]	4528 [2053]	40845 [18527]
118	4549 [2063]	4958 [2249]	4764 [2161]	5314 [2410]	4657 [2112]	5136 [2330]	4735 [2148]	5020 [2277]	4879 [2213]	44011 [19963]
123	4718 [2140]	5148 [2335]	4912 [2228]	5502 [2496]	4816 [2184]	5326 [2416]	4914 [2229]	5189 [2354]	5051 [2291]	45576 [20673]

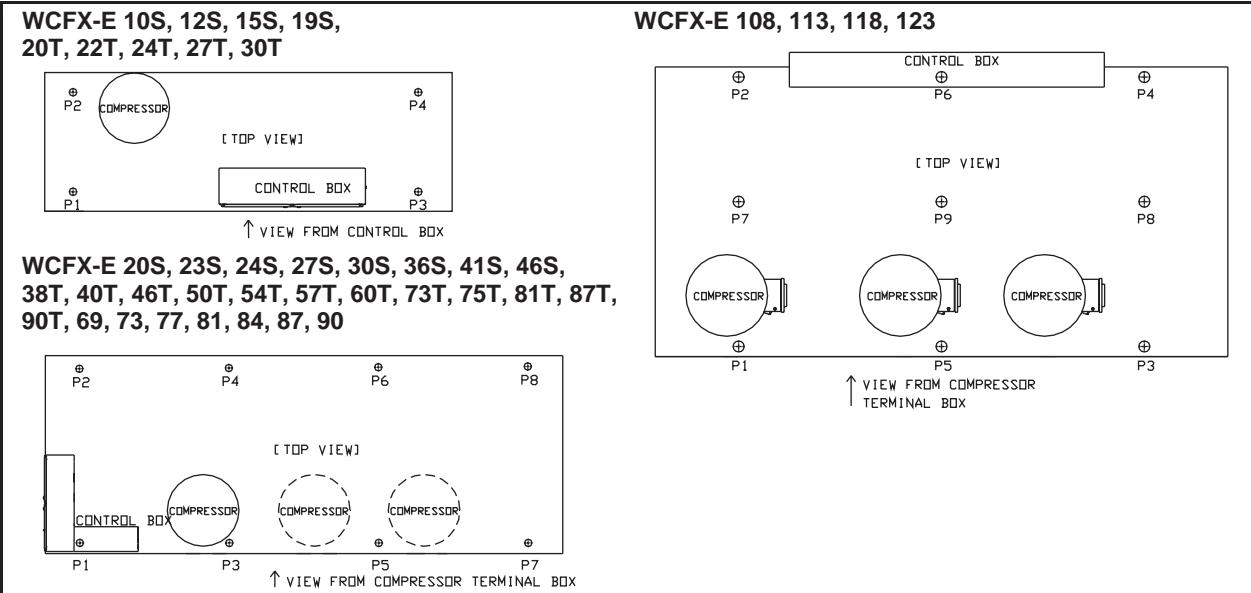
Notes: 1.) Refer to dimensional drawings for location of mounting points.

2.) Unit must be lowered onto mounting springs in a level fashion or spring damage may occur.

3.) Data for Superior models. Consult factory for Standard and Premium model point load data.

# FLOOR LOADING DIAGRAM

60Hz



## POINT LOAD DATA –LBS[KG]

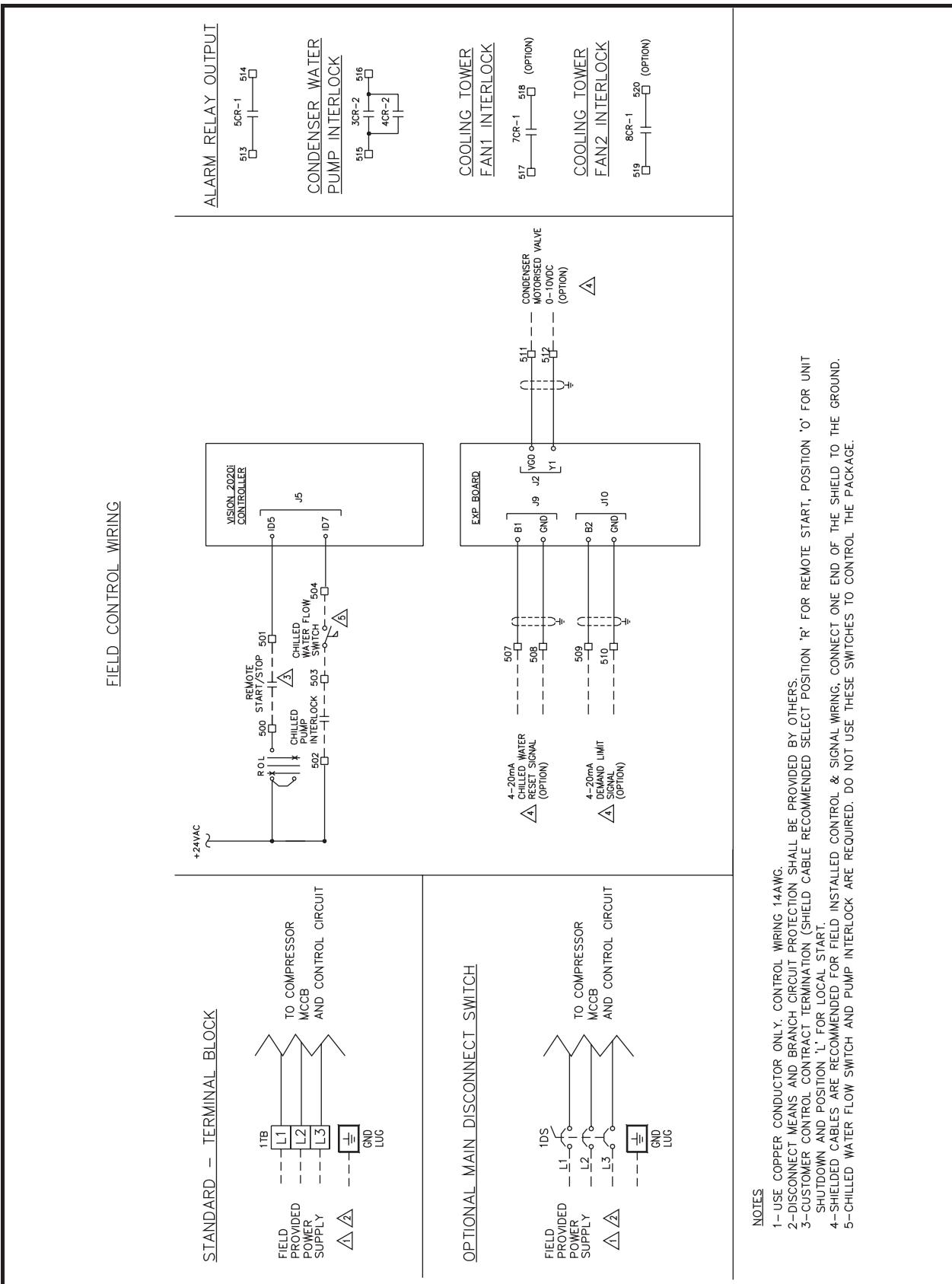
Model WCFX-E	P1	P2	P3	P4	P5	P6	P7	P8	P9	Operating Weight
10S	3405 [1545]	1429 [648]	1162 [527]	1220 [553]	-	-	-	-	-	7216 [3273]
12S	3420 [1551]	1699 [771]	1190 [540]	1429 [649]	-	-	-	-	-	7738 [3510]
15S	3808 [1727]	2138 [970]	1488 [675]	1715 [778]	-	-	-	-	-	9149 [4150]
19S	1131 [513]	1545 [701]	1034 [469]	1420 [644]	935 [424]	1296 [588]	838 [380]	1171 [535]	-	9370 [4254]
20S	1292 [586]	1934 [877]	1173 [532]	1764 [800]	1054 [478]	1595 [724]	935 [424]	1426 [652]	-	11173 [5073]
20T	1786 [810]	2892 [1312]	1742 [790]	2518 [1142]	-	-	-	-	-	8938 [4054]
22T	1940 [880]	3144 [1426]	1889 [857]	2736 [1241]	-	-	-	-	-	9709 [4404]
23S	1329 [603]	2023 [918]	1210 [549]	1846 [837]	1090 [494]	1670 [757]	970 [440]	1493 [677]	-	11631 [5276]
24S	1411 [640]	2106 [955]	1273 [578]	1918 [870]	1136 [515]	1731 [785]	999 [453]	1545 [700]	-	12119 [5497]
24T	2094 [950]	3391 [1538]	2039 [925]	2950 [1338]	-	-	-	-	-	10474 [4751]
27S	1468 [666]	2247 [1019]	1329 [603]	2049 [929]	1190 [540]	1850 [839]	1050 [476]	1651 [749]	-	12833 [5821]
27T	2238 [1015]	3622 [1643]	2178 [988]	3153 [1430]	-	-	-	-	-	11191 [5076]
30S	1621 [735]	2456 [1114]	1463 [664]	2238 [1015]	1305 [592]	2020 [916]	1147 [520]	1815 [823]	-	14065 [6380]
30T	2482 [1126]	4019 [1823]	2414 [1095]	3495 [1585]	-	-	-	-	-	12410 [5629]
36S	1709 [775]	2838 [1287]	1608 [729]	2653 [1203]	1507 [684]	2468 [1120]	1406 [638]	2283 [1036]	-	16473 [7472]
38T	1936 [878]	2357 [1069]	1793 [813]	2202 [999]	1651 [749]	2048 [929]	1510 [685]	1896 [860]	-	15393 [6982]
40T	2348 [1065]	2859 [1297]	2176 [987]	2672 [1212]	2004 [909]	2485 [1127]	1832 [831]	2297 [1042]	-	18673 [8470]
41S	1813 [822]	3055 [1386]	1705 [773]	2856 [1296]	1597 [725]	2658 [1205]	1489 [676]	2459 [1115]	-	17633 [7998]
46S	2026 [919]	2980 [1352]	1954 [886]	2924 [1326]	1883 [854]	2867 [1300]	1811 [821]	2811 [1275]	-	19255 [8734]
46T	2337 [1060]	3057 [1387]	2233 [1013]	2875 [1304]	2129 [966]	2694 [1222]	2025 [919]	2513 [1140]	-	19864 [9010]
50T	2521 [1144]	3385 [1536]	2403 [1090]	3181 [1443]	2285 [1036]	2976 [1350]	2166 [983]	2772 [1257]	-	21689 [9838]
54T	2696 [1223]	3713 [1684]	2579 [1170]	3489 [1583]	2461 [1116]	3265 [1481]	2343 [1063]	3040 [1380]	-	23587 [10699]
57T	2811 [1275]	3809 [1728]	2698 [1224]	3590 [1628]	2585 [1173]	3371 [1529]	2472 [1121]	3174 [1430]	-	24509 [11107]
60T	2888 [1310]	3897 [1768]	2786 [1264]	3677 [1668]	2684 [1218]	3456 [1568]	2582 [1171]	3258 [1478]	-	25230 [11444]
69	3589 [1628]	4396 [1994]	3330 [1511]	4133 [1875]	3072 [1393]	3869 [1755]	2813 [1276]	3606 [1635]	-	28808 [13067]
73T	3733 [1694]	4850 [2200]	3255 [1476]	4464 [2025]	2777 [1259]	4077 [1849]	2298 [1042]	3691 [1674]	-	29145 [13220]
73	3910 [1774]	4973 [2256]	3616 [1640]	4670 [2118]	3322 [1507]	4366 [1981]	3029 [1374]	4063 [1843]	-	31949 [14492]
75T	3840 [1742]	5012 [2274]	3354 [1521]	4615 [2094]	2868 [1301]	4219 [1914]	2382 [1080]	3822 [1734]	-	30111 [13658]
77	3983 [1807]	5033 [2283]	3688 [1673]	4727 [2144]	3393 [1539]	4421 [2005]	3098 [1405]	4116 [1867]	-	32459 [14723]
81T	4082 [1852]	5504 [2497]	3582 [1625]	5076 [2302]	3082 [1398]	4647 [2108]	2582 [1171]	4219 [1913]	-	32774 [14866]
81	4205 [1908]	5454 [2474]	3910 [1773]	5125 [2325]	3614 [1639]	4796 [2175]	3318 [1505]	4466 [2025]	-	34888 [15825]
84	4441 [2014]	5750 [2608]	4132 [1874]	5411 [2454]	3823 [1734]	5072 [2300]	3514 [1594]	4764 [2161]	-	36905 [16740]
87T	2870 [1302]	2294 [1041]	3281 [1488]	4055 [1839]	3691 [1674]	5817 [2639]	4101 [1860]	7578 [3437]	-	33687 [15280]
87	4538 [2059]	5845 [2651]	4228 [1918]	5502 [2496]	3917 [1777]	5158 [2340]	3606 [1636]	4849 [2199]	-	37642 [17074]
90T	2620 [1188]	2100 [953]	3260 [1479]	4348 [1972]	3900 [1769]	6595 [2991]	4541 [2060]	8843 [4011]	-	36207 [16423]
90	4659 [2113]	6050 [2744]	4358 [1977]	5698 [2585]	4058 [1841]	5346 [2425]	3758 [1704]	5030 [2281]	-	38956 [17670]
108	4596 [2085]	4993 [2265]	4795 [2175]	5348 [2426]	4696 [2130]	5171 [2345]	4776 [2166]	5053 [2292]	4914 [2229]	44342 [20113]
113	4713 [2138]	5141 [2332]	4946 [2243]	5523 [2505]	4830 [2191]	5332 [2419]	4908 [2226]	5215 [2366]	5062 [2296]	45669 [20715]
118	5150 [2336]	5729 [2598]	5430 [2463]	6176 [2801]	5290 [2400]	5953 [2700]	5419 [2458]	5785 [2624]	5601 [2540]	50532 [22921]
123	5322 [2414]	5919 [2685]	5581 [2532]	6363 [2886]	5452 [2473]	6141 [2786]	5599 [2540]	5955 [2701]	5776 [2619]	52108 [23636]

Notes: 1.) Refer to dimensional drawings for location of mounting points.

2.) Unit must be lowered onto mounting springs in a level fashion or spring damage may occur.

# TYPICAL WIRING SCHEMATIC

## Two Compressors Unit (Vision 2020i)



- NOTES
- 1– USE COPPER CONDUCTOR ONLY. CONTROL WIRING 14AWG.
  - 2– DISCONNECT MEANS AND BRANCH CIRCUIT PROTECTION SHALL BE PROVIDED BY OTHERS.
  - 3– CUSTOMER CONTROL CONTRACT TERMINATION (SHIELD CABLE RECOMMENDED SELECT POSITION 'R' FOR REMOTE START, POSITION 'O' FOR UNIT SHUTDOWN AND POSITION 'L' FOR LOCAL START).
  - 4– SHIELDED CABLES ARE RECOMMENDED FOR FIELD INSTALLED CONTROL & SIGNAL WIRING. CONNECT ONE END OF THE SHIELD TO THE GROUND.
  - 5– CHILLED WATER FLOW SWITCH AND PUMP INTERLOCK ARE REQUIRED. DO NOT USE THESE SWITCHES TO CONTROL THE PACKAGE.

# APPLICATION DATA

## EVAPORATOR FLUID CIRCUIT

The evaporator fluid circuit requires a minimum system fluid volume of 3 US gallons per Ton [3.3 liters/ cooling kW] for stable operation. The minimum system fluid volume may increase up to 10 US gallons per Ton [11 liters/ cooling kW] for process cooling, low load applications with small temperature range and/or vastly fluctuating load conditions.

### Variable Evaporator Flow

Dunham-Bush chillers are capable for variable evaporator flow system. The chiller may operate to maintain constant leaving fluid temperature with evaporator flow rate changes, with below conditions fulfilled.

- ✿ Evaporator fluid flow rate is within minimum and maximum flow rate of the unit at all time during the operation
- ✿ Rate of flow change shall not exceed 10% per minute

Failure to comply with the above conditions will cause problem to the chiller operation and may cause the chiller to shutdown.

### Operating Limits - Leaving Evaporator Fluid Temperature

Leaving Fluid Temperature	Minimum	Maximum
Standard	40 °F [4.5 °C]	55 °F [12.8 °C]
With Dual Mode Operation	18 °F [-7.8 °C]	55 °F [12.8 °C]

### Performance Correction- Evaporator Fouling Factor

Fouling Factor	Capacity Correction Factor	kW-input Correction Factor
hr.ft <sup>2</sup> .°F/BTU	m <sup>2</sup> .°C/kW	
0.00010	0.018	1.000
0.00025	0.044	0.995
0.00050	0.088	0.985
0.00075	0.132	0.975
0.00100	0.176	0.964

## CONDENSER FLUID CIRCUIT

The unit shall work with constant condenser flow, variable condenser flow is not recommended. Variable condenser flow will keep condenser pressure high at the chiller, and thus, decreases chiller's efficiency and increase power consumption of the system. In addition, variable condenser flow increases rate of fouling of condenser, which will de-rating chiller performance and increases unit maintenance cost.

The unit can be operated with condenser inlet water temperature above 55°F up to 105°F. If the unit is required to operate with condenser inlet water temperature lower than 55°F, a bypass control at condenser water loop is recommended to maintain condenser inlet water temperature is always higher than 55°F.

### Performance Correction - Condenser Fouling Factor

Fouling Factor	Capacity Correction Factor	kW-input Correction Factor
hr.ft <sup>2</sup> .°F/BTU	m <sup>2</sup> .°C/kW	
0.00025	0.044	1.000
0.00050	0.088	0.998
0.00075	0.132	0.996
0.00100	0.176	0.995

## 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-freezing.

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 15°F [8.3°C] lower than the leaving brine temperature.

Table 1 and 2 are to be used to calculate performance and power input with the addition of glycol.

**Table 1 : Ethylene Glycol**

% E. G. By Weight	Freeze Point		C1 Capacity Factor	K1 kW-input Factor	G1 Flow Factor	P1 P.D. Factor
	°F	°C				
10	26.2	-3.2	0.995	0.998	1.019	1.050
15	22.4	-5.3	0.991	0.997	1.030	1.083
20	17.8	-7.9	0.988	0.996	1.044	1.121
25	12.6	-10.8	0.984	0.995	1.060	1.170
30	6.7	-14.1	0.981	0.994	1.077	1.219
35	0.0	-17.8	0.977	0.992	1.097	1.275
40	-10.0	-23.3	0.973	0.991	1.116	1.331
45	-17.5	-27.5	0.968	0.990	1.138	1.398
50	-28.9	-33.8	0.964	0.989	1.161	1.466

**Table 2 : Propylene Glycol**

% P. G. By Weight	Freeze Point		C2 Capacity Factor	K2 kW-input Factor	G2 Flow Factor	P2 P.D. Factor
	°F	°C				
10	26.1	-3.3	0.988	0.994	1.005	1.019
15	22.8	-5.1	0.984	0.992	1.008	1.031
20	19.1	-7.2	0.978	0.990	1.010	1.051
25	14.5	-9.7	0.970	0.988	1.015	1.081
30	8.9	-12.8	0.962	0.986	1.021	1.120

Note: P.D. – Pressure drop vessels across

## HEAT RECOVERY

The Dunham-Bush WCFX-E Chiller can significantly reduce building operating costs when the heat recovery option is selected. Any building which requires simultaneous heating and cooling may be an excellent candidate for this system.

### Hotter Hot Water

Most centrifugal water chillers are limited in producing leaving condenser water temperatures to 105°F[40°C] or below. Dunham-Bush WCFX-E Chillers are able to provide leaving hot water temperatures up 140°F[60°C] allowing for the installation of smaller heating coils at a lower first cost than systems utilizing centrifugal water chillers. The warmer supply air temperatures available will also improve tenant comfort.

### Lower Energy Consumption

The efficient unloading characteristics of the Dunham-Bush WCFX-E Chiller compressor make it ideal for heat recovery duty. Heat recovery chillers must be selected to operate at many operating conditions, not just full load heating and full load cooling duties. Heat recovery chillers spend the majority of their time at lower loads, conditions at which centrifugal chillers must often be operating with energy inefficient hot gas bypass.

# APPLICATION DATA

## Greater Design Flexibility

The heat recovery Dunham-Bush WCFX-E Chiller, utilizes positive displacement compressor which will not surge. This chiller is capable of unloading its compressors to their minimum capacity at all head conditions, both cooling and heat recovery, for greater design flexibility.

In order to maximize the user's flexibility on design and operation, Dunham-Bush chillers offer two heat recovery designs.

**Desuperheater:** A shell-and-tube desuperheater is installed at chiller to reclaim "waste" heat from superheated refrigerant produced by the vapor compression cycle.

**Double-Bundle Condenser:** Double-bundle condenser with two sets of water connectors allow connections to hot water loop and cooling tower water loop simultaneously. Double-Bundle condenser is rated at 300 psig [20.7Bar] working pressure on refrigerant side, and is pressure test up to 330 psig [22.8 Bar] in the factory. This design reclaims "waste" heats generated by vapor compression cycle, and full heat reclaim can be done with this design. Condenser thermal insulation is can be included to provide heat insulation on double-bundle condenser and discharge piping. The 1" thick closed cell insulation will reduce heat losses during heat recovery operation, and prevent unpleasant human contact with hot surface.

To further improve the operational flexibility, for units with full heat recovery design, priority on controlled temperature can be selected through a digital input signal. When "Heating Mode" contact is closed, controlled temperature will switch from leaving evaporator water temperature to leaving condenser water temperature; thus, the unit is now operated as a heat pump. This control function is available when Condenser Water Pump Control & Complete Temperature Monitoring options are included together with double-bundle condenser option.

## CONDENSER PRESSURE CONTROL

Cooling tower control is increasingly becoming an overlooked subject, and it causes problems. The following is a general recommendation that is applicable to all standard packaged chillers.

Most chiller manufacturers recommend that condenser water be controlled so that its temperature never goes below 55°F [12.8°C] (even when the machine is off) and that its rate of change is not rapid. Rapid can be defined as not exceeding 2°F [1.1°C] per minute. 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 chilled water conditions. The additional dynamic of rapidly varying condenser water temperature subjects the machine to fluctuating pressure on differentials across the evaporator and condenser. This varies the refrigerant flow and,

therefore, the capacity. If this occurs faster than the machine can accommodate it, the condenser pressure or evaporator pressure will soon exceed their safety setpoints and the machine will shut down.

The necessary control can sometimes be attained via fan cycling if the tower is rated at the same capacity as the chiller's heat rejection. On multiple chiller jobs, a single tower is oversized relative to the chiller. On other jobs the tower/chiller might be oversized to the design load and the chiller and tower frequently cycle under light load. Under these conditions, fan cycling might result in very rapid temperature swings, which creates a dynamic situation to condenser, that potentially cause unstable operation. Thus, in this case, either variable speed fans or modulating valve control should be used to regain control of the condenser water. Either type of control provides precise modulating control of the condenser water rather than on-off step control. The control can be initiated either by a condenser water temperature sensor/controller or, even better, by direct control from the chiller's controller based upon the chiller's condenser pressure.

It is further recommended that the condenser water pump be cycled by the chiller. This is to eliminate potentially very cold water from going through the condenser while the chiller is shut down. At the same time it is probable that relatively warmer chilled water is in the evaporator (an inversion). Refrigerant tends to migrate if there is a difference in pressures within the components of the chiller. It will seek the lowest pressure area of the packaged chiller which, in this case, would be the condenser. Starting of a chiller where the refrigerant has migrated to the condenser is not desirable. The presence of highly subcooled liquid refrigerant in the condenser will cause low suction pressures and possibly liquid slugging of the compressor. If the condenser water pump is off until prior to the chiller starts, the water in the condenser is at the chiller room ambient, which is usually much closer to the evaporator water temperature.

Further to condenser pump control, a 0-10 Vdc analog signal can be output from the chiller's controller to bypass some of the condenser water flow to maintain chiller's condenser pressure. Cooling tower fans control is also available to achieve better system efficiency.

Thus, even though there has been a trend toward fan cycling control of cooling towers, it is not a device that is suitable to every installation. We recommend that the designer carefully evaluate the system to determine if a more precise method of control is indicated. If there is any doubt, the more precise control is required.

Dunham-Bush WCFX-E Chillers have as standard a control feature called EPCAS (Evaporator Pressure Control at Start) which will allow for an inverted start. This occurs when the chilled water loop in a building is at a higher temperature than the condenser/tower loop. This occurs in many buildings after a weekend shut down. The chilled water loop can be as high as 90°F and the condenser/tower loop as low as 60°F. With the EPCAS feature, the valve feeding the evaporator will be throttled to create a pressure differential to help load the compressor.

# APPLICATION DATA

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## ICE THERMAL STORAGE SYSTEM (ITES)

The globe is progressively marching towards a serious electric energy crisis. The HVAC/R industry is shifting to operate with more efficient machines, as well as alternate system designs and solutions. Dunham-Bush, as a leader of HVAC/R solutions provider, we provide packaged solution for ITES, which include, equipments selections, chillers, Ice Cels and CPM for ITES system controls.

Dunham-Bush WCFX-E Chillers, with positive displacement rotary screw compressor can easily cool low temperature glycol down to 20°F [-6.7 °C] to charge the ice storage tanks. The same chiller can also produce warmer supply fluid temperature, 40 to 45 °F [4.4 to 7.2 °C], for those building systems designed for only peak shaving.

Dunham-Bush is the only HVAC/R manufacturer who can provide complete ITES packaged solution, with own products for chillers, ice storage tanks and plant room control system, with following benefits.

**Demand Charge:** ITES allows some of the peak

demand to be shifted to low-demand nighttime periods, thus reducing demand charges for the entire year.

**Energy Cost:** ITES, by operating chillers at night, will fully utilize incentive on electricity night tariff, which is much lower compare to day tariff.

**Rebates:** ITES usually qualifies for rebates offered by electric utilities or governments for equipment that shift peak loads to off-peak hours.

**Colder Air Temperature:** ITES can produce chilled liquid at supply temperature of 38°F [3.3°C] or even lower without scarifying system's efficiencies. This realizes energy saving on chilled water pumping system, AHUs and FCUs. Colder supply air distribution lowers room humidity, and thus, comfort cooling can be achieved with higher room temperature. This reduce air conditioning load required, and therefore, reduces the installation cost and system operating cost.

**Standby Cooling Capacity:** Energy stored in ITES can be utilized to cater peak or unexpected loads which exceeded total cooling capacity available from the installed chillers. This is savior to the regions which having difficulties on power generation plants expansion, where with ITES, will significantly reduced total demand of the buildings.

## GUIDE SPECIFICATIONS

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### SCOPE

Supply and commissioning of complete factory assembled water cooled rotary screw chiller(s). The rotary screw chiller(s) shall contain rotary screw compressor(s), evaporator, condenser, interconnecting refrigerant piping, electronic expansion valve, control panel, chilled liquid connections, condenser water connections. The control panel shall be fully wired by the manufacturer connecting & interlocking controller, starter, electrical protection devices with electrical power and control connections. Packaged chiller shall be factory assembled, charged and tested with a full operating refrigerant and oil charge. The refrigerant type shall be R134a. and shall not have phasing out schedule.

Capacity of each chiller shall be not less than \_\_\_\_\_ refrigerant tons (kW output) cooling at \_\_\_\_\_ USGPM (liters/min.) of water from \_\_\_\_\_ °F[°C] to \_\_\_\_\_ °F[°C]. Power input requirements for the unit(s), incorporating all appurtenances necessary for unit operation, including but not limited to the control accessories and pumps, if required, shall not exceed \_\_\_\_\_ kW input at design conditions. The unit shall be able to unload to \_\_\_\_\_ % of cooling (refrigeration) capacity when operating with leaving chilled water and entering condenser water at design temperatures. The unit shall be capable of continuous operation at this point, with stable compressor operation, without the use of hot gas bypass.

Heat transfer surfaces shall be selected to reflect the incorporation of a fouling factor of 0.00025

hr.sq.ft.°F/BTU [0.000044m<sup>2</sup>. °C/W] for the water condenser and 0.0001 hr.sq.ft.°F/BTU [0.0000176 m<sup>2</sup>. °C/W] for evaporator. Water pressure drop at design conditions shall not exceed \_\_\_\_\_ feet of water through the condenser, and \_\_\_\_\_ feet of water through the evaporator.

### QUALITY ASSURANCE

- ✿ Chiller performance shall be certified by AHRI as per AHRI 550/590 standard latest edition.
- ✿ [Optional] ASHRAE Standard 15 safety code for mechanical refrigeration
- ✿ ASME standard B31.5 for Refrigerant piping
- ✿ Vessels shall be fabricated and pressure tested in compliance with ASME Boiler and Pressure vessel code, Section VIII, Division 1 "Unfired Pressure Vessels"
- ✿ [Optional] JKPP code for vessels required in Malaysia market place.
- ✿ [Optional] PED certification required in Europe market place
- ✿ Manufacturer shall have experience of minimum 10 years in manufacturing water cooled screw chillers in their facility.
- ✿ Unit shall be manufactured in ISO9001 registered manufacturing facility.
- ✿ Factory run test: Chiller shall be pressure tested, evacuated and fully charged with refrigerant and oil. The chiller shall be run tested with water flowing through the vessels.
- ✿ Manufacturer shall have a service organization with trained service personal.

# GUIDE SPECIFICATIONS

## OPERATING REQUIREMENT

The unit shall be capable of starting up with entering fluid temperature to the cooler at 95°F. Unit shall be able to operate with 3-phase 50Hz/60Hz with unit rated voltage +/- 10%. Control Volatge shall be 115V/1ph/50Hz or 115V/1ph/60Hz.

## COMPRESSOR AND MOTOR

The packaged chiller shall be furnished with single-stage hermetic direct connected positive displacement rotary screw compressor(s) as required, driven by a 2900 RPM (3500 RPM-60Hz) 2 pole motor. Each compressor shall include integral oil separation system, oil sump and oil filter. The oil differential pressure shall be controlled during operation to maintain proper oil lubrication throughout the lubrication system. An electric oil heater shall be supplied with each compressor to maintain oil temperature during shutdown period. The heater shall be energized when the chiller is switched off. Each compressor shall have a sight glass, suction check valve, suction filter, suction service valve, a discharge check valve (for multiple compressor chillers) and a discharge service valve. Compressor capacity control shall be obtained by an electrically initiated, hydraulically actuated slide valve within each compressor. (Provide isolation valves on all connections to compressor to allow condenser to be used as a pump down receiver). The bearing shall be heavy duty, anti-friction tapered roller type, anti-reverse, shall be able to carry both radial and thrust loads.

The compressor motor shall be hermetic refrigerant gas cooled, 2 pole, squirrel cage induction type with class H insulation. Motor winding shall have thermistors embedded in the motor windings to protect motor from over heating. The thermistors shall be wired to the solid state motor protection module.

## EVAPORATOR

Evaporator vessel shall be cleanable shell and tube, flooded type. Shell shall be fabricated from rolled carbon steel sheet with fusion welded seams or carbon steel standard pipes. End plates shall be of carbon steel with precision drilling, reamed in order to accommodate tubes. Intermediate tube support shall be in place to provide required tube support between tube sheets. Tubes shall be of copper, seamless, high efficient, internally enhanced and externally finned, mechanically expanded into fixed steel tube sheets. Tube dia shall be  $\frac{3}{4}$  inch and thickness shall be 0.025 inch. The flooded evaporator 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. Water box shall be removable for tube cleaning, shall have stubout water connections with victaulic grooves in compliance to ANSI / AWWAC-606. They are to be available in one, two or three pass design as required on the drawings. Vent and drain plugs are to be provided in water box. The shell side of the evaporator shall have pressure relief valve with provision for refrigerant venting. Evaporators refrigerant side shall be designed, constructed in accordance with the ASME

Code for Unfired Pressure Vessels. Evaporator shell side shall undergo pneumatic pressure test at 220psi, shall be designed for working pressure upto 200psi. Tube side shall undergo hydrostatic pressure test at 195psi, shall be designed for 150psi working pressure.

The flooded evaporator shall have an efficient and reliable oil recovery system. The oil recovery system will insure the evaporator is operating at peak efficiency at all times and provide optimal energy efficiency during extended periods of part load. Units without such oil recovery systems will not be acceptable.

All low temperature surfaces shall be factory insulated with 25mm thk Polyethylene resin having K factor of 0.26 btu-in / hr – ft<sup>2</sup> – °F

## CONDENSER

Condenser vessel shall be cleanable shell and tube . Shell shall be fabricated from rolled carbon steel sheet with fusion welded seams or carbon steel standard pipes. End plates shall be of carbon steel with precision drilling, reamed in order to accommodate tubes. Intermediate tube support shall be in place to provide required tube support between tube sheets. Tubes shall be of copper, seamless, high efficient, internally enhanced and externally finned, mechanically expanded into fixed steel tube sheets. Tube dia shall be  $\frac{3}{4}$  inch and thickness shall be 0.025 inch. Water box shall be removable for tube cleaning, shall have stubout water connections with victaulic grooves in compliance to ANSI / AWWAC-606. They are to be available in one, two or three pass design as required on the drawings. Vent and drain plugs are to be provided in water box. The shell side of the condenser shall have pressure relief valve with provision for refrigerant venting. Condenser refrigerant side shall be designed, constructed in accordance with the ASME Code for Unfired Pressure Vessels. Condenser shell side shall undergo pneumatic pressure test at 220psi, shall be designed for working pressure upto 200psi. Tube side shall undergo hydrostatic pressure test at 195psi, shall be designed for 150psi working pressure.

The condenser shall be sized for full pump down capacity.

## REFRIGERANT CIRCUIT

The refrigerant circuit shall include suction and discharge service valves (which facilitate compressor isolation), oil filter, replaceable filter drier on oil return line, sight glass on liquid line, economizer, pressure relief valves on the cooler and condenser, liquid line angle valve for refrigerant charging. The packaged chiller shall be furnished with an electronic expansion valve for precise modulation of refrigerant flow control and improve efficiency by optimizing the suction and discharge superheat while protecting compressor. In addition, the refrigerant control system shall monitor the liquid refrigerant level in the flooded evaporator and restrict refrigerant flow entering the evaporator upon a rise in the level, protecting the compressor from slugging liquid refrigerant. Fixed orifice control systems will not be acceptable. (Option Hot gas bypass shall be factory installed for operation down to approximately 10% of full load.)

# GUIDE SPECIFICATIONS

## OIL MANAGEMENT

The chiller package shall ensure proper lubrication during the operation in order to have prolonged compressor life as well as maintaining system efficiency. An efficient Pressure differential lubrication system shall be provided with oil filter, sight glass, oil sump and oil sump heater. The oil heater shall be energized during the chiller switched off to prevent oil from dilution. Oil pump is not acceptable.

## ELECTRICAL AND CONTROL PANEL

The electrical switch gears, controller, control sensors and relays shall be housed in NEMA-1 panel. The panel casing shall be of galvanized steel with powder coating for corrosion resistance. The panel shall be divided into two separate compartments or shall have two separate panels to house power and control devices separately.

## ELECTRICAL POWER PANEL

The chiller manufacturer shall provide suitable part winding starter for the compressor motor in order to minimize the starting current. The starter shall be factory mounted, wired to the motor and controller. The starter shall be able to provide adequate starting torque and the required acceleration for the compressor during starting.

NEMA-1 electrical panel compartment shall include:

- ✿ Main incoming power terminal block suitable to receive single entry of three phase 3-wire power supply with specified voltage.
- ✿ Circuit breakers for each compressor
- ✿ Solid state compressor motor over Current protection module for each phase
- ✿ Solid state compressor motor overheat protection module
- ✿ Under/over voltage phase reversal and imbalance relay.
- ✿ [Optional] Ground fault interrupter.

The compressor starter contactors and circuit breakers shall be wired securely to the main incoming terminal block. Solid state external compressor over load protector, over heating protection modules, over/under voltage phase relay shall be interlocked with the compressor starter contactors to provide adequate protection to the compressor motor.

## CONTROL PANEL

The packaged chiller shall be equipped with stand along proactive advance controller which adapts to abnormal operation conditions. The unit algorithm program and operating parameters shall be stored in flash-memory. Battery back-up is not acceptable. 115V Power supply to the controller shall be provided by a control transformer provided with the panel. External power source to the controller is not acceptable. The controller shall be equipped with a user friendly terminal with color touch screen LED back lit graphical display and dedicated touch keys that provides easy access to the unit operating parameters, control set points and alarm history. There shall be dedicated

physical buttons and touch keys enable user to access information, based on security level of password. There shall be min three level of password for operator, service personnel and for the critical manufacturer settings in order to protect the chiller controller from unauthorized access.

The controller board shall be provided with a set of terminals that connected to various devices such as temperature sensors, pressure transducers, current transducers, solenoid valves, compressor contactors, electronic expansion valve, controls relays. The controller should be able to configured and connected multiple unit that allow sequencing control without additional hardware. The controller shall be able to carry out all program operations, It shall be able to display unit operating parameters, compressor information, alarm history and shall able to modify the parameters.

The controller shall be able to carry out its own diagnose test on the controller and the connected devices and alarm messages shall be displayed automatically on faulty devices.

All messages shall be displayed in English language. shall be displayed either in Imperial or SI units.

Leaving chilled water temperature control shall be accomplished by entering the water temperature set point with accuracy to 0.8°F and placing the controller automatic control mode. The controller shall monitor all control functions and move the compressor slide valve to the calibrated position. The compressor loading cycle shall be programmable and shall be adjusted to the building load requirement. The loading adjustable range shall be from 0.1% to 0.4% per increment to prevent excessive demand hike at start up.

The controller shall continuously monitor evaporator leaving water temperature, rate of change of chilled water leaving temperature, evaporator and condenser pressure; compressor amp draw; and discharge refrigerant temperature.

The controller shall be complete with all hardware and software necessary to enable remote monitoring of all data through the addition of an optional web card if accessing the controller via web or network cards if linking chiller to the Building Management Systems. The controller shall be complete with a RS485 long distance differential communications port, the remote connection shall be established by a twisted pair of wire. The controller shall also accept a remote start and stop signal, 0 to 5VDC [optional], chilled water temperature reset signal [optional] and 0 to 5VDC compressor current limit reset signal [optional].

The electrical control panel shall be wired to permit fully automatic operation during - initial start-up, normal operation, and shutdown conditions. The control system shall contain the following control, displays and safety devices:

## MANUAL CONTROLS

- ✿ Auto/Local/Remote switch
- ✿ Control circuit stop and start switches
- ✿ Compressor enable switch
- ✿ Compressor over current
- ✿ Compressor anti-recycle

# GUIDE SPECIFICATIONS

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- ⌘ Programmable with Seven day operation cycle
- ⌘ [Optional] chilled liquid and condenser water pump on/off control
- ⌘ [Optional] dual mode operation to produce Ice at 21F-26F for Ice thermal energy systems

## AUTOMATIC CONTROLS

- ⌘ Compressor motor increment contactors
- ⌘ Start delay timer
- ⌘ Anti-recycle timer
- ⌘ Oil sump heater interlock relays

## REFRIGERANT FLOW CONTROLS

- ⌘ Refrigerant flow control shall be carried out electronically by a precision electronic expansion valve
- ⌘ Liquid refrigerant level sensor for evaporator
- ⌘ Compressor loading and unloading solenoid valves

## INDICATOR LIGHTS

- ⌘ Compressor Motor high temperature
- ⌘ Compressor motor overload
- ⌘ System common alarm

The control system shall be provided with an anti-recycle device. The control shall limit compressor starting to a minimum of 15 minutes between starts.

## SYSTEM OPERATION INFORMATION

The chiller display shall provide following operating information

- ⌘ Leaving chilled water temperature
- ⌘ Leaving chilled water temperature derivative
- ⌘ Evaporator pressure
- ⌘ Condenser pressure
- ⌘ Compressor amps draw for each compressor
- ⌘ Operating supply Voltage [optional]
- ⌘ Compressor elapsed run time of each compressor
- ⌘ Compressor start status
- ⌘ Oil level sensor status
- ⌘ Water temperature re-set value [optional]
- ⌘ Water flow switch status
- ⌘ External start/stop command status
- ⌘ Trend graph for leaving chilled water temp
- ⌘ Percentage of compressor capacity
- ⌘ Electronic expansion valve percentage of opening.

## SAFETY PROTECTIONS

- ⌘ Short circuit protection.
- ⌘ Compressor motor over load protection (3 phase)
- ⌘ Compressor motor overheat protection
- ⌘ High discharge temperature protection
- ⌘ Under voltage phase failure relay
- ⌘ Low oil level protection via optical sensor
- ⌘ High condenser pressure
- ⌘ Low evaporator pressure
- ⌘ Freeze protection (low chilled liquid leaving temperature )
- ⌘ Chilled water flow loss

- ⌘ Low differential pressure
- ⌘ Compressor run error
- ⌘ Power loss
- ⌘ Sensor error
- ⌘ Refrigerant loss
- ⌘ Reverse rotation

Controller shall be able to retain upto 99 alarm conditions complete with time of failure and all critical sensor readings. This aids service technicians in their trouble shooting task enabling downtime and nuisance trip-outs to be minimized.

## DELIVERY, STORAGE AND HANDLING

Unit shall be delivered to job site fully assembled with all interconnecting refrigerant piping and internal wiring ready for field installation and charged with refrigerant and oil by manufacturer. When delivered, machine shall be stored indoors, away from construction dirt, dust , moisture or any other hazardous material that would harm the chillers. Inspect under shipping tarps, bags, or crates to be sure there is no water collected during transit. Protective shipping covers shall be kept with the unit until machine is ready for installation.

## WARRANTY

Chiller manufacturer's warranty shall cover for 12 months from the date of start-up or 18 months from the date of shipment whichever is first. The start-up shall be carried out by a authorized service personnel and the warranty is limited to part replacement excluding labor and consumables such as refrigerant, oil & filter driers etc.

## EXECUTION

### INSTALLATION

Chiller shall be installed strictly according to manufacturer's recommendations as stipulated in the installation manual, drawings and tender documents. Care should be taken to provide necessary service clearance as required in the manufacturer's drawing. Install the strainers at the inlet to the evaporator to prevent debris or other particles entering to the evaporator during piping work and initial flushing the system. Required coordination to be done with the electrical contractor and the control contractors to ensure electrical supply and required communications links are established.

### START-UP/COMMISSIONING

Chiller shall be commissioned by a service representative from manufacturer or by their local representative. The service personnel shall be trained and authorized by the manufacturer for start up of the supplied units. The start-up shall include briefing operators on chiller operations and maintenance as well.

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