POSEIDON

Water Cooled Screw Liquid Chillers

WCFX-EU 60Hz

Cooling Capacity: 65 to 581 TR (229 to 2043 kW)

R134a R513A AHRI CERTIFIED Intertek ASHRAE 90.1 COMPLIANT

DUNHAM-BUSH®

Products that perform...By people who care

INTRODUCTION

The Dunham-Bush POSEIDON series WCFX-EU Water Cooled Rotary Screw Flooded Chillers are available from 65 to 581 TR [229 to 2043 kW]. These units are supplied with rotary screw compressors that are backed by more than 45 years of experience. The WCFX-EU 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-EU series are certified to AHRI Standard 550-590, meets ASHRAE Standard 90.1, and ETL listed.

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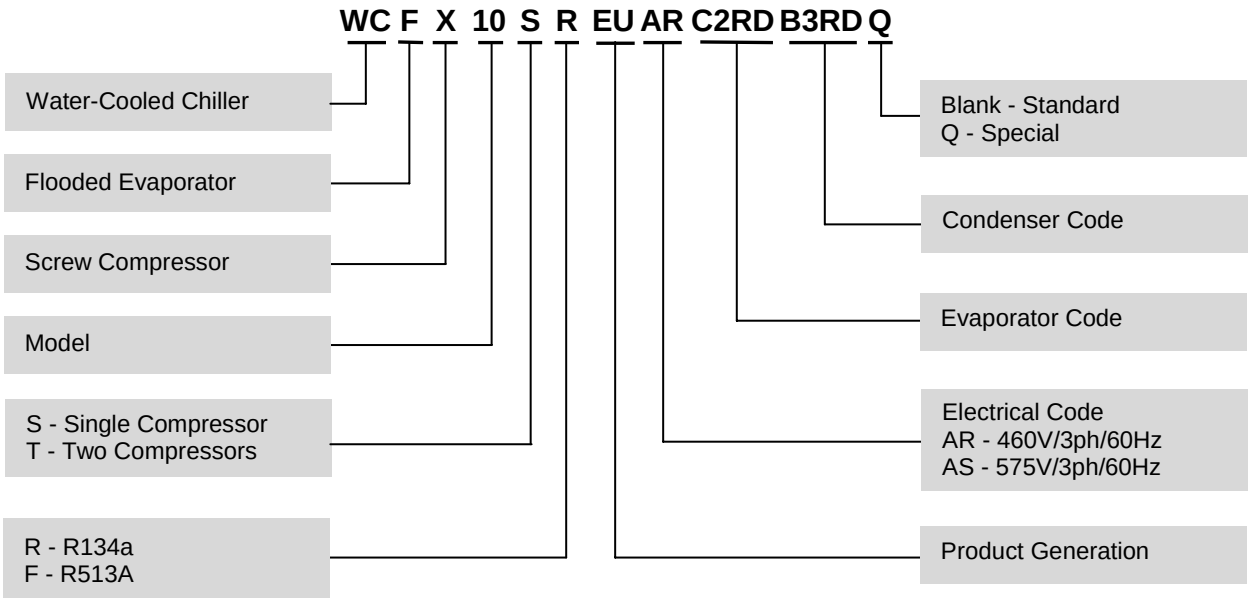
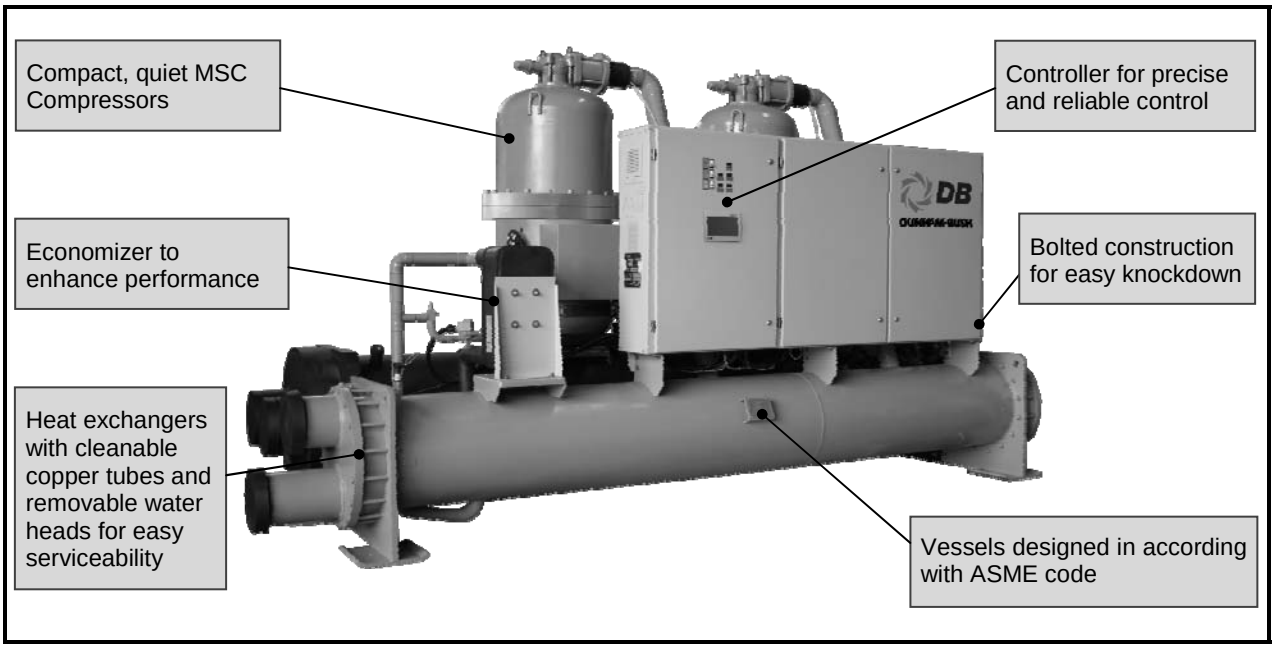
NOMENCLATURE



COMPONENTS



Note: Picture is for illustration purpose only. Actual model may vary accordingly to the regions and options selected. Do consult factory for details.

GENERAL CHARACTERISTICS

General

- Rated in accordance with AHRI standard conditions
- Multiple compressors models provide unparallel redundancy and reliability, with enhanced superior part load energy efficiency
- The unit is designed to operates with HFC-134a & HFO-513A. Both refrigerants are environment friendly refrigerant with zero ***ODP*** (Ozone Depletion Potential).
- Units are ETL listed

Computer Performance Ratings

Dunham-Bush WCFX-EU Chillers are available from 65 to 581 TR [229 to 2043 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-EU 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

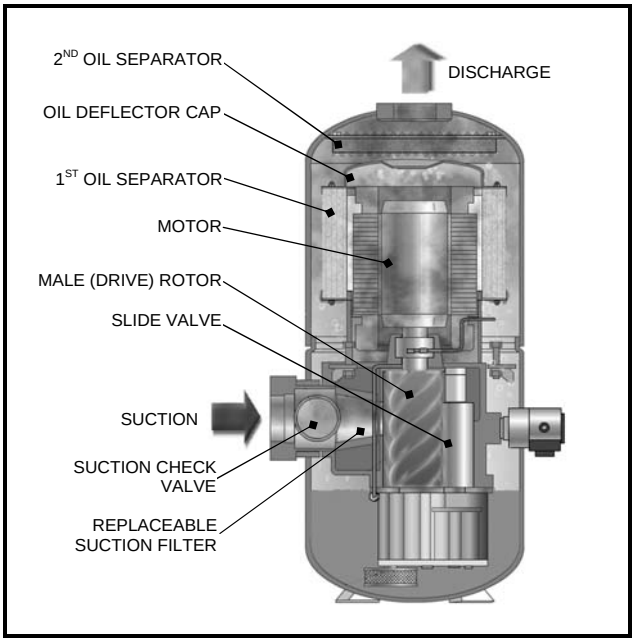
Contact our local Dunham-Bush Sales Representative for Customized Solutions that can be offered to meet your specific application needs.

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 & R513A application, to assure operation at highest efficiencies

GENERAL CHARACTERISTICS

- 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



- 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)
- 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

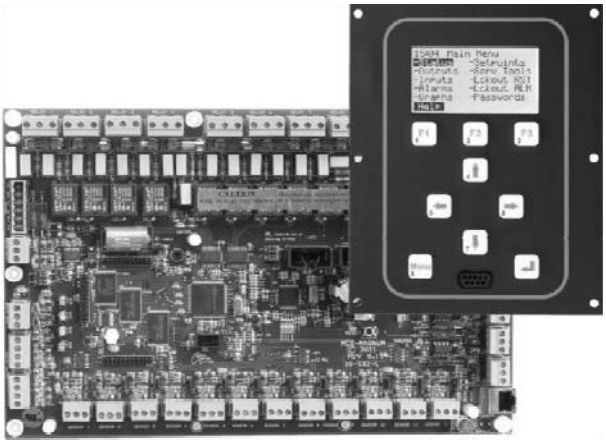
- The economizer circuit consists of plate type heat exchanger, expansion valve and solenoid valve
- Refrigerant is sub-cooled at economizer before entering the evaporator; the flash refrigerant from economizer is fed into compressor at intermediate pressure
- The economizer increased cooling capacity by means of the sub-cooling circuit
- 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
- DB Director – the state-of-art Dunham-Bush proactive advanced controller monitors the unit operation and maintains optimal operation of the unit. DB Director, an intelligent controller that is able to operate the unit with optimum efficiency at off-design conditions. DB Director adapts to any abnormal operating conditions and will execute preventive controls and actions for safety protections

UNIT FEATURES

DB DIRECTOR



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 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 TCPIP, or BACnet over IP communication protocol.

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

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.

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 achieved optimized chiller plant room controls, operation and performance.

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

In a chiller system with multiple Dunham-Bush chillers, The 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.

UNIT FEATURES

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

The controller 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

- **1-pass Evaporator and Condenser** – 1-pass evaporator or condenser is suitable for applications with low temperature different (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 think 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^{o}F [60^{o}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
- **Thermal Dispersion Flow Switch** – Optional thermal dispersion flow switch (TDFS) can be installed at the evaporator and condenser leaving fluid connector. The TDFS function is to provide evaporator and condenser fluid flow indication for chiller startup.
- **Hotgas Bypass** – To maintain unit operation below minimum unloaded capacity
- **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 22.5^{o}F [-5.3^{o}C] with PG 30% and 20.1^{o}F [-6.6^{o}C] with EG 30% 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 22.5^{o}F [-5.3^{o}C] with PG 30% and 20.1^{o}F [-6.6^{o}C] with EG 30% for process cooling application
- **ASME / PED / CRN Compliance** – Evaporator, condenser and desuperheater with ASME / PED / CRN approval is available on request
- **Extended Warranty Period for Compressors** – Extended compressor warranty is available on request

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

OPTIONS AND ACCESSORIES

- **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 controller 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 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 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 controller based on entering condenser water temperature. 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 controller
- **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.

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 and R513A with proven efficiency and reliability

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 $\pm 0.8^{o}F$ [$0.5\ ^{o}C$] range for your comfort cooling, with best energy saving

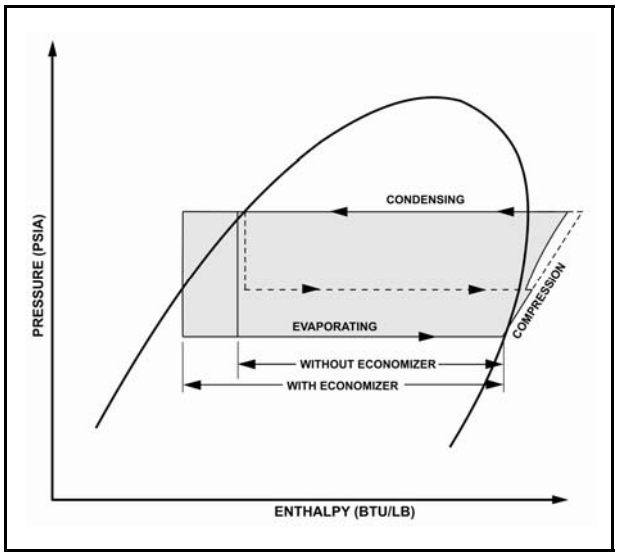
OPERATING BENEFITS

REFRIGERATION CYCLE

Dunham-Bush WCFX-EU 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 camber. 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-EU Chillers offer some of the best part-load performance characteristics in the industry when measured in accordance with AHRI Standard 550/590.

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-EU 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, 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

R134a

Model WCFX-EU		10S	12S	15S	19S	20S	23S	24S	27S	30S	36S
Nominal Capacity	TR	64.8	80.7	98.8	130.5	161.4	170.5	191.5	203.0	230.4	272.6
	kW	227.9	283.8	347.5	458.9	567.6	599.6	673.5	713.9	810.3	958.7
Nominal Power Input	kW	46.74	58.31	69.53	81.08	98.34	106.30	117.90	125.90	143.40	167.20
Energy Efficiency	kW/TR	0.722	0.723	0.704	0.621	0.609	0.623	0.616	0.620	0.623	0.613
	COP	4.87	4.86	5.00	5.66	5.78	5.65	5.71	5.67	5.65	5.74
Min % Unit Capacity		25%	25%	25%	25%	25%	25.00%	25.00%	25.00%	25.00%	25.00%
No Of Refrigerant Circuit		1									
Power Supply		460V/3Ph/60Hz, 575V/3Ph/60Hz									
Compressor											
Model(Qty.)		1210(1)	1212(1)	1215(1)	1220(1)	1222(1)	1222(1)	1227(1)	1227(1)	1230(1)	2233(1)
Oil Charge Approx (Each)	Liter	37.3	33.5	45.2	55	50	50	46	46	46	62
Evaporator											
Model		C2RD	C3RD	D2RD	E2RD	2CRD	2DRD	EARD	JARD	JBRD	6ARD
Water Flow Rate	Usgpm	155.0	193.2	236.6	312.4	386.4	408.5	458.3	485.9	551.5	652.6
	L/s	9.8	12.2	14.9	19.7	24.4	25.8	28.9	30.7	34.8	41.2
Pressure Drop	ft.wg	4.8	5.2	5.1	5.5	13.4	13.3	13.8	12.3	13.9	15.6
	kPa	14.3	15.5	15.2	16.4	40.1	39.8	41.2	36.8	41.5	46.6
Design Press. Water Side psig[kPa]		150 [1034]									
Connection Size inches		4	5	6	6	6	6	6	8	8	8
Condenser											
Model		B3RD	B4RD	B5RD	C2RD	E5RD	4ARD	5ARD	5BRD	5CRD	K4RD
Water Flow Rate	Usgpm	202.4	252.2	307.5	398.1	491.0	520.8	583.3	619.1	703.0	830.1
	L/s	12.8	15.9	19.4	25.1	31.0	32.9	36.8	39.1	44.4	52.4
Pressure Drop	ft.wg	5.7	5.9	6.0	7.2	14.3	14.6	15.5	14.6	14.5	14.3
	kPa	17.0	17.6	17.9	21.5	42.7	43.6	46.3	43.6	43.3	42.7
Design Press. Water Side psig[kPa]		150 [1034]									
Connection Size inches		4	5	5	6	5	6	6	6	6	8
General Information											
Length	inches	117 3/8	123 3/8	123 3/8	123 5/8	155 3/8	155 3/8	149 7/8	149 7/8	149 7/8	174 3/16
	mm	2980	3130	3130	3140	3950	3950	3810	3810	3810	4430
Width	inches	44 5/16	45 1/8	48 1/2	53 15/16	49 3/8	53 5/8	53 3/8	55 5/8	55 5/8	70
	mm	1130	1150	1230	1370	1250	1360	1360	1410	1410	1780
Height	inches	78	78	85	97	96	96	99	99	99	88
	mm	1980	1980	2160	2460	2440	2440	2520	2520	2520	2230
Shipping Weight	lbs	4298	4578	5262	6979	7018	7362	8127	8753	9284	12291
	kg	1949	2076	2386	3165	3183	3339	3685	3970	4210	5574
Operating Weight	lbs	4659	5007	5773	7612	7710	8099	8953	9673	10280	13547
	kg	2113	2271	2618	3452	3496	3673	4060	4387	4662	6144
Approx. R134a Charge	lbs	171	214	261	345	427	451	507	537	609	721
	kg	78	97	118	156	194	205	230	244	276	327

Notes: 1. The above data are models with 2-pass evaporator and condenser which rated in accordance with AHRI Standard 550/590 (I-P)-2015 at standard conditions. The standard rating conditions are as below:
Chilled Water Inlet/Outlet Temperature 54/44°F [12.2/6.7°C]; Cooling Water Inlet/Outlet Temperature 85/94.3°F [29.4/34.6°C]; evaporator fouling factor 0.0001hr.ft².°F/Btu [0.018 m²·K/kW]; condenser fouling factor 0.00025 hr.ft².°F/Btu [0.044 m²·K/kW]
2. 3 passes and flanges water connection may increase unit length up to 6".
3. Please consult factory for unit dimensions with different side of water connections and Marine Water Box options.

PHYSICAL SPECIFICATIONS

R134a

Model WCFX-EU		38T	40T	41S	46T	50T	54T	57T	60T	73T	75T
Nominal Capacity	TR	265.5	324.9	306.5	345.6	378.0	410.4	438.3	466.3	547.2	580.9
	kW	933.7	1142.6	1077.9	1215.4	1329.4	1443.3	1541.4	1639.9	1924.4	2042.9
Nominal Power Input	kW	159.90	195.30	188.40	208.00	227.80	247.10	264.40	281.70	332.80	353.80
Energy Efficiency	kW/TR	0.602	0.601	0.615	0.602	0.603	0.602	0.603	0.604	0.608	0.609
	COP	5.84	5.85	5.72	5.84	5.83	5.84	5.83	5.82	5.78	5.78
Min % Unit Capacity		12.50%	12.50%	25.00%	12.50%	12.50%	12.50%	12.50%	12.50%	12.50%	12.50%
No Of Refrigerant Circuit		1									
Power Supply		460V/3Ph/60Hz, 575V/3Ph/60Hz									
Compressor											
Model(Qty.)		1220(2)	1222(2)	2236(1)	1222(2)	1222(1)/ 1227(1)	1227(2)	1227(1)/ 1230(1)	1230(2)	2233(2)	2233(1)/ 2236(1)
Oil Charge Approx (Each)	Liter	55/55	50/50	60	50/50	50/46	46/46	46/46	46/46	62/62	62/60
Evaporator											
Model		5BRD	6CRD	6CRD	8DRD	KBRD	YARD	YBRD	YCRD	MARD	MBRD
Water Flow Rate	Usgpm	635.6	777.7	733.7	827.3	904.8	982.5	1049.0	1116.0	1310.0	1391.0
	L/s	40.1	49.1	46.3	52.2	57.1	62.0	66.2	70.4	82.6	87.8
Pressure Drop	ft.wg	17.4	16.6	15.0	11.0	11.0	11.1	11.5	11.8	13.0	13.3
	kPa	52.0	49.6	44.8	32.9	32.9	33.2	34.4	35.3	38.9	39.8
Design Press. Water Side psig[kPa]		150 [1034]									
Connection Size inches		8	8	8	10	10	10	10	10	12	12
Condenser											
Model		K3RD	K5RD	K5RD	M5RD	T5RD	YARD	YBRD	YCRD	JARD	JBRD
Water Flow Rate	Usgpm	806.3	986.3	933.5	1049.0	1148.0	1246.0	1331.0	1417.0	1664.0	1767.0
	L/s	50.9	62.2	58.9	66.2	72.4	78.6	84.0	89.4	105.0	111.5
Pressure Drop	ft.wg	15.5	15.1	13.8	9.3	10.1	9.6	10.0	10.1	11.8	11.1
	kPa	46.3	45.1	41.2	27.8	30.2	28.7	29.9	30.2	35.3	33.2
Design Press. Water Side psig[kPa]		150 [1034]									
Connection Size inches		8	8	8	10	10	10	10	10	12	12
General Information											
Length	inches	168 7/8	169 1/8	174 3/16	170 5/8	196 3/4	196 3/4	196 3/4	196 3/4	206 3/4	206 3/4
	mm	4290	4300	4430	4330	5000	4997	4997	4997	5250	5250
Width	inches	57 1/8	56 15/16	70	64 11/16	80	80	80	80	88	88
	mm	1450	1450	1780	1640	2032	2032	2032	2032	2240	2240
Height	inches	99	99	88	99	92	97	97	97	99	99
	mm	2520	2520	2230	2510	2337	2464	2464	2464	2520	2520
Shipping Weight	lbs	12579	13467	12826	15995	18398	19953	20464	21019	24974	25515
	kg	5705	6108	5817	7254	8344	9049	9281	9532	11326	11571
Operating Weight	lbs	13746	14892	14236	18005	20552	22387	22986	23646	27857	28588
	kg	6234	6754	6456	8166	9321	10153	10425	10724	12633	12965
Approx. R134a Charge	lbs	702	859	811	914	1000	1086	1160	1234	1448	1537
	kg	318	390	368	415	454	493	526	560	656	697

Notes: 1. The above data are models with 2-pass evaporator and condenser which rated in accordance with AHRI Standard 550/590 (I-P)-2015 at standard conditions. The standard rating conditions are as below:
Chilled Water Inlet/Outlet Temperature 54/44°F [12.2/6.7°C]; Cooling Water Inlet/Outlet Temperature 85/94.3°F [29.4/34.6°C]; evaporator fouling factor 0.0001hr.ft².°F/Btu [0.018 m²·K/kW]; condenser fouling factor 0.00025 hr.ft².°F/Btu [0.044 m²·K/kW]
2. 3 passes and flanges water connection may increase unit length up to 6".
3. Please consult factory for unit dimensions with different side of water connections and Marine Water Box options.

PHYSICAL SPECIFICATIONS

R513A

Model WCFX-EU		10S	12S	15S	19S	20S	23S	24S	27S	30S	36S
Nominal Capacity	TR	66.9	83.3	102.0	132.8	164.3	176.2	194.8	209.5	237.9	281.5
	kW	235.3	292.9	358.7	467.0	577.8	619.7	685.1	736.8	836.6	990.0
Nominal Power Input	kW	49.49	61.75	73.63	84.58	102.60	112.60	123.00	133.30	151.80	176.80
Energy Efficiency	kW/TR	0.740	0.741	0.722	0.637	0.625	0.639	0.631	0.636	0.638	0.628
	COP	4.75	4.75	4.87	5.52	5.63	5.50	5.57	5.53	5.51	5.60
Min % Unit Capacity		25.00%	25.00%	25.00%	25.00%	25.00%	25.00%	25.00%	25.00%	25.00%	25.00%
No Of Refrigerant Circuit		1									
Power Supply		460V/3Ph/60Hz, 575V/3Ph/60Hz									
Compressor											
Model(Qty.)		1210(1)	1212(1)	1215(1)	1220(1)	1222(1)	1222(1)	1227(1)	1227(1)	1230(1)	2233(1)
Oil Charge Approx (Each)	Liter	37.3	33.5	45.2	55	50	50	46	46	46	62
Evaporator											
Model		C2RD	C3RD	D2RD	E2RD	2CRD	2DRD	EARD	JARD	JBRD	6ARD
Water Flow Rate	Usgpm	160.0	199.4	244.2	317.8	393.3	421.8	466.4	501.6	569.4	673.9
	L/s	10.1	12.6	15.4	20.1	24.8	26.6	29.4	31.6	35.9	42.5
Pressure Drop	ft.wg	5.1	5.5	5.4	5.6	13.8	14.1	14.3	13.1	14.6	16.5
	kPa	15.2	16.4	16.1	16.7	41.2	42.1	42.7	39.2	43.6	49.3
Design Press. Water Side psig[kPa]		150 [1034]									
Connection Size inches		4	5	6	6	6	6	6	8	8	8
Condenser											
Model		B3RD	B4RD	B5RD	C2RD	E5RD	4ARD	5ARD	5BRD	5CRD	K4RD
Water Flow Rate	Usgpm	209.8	261.5	318.7	406.7	501.6	539.8	595.8	641.6	728.6	860.2
	L/s	13.2	16.5	20.1	25.7	31.6	34.1	37.6	40.5	46.0	54.3
Pressure Drop	ft.wg	6.1	6.3	6.5	7.4	14.9	15.6	16.1	15.6	15.4	15.3
	kPa	18.2	18.8	19.4	22.1	44.5	46.6	48.1	46.6	46.0	45.7
Design Press. Water Side psig[kPa]		150 [1034]									
Connection Size inches		4	5	5	6	5	6	6	6	6	8
General Information											
Length	inches	117 3/8	123 3/8	123 3/8	123 5/8	155 3/8	155 3/8	149 7/8	149 7/8	149 7/8	174 3/16
	mm	2980	3130	3130	3140	3950	3950	3810	3810	3810	4430
Width	inches	44 5/16	45 1/8	48 1/2	53 15/16	49 3/8	53 5/8	53 3/8	55 5/8	55 5/8	70
	mm	1130	1150	1230	1370	1250	1360	1360	1410	1410	1780
Height	inches	78	78	85	97	96	96	99	99	99	88
	mm	1980	1980	2160	2460	2440	2440	2520	2520	2520	2230
Shipping Weight	lbs	4298	4578	5262	6979	7018	7362	8127	8753	9284	12291
	kg	1949	2076	2386	3165	3183	3339	3685	3970	4210	5574
Operating Weight	lbs	4659	5007	5773	7612	7710	8099	8953	9673	10280	13547
	kg	2113	2271	2618	3452	3496	3673	4060	4387	4662	6144
Approx. R513A Charge	lbs	177	220	270	351	435	466	515	554	629	745
	kg	80	100	122	159	197	211	234	251	285	338

Notes: 1. The above data are models with 2-pass evaporator and condenser which rated in accordance with AHRI Standard 550/590 (I-P)-2015 at standard conditions. The standard rating conditions are as below:
Chilled Water Inlet/Outlet Temperature 54/44°F [12.2/6.7°C]; Cooling Water Inlet/Outlet Temperature 85/94.3°F [29.4/34.6°C]; evaporator fouling factor 0.0001hr.ft².°F/Btu [0.018 m²·K/kW]; condenser fouling factor 0.00025 hr.ft².°F/Btu [0.044 m²·K/kW]
2. 3 passes and flanges water connection may increase unit length up to 6".
3. Please consult factory for unit dimensions with different side of water connections and Marine Water Box options.

PHYSICAL SPECIFICATIONS

R513A

Model WCFX-EU		38T	40T	46T	50T	54T	57T	60T	73T
Nominal Capacity	TR	270.4	330.8	357.0	390.5	424.0	452.9	481.7	565.1
	kW	950.9	1163.4	1255.5	1373.3	1491.1	1592.8	1694.0	1987.3
Nominal Power Input	kW	166.80	203.70	219.90	240.80	261.10	279.50	297.80	351.80
Energy Efficiency	kW/TR	0.617	0.616	0.616	0.617	0.616	0.617	0.618	0.623
	COP	5.70	5.71	5.71	5.70	5.71	5.70	5.69	5.65
Min % Unit Capacity		12.50%	12.50%	12.50%	12.50%	12.50%	12.50%	12.50%	12.50%
No Of Refrigerant Circuit		1							
Power Supply		460V/3Ph/60Hz, 575V/3Ph/60Hz							
Compressor									
Model(Qty.)		1220(2)	1222(2)	1222(2)	1222(1)/ 1227(1)	1227(2)	1227(1)/ 1230(1)	1230(2)	2233(2)
Oil Charge Approx (Each)	Liter	55/55	50/50	50/50	50/46	46/46	46/46	46/46	62/62
Evaporator									
Model		5BRD	6CRD	8DRD	KBRD	YARD	YBRD	YCRD	MARD
Water Flow Rate	Usgpm	647.2	791.9	854.7	934.8	1015.0	1084.0	1153.0	1353.0
	L/s	40.8	50.0	53.9	59.0	64.0	68.4	72.7	85.4
Pressure Drop	ft.wg	18.0	17.2	11.7	11.6	11.7	12.2	12.5	13.9
	kPa	53.8	51.4	35.0	34.7	35.0	36.5	37.4	41.5
Design Press. Water Side psig[kPa]		150 [1034]							
Connection Size inches		8	8	10	10	10	10	10	12
Condenser									
Model		K3RD	K5RD	M5RD	T5RD	YARD	YBRD	YCRD	JARD
Water Flow Rate	Usgpm	823.9	1008.0	1088.0	1190.0	1292.0	1380.0	1469.0	1725.0
	L/s	52.0	63.6	68.6	75.1	81.5	87.1	92.7	108.8
Pressure Drop	ft.wg	16.1	15.7	9.9	10.8	10.2	10.6	10.8	12.6
	kPa	48.1	46.9	29.6	32.3	30.5	31.7	32.3	37.7
Design Press. Water Side psig[kPa]		150 [1034]							
Connection Size inches		8	8	10	10	10	10	10	12
General Information									
Length	inches	168 7/8	169 1/8	170 5/8	196 3/4	196 3/4	196 3/4	196 3/4	206 3/4
	mm	4290	4300	4330	5000	4997	4997	4997	5250
Width	inches	57 1/8	56 15/16	64 11/16	80	80	80	80	88
	mm	1450	1450	1640	2032	2032	2032	2032	2240
Height	inches	99	99	99	92	97	97	97	99
	mm	2520	2520	2510	2337	2464	2464	2464	2520
Shipping Weight	lbs	12579	13467	15995	18398	19953	20464	21019	24974
	kg	5705	6108	7254	8344	9049	9281	9532	11326
Operating Weight	lbs	13746	14892	18005	20552	22387	22986	23646	27857
	kg	6234	6754	8166	9321	10153	10425	10724	12633
Approx. R513A Charge	lbs	715	875	945	1033	1122	1198	1274	1495
	kg	324	397	429	469	509	543	578	678

Notes: 1. The above data are models with 2-pass evaporator and condenser which rated in accordance with AHRI Standard 550/590 (I-P)-2015 at standard conditions. The standard rating conditions are as below:
Chilled Water Inlet/Outlet Temperature 54/44°F [12.2/6.7°C]; Cooling Water Inlet/Outlet Temperature 85/94.3°F [29.4/34.6°C]; evaporator fouling factor 0.0001hr.ft².°F/Btu [0.018 m²·K/kW]; condenser fouling factor 0.00025 hr.ft².°F/Btu [0.044 m²·K/kW]
2. 3 passes and flanges water connection may increase unit length up to 6".
3. Please consult factory for unit dimensions with different side of water connections and Marine Water Box options.

SOUND PRESSURE DATA

Model WCFX-EU	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	82
19S	68	57	63	68	75	72	72	54	79
20S	68	57	63	68	75	72	72	54	79
23S	68	57	63	68	75	72	72	54	79
24S	69	59	64	68	76	73	74	56	80
27S	69	59	64	68	76	73	74	56	80
30S	70	61	65	69	78	75	74	59	81
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
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
73T	74	65	69	73	82	79	78	63	85
75T	74	65	69	73	82	79	78	63	85

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

ELECTRICAL DATA

R134a

Model WCFX-EU	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)
23S		400	225	1222(1)	180(1)	302(1)	733(1)
24S		450	264	1227(1)	211(1)	394(1)	904(1)
27S		450	264	1227(1)	211(1)	394(1)	904(1)
30S		500	295	1230(1)	236(1)	476(1)	999(1)
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)
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)
73T		1000	617	2233(2)	274(2)	610(2)	1334(2)
75T		1000	667	2233(1)/ 2236(1)	274(1)/ 314(1)	610(1)/ 718(1)	1334(1)/ 1760(1)

Note: RLA – Rated Load Amps LRA – Locked Rotor Amps

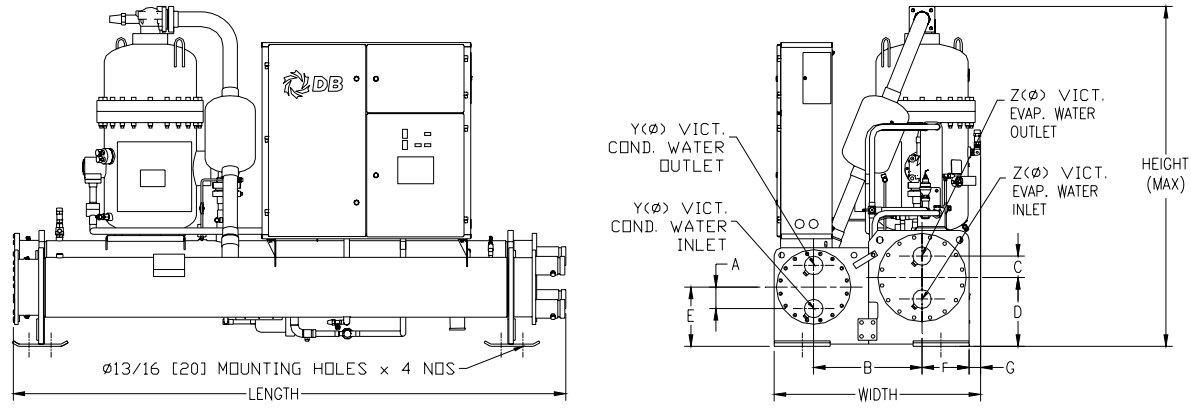
R513A

Model WCFX-EU	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)
23S		400	225	1222(1)	180(1)	302(1)	733(1)
24S		450	264	1227(1)	211(1)	394(1)	904(1)
27S		450	264	1227(1)	211(1)	394(1)	904(1)
30S		500	295	1230(1)	236(1)	476(1)	999(1)
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)
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)
73T		1000	617	2233(2)	274(2)	610(2)	1334(2)

Note: RLA – Rated Load Amps LRA – Locked Rotor Amps

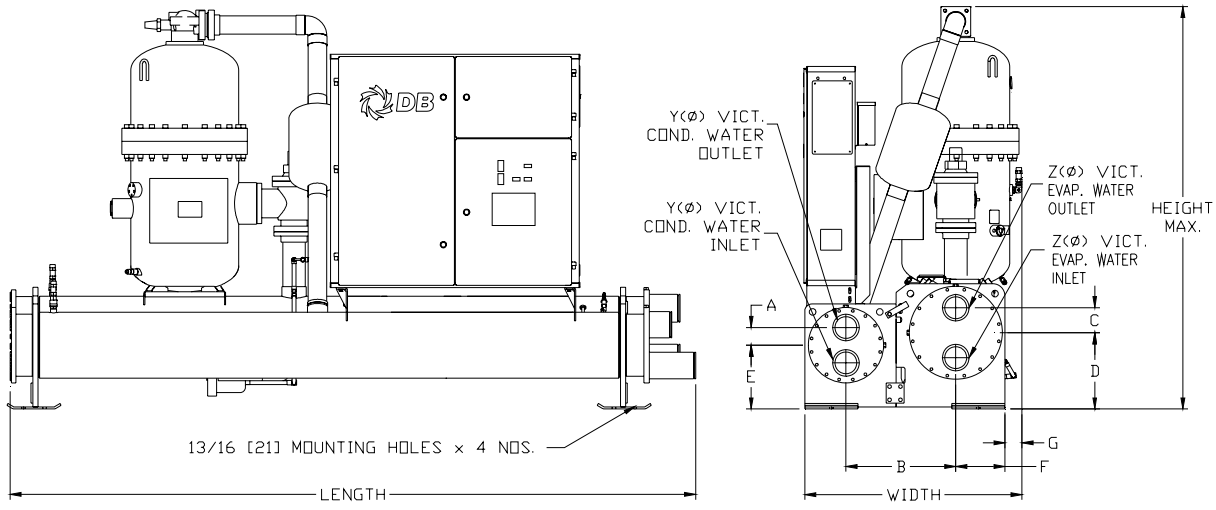
DIMENSIONAL DATA

WCFX-EU 10S, 12S, 15S



Model WCFX-EU	HZ	Dimensions- inches [mm]										Water Connector - inches	
		Length	Width	Height	A	B	C	D	E	F	G	YØ	ZØ
10S	60	117 3/8 [2980]	44 5/16 [1130]	78 [1980]	4 5/8 [118]	23 1/4 [591]	4 5/8 [117]	14 3/4 [374]	12 11/16 [322]	10 1/16 [256]	2 1/2 [65]	4	4
12S		123 3/8 [3130]	45 1/8 [1150]	78 [1980]	4 [102]	23 1/2 [597]	5 1/8 [130]	14 3/4 [374]	13 3/16 [335]	10 1/16 [256]	3 [76]	5	5
15S		123 3/8 [3130]	48 1/2 [1230]	85 [2160]	4 [102]	24 13/16 [630]	5 5/8 [143]	17 1/4 [438]	14 7/16 [366]	11 1/8 [282]	2 7/8 [73]	5	6

WCFX-EU 19S, 20S, 24S

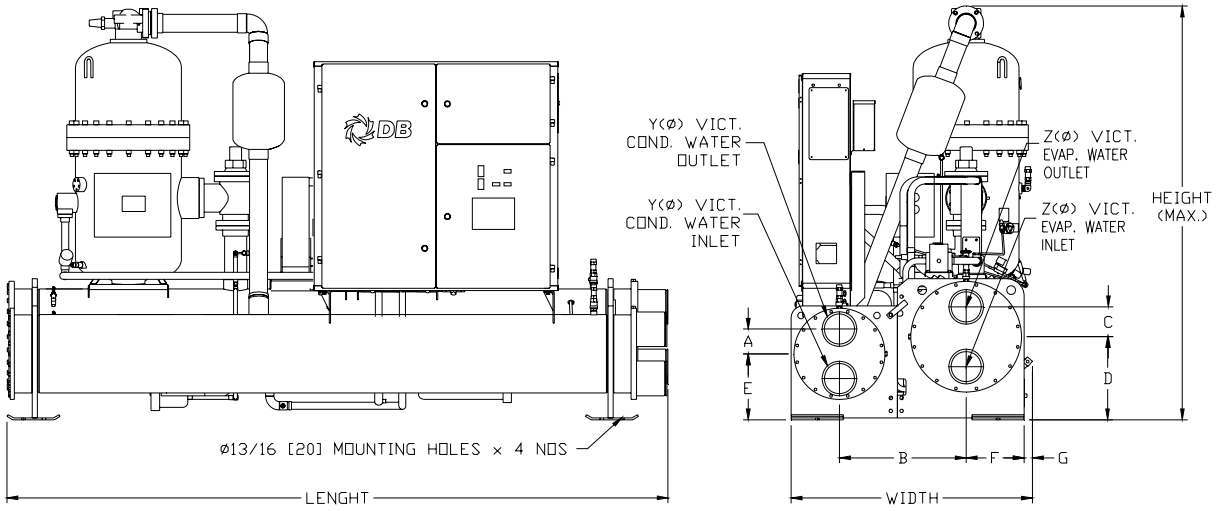


Model WCFX-EU	HZ	Dimensions- inches [mm]										Water Connector - inches	
		Length	Width	Height	A	B	C	D	E	F	G	YØ	ZØ
19S	60	123 5/8 [3140]	53 15/16 [1370]	97 [2460]	4 1/2 [114]	28 3/16 [716]	5 5/8 [143]	18 1/4 [464]	15 7/16 [392]	12 3/8 [314]	3 5/16 [84]	6	6
20S		155 3/8 [3950]	49 3/8 [1250]	96 [2440]	4 [101]	24 3/16 [630]	5 5/8 [143]	17 1/4 [438]	14 7/16 [366]	11 1/8 [283]	3 3/4 [95]	5	6
24S		149 7/8 [3810]	53 3/8 [1360]	99 [2520]	5 5/8 [142]	27 3/8 [695]	5 5/8 [143]	18 1/4 [464]	15 1/4 [387]	12 3/8 [314]	2 3/4 [70]	6	6

Notes: 1.) Above drawings and dimensions are models with vessels construction based on flat head and comply with PED/ Chinese Machinery codes.
2.) Unit layout shown are for reference only. Some orientations may vary.
3.) Consult factory for models with ASME/ other approved vessels.

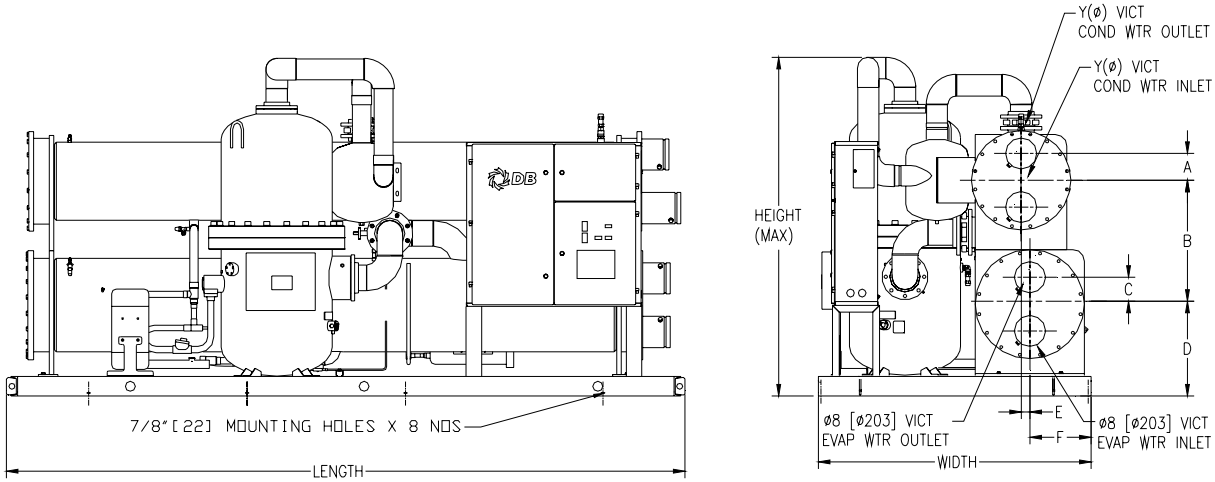
DIMENSIONAL DATA

WCFX-EU 23S, 27S, 30S



Model WCFX-EU	HZ	Dimensions- inches [mm]										Water Connector - inches	
		Length	Width	Height	A	B	C	D	E	F	G	YØ	ZØ
23S	60	155 3/8 [3950]	53 [1360]	96 [2440]	4 1/2 [114]	27 9/16 [701]	5 5/8 [143]	17 1/4 [438]	15 7/16 [392]	11 1/48 [280]	4 7/8 [124]	6	6
27S		149 7/8 [3810]	55 5/8 [1410]	99 [2520]	5 5/8 [143]	29 3/16 [742]	6 7/8 [175]	19 3/16 [487]	15 1/4 [387]	13 3/8 [340]	1 15/16 [49]	6	8
30S		149 7/8 [3810]	55 5/8 [1410]	99 [2520]	5 5/8 [143]	29 3/16 [742]	6 7/8 [175]	19 3/16 [487]	15 1/4 [387]	13 3/8 [340]	1 15/16 [49]	6	8

WCFX-EU 36S, 41S

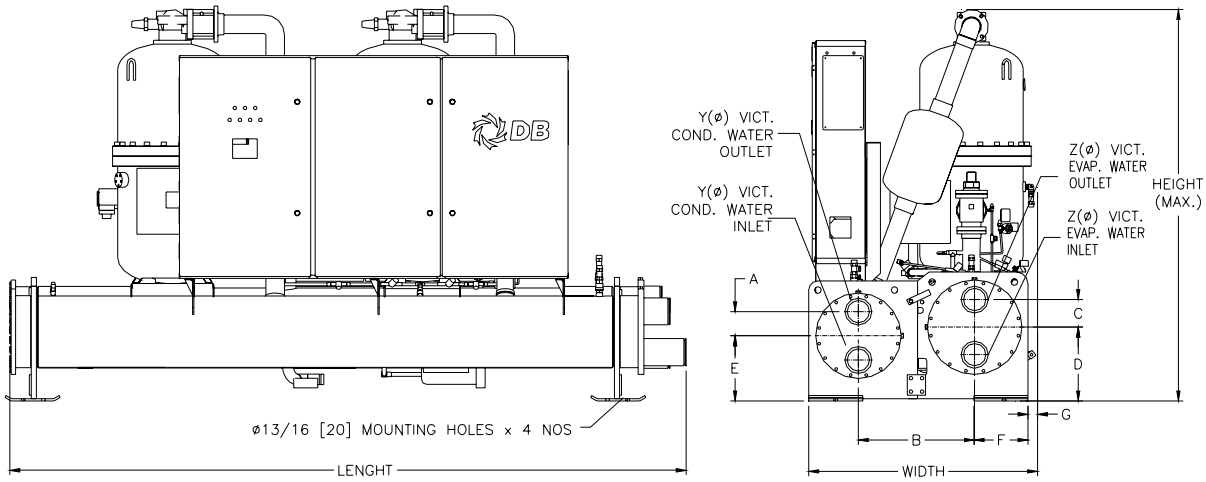


Model WCFX-EU	Hz	Dimensions- inches [mm]									Water Connector - inches	
		Length	Width	Height	A	B	C	D	E	F	YØ	ZØ
36S	60	174 3/16 [4430]	70 [1780]	88 [2230]	6 1/16 [155]	33 1/4 [844]	6 7/8 [175]	23 5/16 [592]	2 1/8 [54]	15 7/8 [403]	8	8
41S		174 3/16 [4430]	70 [1780]	88 [2230]	6 1/16 [155]	33 1/4 [844]	6 7/8 [175]	23 5/16 [592]	2 1/8 [54]	15 7/8 [403]	8	8

Notes: 1.) Above drawings and dimensions are models with vessels construction based on flat head and comply with PED/ Chinese Machinery codes.
2.) Unit layout shown are for reference only. Some orientations may vary.
3.) Consult factory for models with ASME/ other approved vessels.

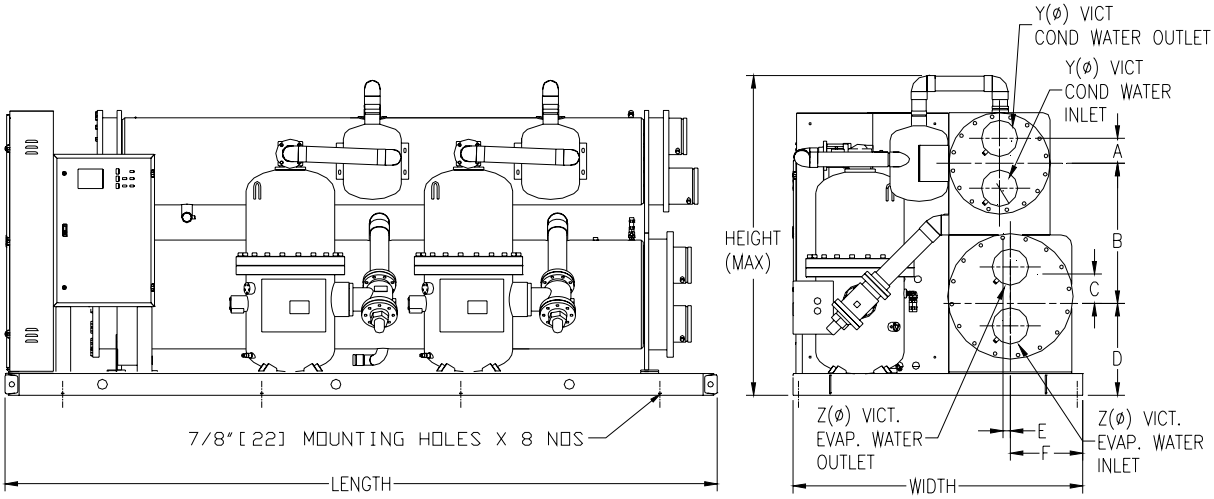
DIMENSIONAL DATA

WCFX-EU 38T, 40T, 46T



Model WCFX-EU	Hz	Dimensions- inches [mm]										Water Connector - inches	
		Length	Width	Height	A	B	C	D	E	F	G	YØ	ZØ
38T	60	168 7/8 [4290]	57 1/8 [1450]	99 [2520]	6 1/16 [153]	29 [737]	6 7/8 [175]	19 3/16 [487]	16 1/4 [413]	13 3/8 [340]	2 3/8 [60]	8	8
40T		169 1/8 [4300]	56 15/16 [1450]	99 [2510]	6 1/16 [153]	28 13/16 [732]	6 7/8 [175]	20 1/4 [514]	16 1/4 [413]	14 7/16 [367]	1 5/16 [33]	8	8
46T		170 5/8 [4330]	64 11/16 [1640]	99 [2510]	6 7/8 [175]	32 13/16 [834]	8 1/8 [206]	19 7/16 [494]	20 3/16 [513]	16 7/16 [418]	1 [25]	10	10

WCFX-EU 50T

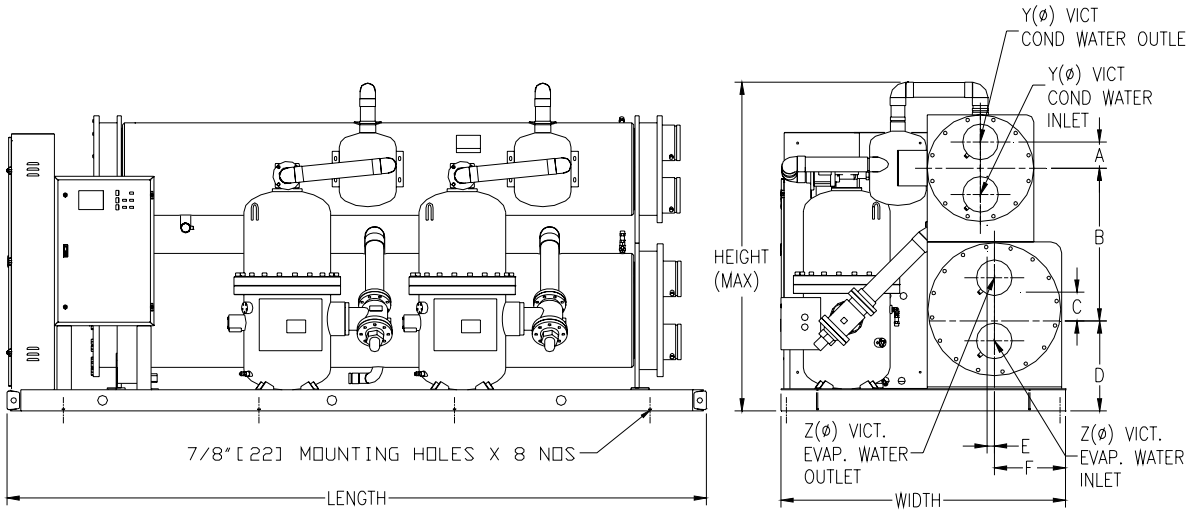


Model WCFX-EU	Hz	Dimensions- inches [mm]									Water Connector – inches	
		Length	Width	Height	A	B	C	D	E	F	YØ	ZØ
50T	60	196 3/4 [5000]	80 [2032]	92 [2337]	6 7/8 [175]	36 3/4 [934]	8 5/8 [219]	27 5/16 [694]	3 [76]	20 [508]	10	10

Notes: 1.) Above drawings and dimensions are models with vessels construction based on flat head and comply with PED/ Chinese Machinery codes.
2.) Unit layout shown are for reference only. Some orientations may vary.
3.) Consult factory for models with ASME/ other approved vessels.

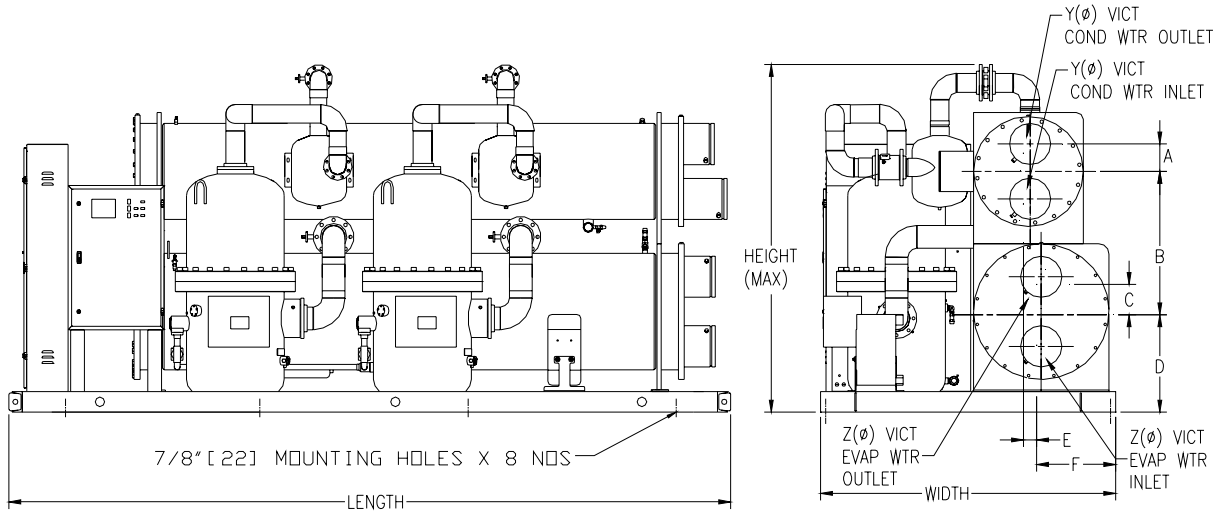
DIMENSIONAL DATA

WCFX-EU 54T, 57T, 60T



Model WCFX-EU	Hz	Dimensions- inches [mm]									Water Connector – inches	
		Length	Width	Height	A	B	C	D	E	F	YØ	ZØ
54T	60	196 3/4 [4997]	80 [2032]	97 [2464]	7 3/8 [187]	39 11/16 [1008]	8 7/8 [226]	28 5/16 [719]	3 7/8 [99]	20 [508]	10	10
57T		196 3/4 [4997]	80 [2032]	97 [2464]	7 3/8 [187]	39 11/16 [1008]	8 7/8 [225]	28 5/16 [719]	3 7/8 [99]	20 [508]	10	10
60T		196 3/4 [4997]	80 [2032]	97 [2464]	7 3/8 [187]	39 11/16 [1008]	8 7/8 [225]	28 5/16 [719]	3 7/8 [99]	20 [508]	10	10

WCFX-EU 73T, 75T

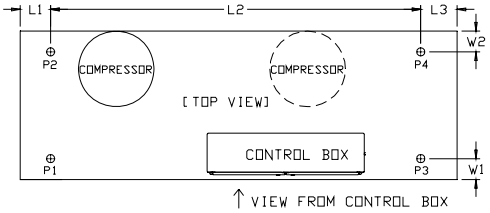


Model WCFX-EU	Hz	Dimensions- inches [mm]									Water Connector - inches	
		Length	Width	Height	A	B	C	D	E	F	YØ	ZØ
73T	60	206 3/4 [5250]	88 [2240]	99 [2520]	8 [203]	40 13/16 [1036]	10 1/8 [258]	29 5/16 [744]	3 1/4 [82]	24 1/2 [622]	12	12
75T		206 3/4 [5250]	88 [2240]	99 [2520]	8 [203]	40 13/16 [1036]	10 1/8 [258]	29 5/16 [744]	3 1/4 [83]	24 1/2 [622]	12	12

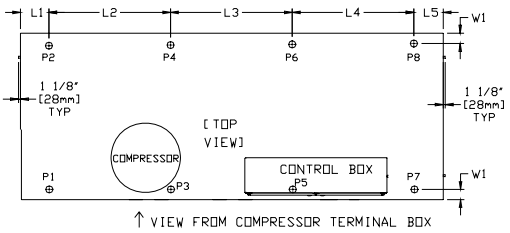
Notes: 1.) Above drawings and dimensions are models with vessels construction based on flat head and comply with PED/ Chinese Machinery codes.
2.) Unit layout shown are for reference only. Some orientations may vary.
3.) Consult factory for models with ASME/ other approved vessels.

FLOOR LOADING DIAGRAM

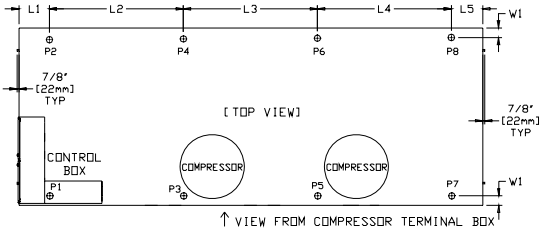
WCFX-EU 10S, 12S, 15S, 19S, 20S, 23S, 24S, 27S, 30S, 38T, 40T, 46T



WCFX-EU 36S, 41S



WCFX-EU 50T, 54T, 57T, 60T, 73T, 75T



POINT LOAD LOCATION - INCHES[MM]

Model WCFX-EU	L1	L2	L3	L4	L5	W1	W2
10S	3 1/8 [79]	105 7/8 [2689]	14 3/8 [365]	-	-	6 [153]	8 1/2 [220]
12S	3 1/8 [79]	105 7/8 [2689]	14 3/8 [365]	-	-	6 [153]	7 7/16 [189]
15S	3 3/8 [86]	105 7/8 [2689]	14 3/8 [365]	-	-	6 [153]	7 9/16 [192]
19S	3 3/8 [86]	105 7/8 [2689]	8 5/8 [219]	-	-	6 [153]	8 7/16 [214]
20S	3 3/8 [86]	137 7/8 [3503]	8 5/8 [219]	-	-	6 [153]	8 1/2 [216]
23S	3 3/8 [86]	137 7/8 [3503]	8 5/8 [219]	-	-	6 [153]	7 15/16 [202]
24S	3 3/8 [86]	137 7/8 [3503]	8 5/8 [219]	-	-	6 [153]	7 15/16 [202]
27S	3 5/8 [92]	137 7/8 [3503]	8 5/8 [219]	-	-	6 [153]	7 1/2 [191]
30S	3 5/8 [92]	137 7/8 [3503]	14 5/8 [371]	-	-	6 [153]	7 1/2 [191]
36S	20 [508]	40 11/16 [1033]	40 11/16 [1033]	50 11/16 [1287]	20 [508]	11/16 [17]	-
38T	3 5/8 [92]	150 7/8 [3832]	14 5/8 [371]	-	-	6 [152]	7 5/16 [186]
40T	4 7/8 [124]	150 7/8 [3832]	14 7/8 [378]	-	-	6 [152]	6 [152]
41S	20 [508]	40 11/16 [1033]	40 11/16 [1033]	50 11/16 [1287]	20 [508]	11/16 [17]	-
46T	4 7/8 [124]	150 7/8 [3832]	14 7/8 [378]	-	-	6 [152]	6 7/8 [175]
50T	15 [381]	55 [1397]	55 [1397]	55 [1397]	15 [381]	1 1/2 [38]	-
54T	15 [381]	55 [1397]	55 [1397]	55 [1397]	15 [381]	1 1/2 [38]	-
57T	15 [381]	55 [1397]	55 [1397]	55 [1397]	15 [381]	1 1/2 [38]	-
60T	15 [381]	55 [1397]	55 [1397]	55 [1397]	15 [381]	1 1/2 [38]	-
73T	15 [381]	53 11/16 [1363]	60 11/16 [1541]	60 11/16 [1541]	15 [381]	1 1/2 [38]	-
75T	15 [381]	53 11/16 [1363]	60 11/16 [1541]	60 11/16 [1541]	15 [381]	1 1/2 [38]	-

POINT LOAD DATA –LBS[KG]

Model WCFX-EU	P1	P2	P3	P4	P5	P6	P7	P8	P9	Operating Weight
10S	1076 [488]	1501 [681]	1066 [483]	1016 [461]	-	-	-	-	-	4659 [2113]
12S	1172 [531]	1567 [711]	1178 [534]	1090 [495]	-	-	-	-	-	5007 [2271]
15S	1289 [585]	1934 [877]	1241 [563]	1309 [594]	-	-	-	-	-	5773 [2618]
19S	1677 [761]	2477 [1123]	1732 [785]	1727 [783]	-	-	-	-	-	7612 [3452]
20S	1858 [842]	2586 [1173]	1684 [764]	1581 [717]	-	-	-	-	-	7710 [3496]
23S	1998 [906]	2633 [1194]	1829 [829]	1639 [743]	-	-	-	-	-	8099 [3673]
24S	2178 [988]	3113 [1412]	1847 [837]	1816 [823]	-	-	-	-	-	8953 [4060]
27S	2228 [1010]	3274 [1485]	2049 [929]	2123 [963]	-	-	-	-	-	9673 [4387]
30S	2371 [1075]	3509 [1592]	2162 [980]	2239 [1015]	-	-	-	-	-	10280 [4662]
36S	1557 [706]	2083 [945]	1483 [672]	1988 [902]	1408 [639]	1894 [859]	1333 [605]	1800 [816]	-	13547 [6144]
38T	2926 [1327]	4028 [1827]	3009 [1365]	3783 [1716]	-	-	-	-	-	13746 [6234]
40T	3186 [1445]	4364 [1979]	3255 [1476]	4087 [1853]	-	-	-	-	-	14892 [6754]
41S	1628 [738]	2200 [998]	1548 [702]	2101 [953]	1468 [666]	2001 [908]	1389 [630]	1902 [862]	-	14236 [6456]
46T	4068 [1845]	5122 [2323]	4046 [1835]	4769 [2163]	-	-	-	-	-	18005 [8166]
50T	2356 [1069]	2753 [1249]	2312 [1049]	2816 [1277]	2269 [1029]	2879 [1306]	2225 [1009]	2941 [1334]	-	20552 [9321]
54T	2506 [1136]	3024 [1372]	2474 [1122]	3100 [1406]	2443 [1108]	3176 [1440]	2412 [1094]	3252 [1475]	-	22387 [10153]
57T	2597 [1178]	3096 [1404]	2558 [1160]	3171 [1438]	2518 [1142]	3246 [1472]	2479 [1124]	3322 [1506]	-	22986 [10425]
60T	2664 [1208]	3168 [1437]	2636 [1196]	3249 [1473]	2609 [1183]	3329 [1510]	2582 [1171]	3410 [1546]	-	23646 [10724]
73T	3522 [1597]	3610 [1637]	3319 [1505]	3701 [1679]	3116 [1413]	3792 [1720]	2913 [1321]	3883 [1761]	-	27857 [12633]
75T	3601 [1633]	3714 [1684]	3394 [1539]	3809 [1727]	3187 [1445]	3904 [1770]	2980 [1352]	3999 [1814]	-	28588 [12965]

Notes: 1.) Unit must be lowered onto mounting springs in a level fashion or spring damage may occur.

UNIT CLEARANCE

CLEARANCE FOR SERVICE

Sufficient clearance around the unit is required to ensure proper unit operation, and as space for service and maintenance works.

Below clearance requirements are general guideline, where local health and safety regulations and other practical considerations shall be taken into account. Failure to allow these clearances will cause serious trouble and result in higher costs for operation, maintenance and repair.

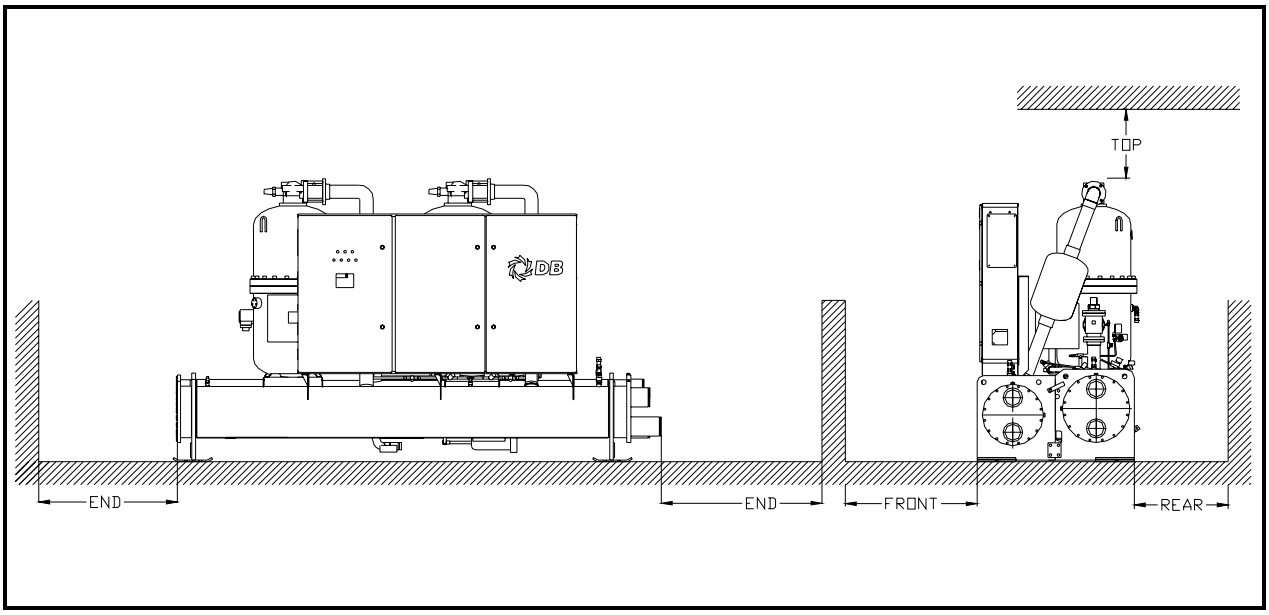
Front – 45” [1143mm]

Rear – 18” [457mm]

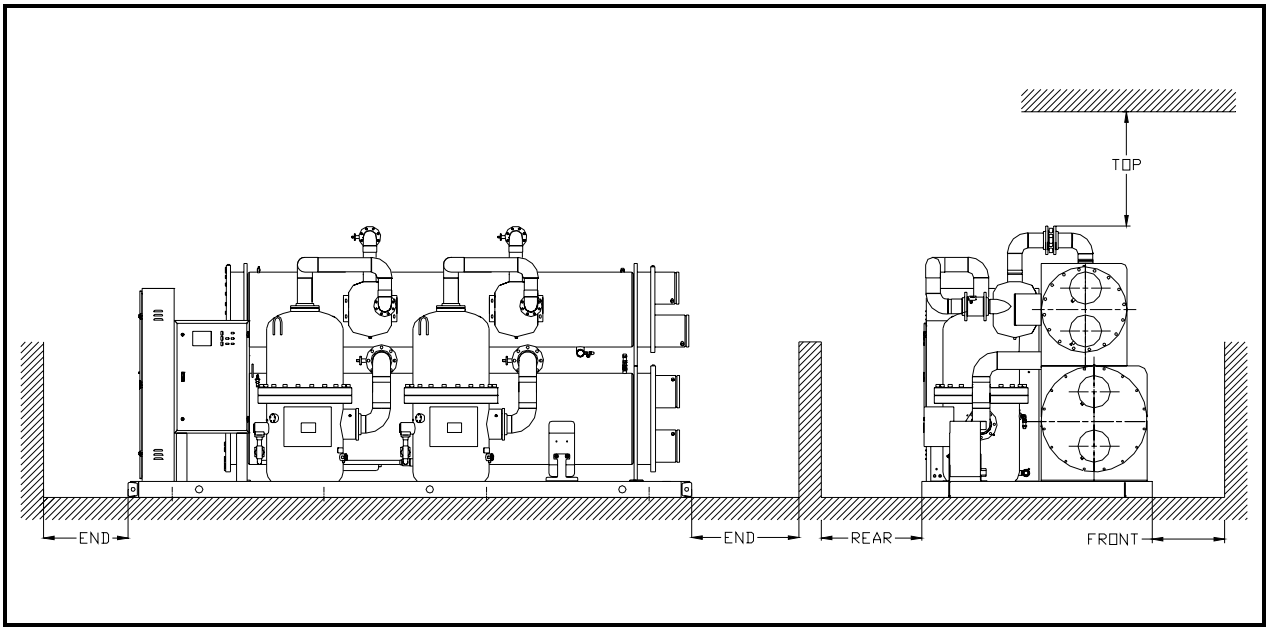
Top – 18” [457mm]

End – Tube length at one side for tube servicing; 36” [914mm] at the other end

Single/ Two Compressors (Side-By-Side Construction)



Single/ Two Compressors (Base Construction)



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 increasing 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 changed shall not exceeded 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	39.2 °F [4.0 °C]	50 °F [10 °C]
Dual Mode Operation (with PG 30%)	22.5 °F [-5.3 °C]	50 °F [10 °C]
Dual Mode Operation (with EG 30%)	20.1°F [-6.6°C]	50 °F [10 °C]

Performance Correction- Evaporator Fouling Factor

Fouling Factor		Capacity Correction Factor	kW-input Correction Factor
hr.ft².°F/BTU	m².°C/kW		
0.00010	0.018	1.000	1.000
0.00025	0.044	0.995	0.998
0.00050	0.088	0.985	0.995
0.00075	0.132	0.975	0.991
0.00100	0.176	0.964	0.987

CONDENSER FLUID CIRCUIT

The unit shall works 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.ft².°F/BTU	m².°C/kW		
0.00025	0.044	1.000	1.000
0.00050	0.088	0.998	1.007
0.00075	0.132	0.996	1.010
0.00100	0.176	0.995	1.014

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 39.2°F [4°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

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-EU 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-EU 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.

APPLICATION DATA

Lower Energy Consumption

The efficient unloading characteristics of the Dunham-Bush WCFX-EU 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.

Greater Design Flexibility

The heat recovery Dunham-Bush WCFX-EU 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.

Retrofit Knockdown

It is estimated that fifty percent of retrofit applications require partial or complete disassembly of the chiller. WCFX-EU chillers are relatively easy to disassemble due to the simple and compact design arrangement. Two knockdown arrangements, Type A and Type B, are available as option. Do consult factory for further details including the price involve.

Type A: Complete knockdown ready (CKD)

1.) Chillers are built and shipped completely assembled with bolt-together construction (with flanges, bolts, nuts, refrigerant isolation valves on major components) for the unit to be readily disassemble and reassemble at site.

2.) Unit will be shipped with a refrigerant charged.

3.) Unit will be fully tested prior to shipment.

4.) Site disassemble and reassemble process shall be supervised and handled by a competent personnel.

5.) End plates or block off plates are required to cover any refrigerant connection left open for extended period of time.

6.) Do consult factory for a special arrangements (out of the above) and on the price involve.

7.) Do refer to MP-036 for details on disassemble and site reassemble procedure.

Type B: Partial Knockdown (PKD)

1.) Apart of major components, (compressor/ control panel/ condenser/ evaporator) are removed (at the factory), and shipped on separate skids. Others are shipped as a complete sub assembly as possible.

2.) All associated piping and wiring remain attached, if possible.

3.) Suction and discharge lines have bolt-on flanges and remain attached, if possible.

4.) All free ends are capped.

5.) Refrigerant will not be shipped with the chiller and must be procure by others.

6.) Unit will be fully tested at the factory prior to shipment.

7.) Site reassemble process shall be supervised and handled by a competent personnel.

8.) Do consult factory for a special arrangements (out of the above) and on the price involve.

9.) Do refer to MP-036 for details on disassemble and site reassemble procedure.

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 1°F [0.55°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-EU 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.

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-EU Chillers, with positive displacement rotary screw compressor can easily cool low temperature glycol down to 20°F [-6.7 ^{o}C] to charge the ice storage tanks. The same chiller can also produce warmer supply fluid temperature, 40 to 45 ^{o}F [4.4 to 7.2 ^{o}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

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 & R513A. 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 [0.000044m².°C/W] for the water condenser and 0.0001 hr.sq.ft.°F/BTU [0.0000176 m².°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] 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

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 60Hz with unit rated voltage +/-10%. Control Voltage shall be 115V/1ph/60Hz.

COMPRESSOR AND MOTOR

The packaged chiller shall be furnished with semi hermetic direct connected positive displacement rotary screw compressor(s) as required, driven by a 3500 RPM 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 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 ¾ 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 thick Polyethylene resin having K factor of 0.26 btu-in / hr – ft² – °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 ¾ 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.)

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 or Star-Delta 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.

GUIDE SPECIFICATIONS

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. 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, and 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
- Programmable with Seven day operation cycle
- [Optional] chilled liquid and condenser water pump on/off control
- [Optional] dual mode operation to produce Ice at 21°F-26°F 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 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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