DB

HYPERION

Water Cooled Screw Chillers

WCHX-A 50Hz

Cooling Capacity: 85 to 400 TR (300 to 1467 kW)

R134a

AHRI CERTIFIED

ASHRAE 90.1 COMPLIANT

DUNHAM-BUSH®

Products that perform...By people who care

INTRODUCTION

For more than 100 years, Dunham-Bush has focused on innovative product development. Today, we provide a full portfolio of HVAC/R products from Fan Coil Units to large centrifugal chillers as well as many other innovative green solutions. Our commitment to innovation, matched with an aggressive attitude toward growth, makes Dunham-Bush a leader in global markets. Our product development is tailored to meet the specific needs of customers, building-by-building, country-by-country and region-by-region. No other HVAC/R manufacturer takes this approach to meeting your performance expectations.

The Dunham-Bush name is synonymous worldwide with the Rotary Screw Compressor Chillers technology. With over 45 years of proven experience and track records in manufacturing and installation of Rotary Screw Compressors and chillers, thousands of our Chillers have clocked more than 100,000 operating hours without any compressor tear-out or overhaul! As a pioneer and industry leader in the Rotary Screw compressor technology for HVAC/R systems, Dunham-Bush now introduces the Water Cooled Rotary Screw Flooded Chillers with unsurpassed performance and reliability.

WCHX-A Water Cooled Screw Chillers, using environmentally sound R134a refrigerant. The entire product line features high energy efficiency, compact construction, installation ease, control flexibility, high reliability and advanced controller. The WCHX-A series are certified to AHRI Standard 550-590, meets ASHRAE Standard 90.1.

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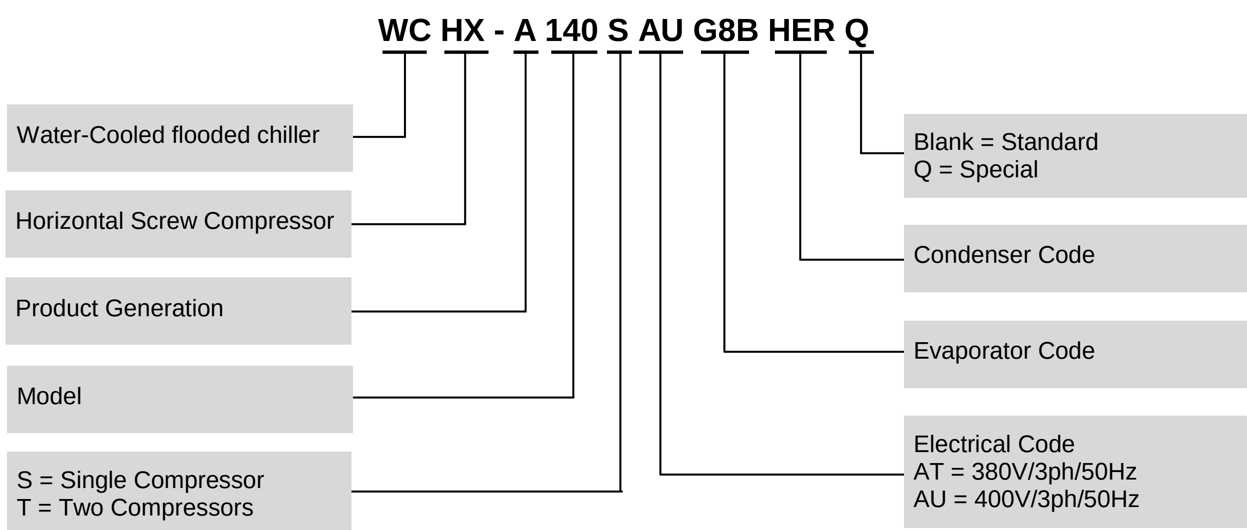
NOMENCLATURE



UNIT FEATURES

COMPRESSOR

- Semi-hermetic Rotary Twin Screw Compressor
- Suction gas-cooled compressor motor
- Multiple rotary screw compressors design for better reliability and redundancy
- External oil pump not required
- Optimized oil management
- Infinite variable capacity control with sliding valve mechanism

REFRIGERANT LIQUID LEVEL CONTROL

By using Electronic Expansion Valve (EEV), the refrigerant flow into evaporator can be control precisely. In such, the refrigerant liquid level in evaporator can be controlled at the optimum level to maximized heat transfer in the flooded type, shell-and-tube heat exchanger.

COMPACT FOOTPRINT

The revolutionary new WCHX-A compact water cooled screw chiller innovative, space-conscious design elements focused on convenience and serviceability into the smallest footprint available and helps the chiller fit in buildings where space is limited, making it ideal for retrofit projects.

Having one of the smallest footprints in its class allows the WCHX-A Series to occupy less space in cramped mechanical rooms and it can pass through in single access door

ECONOMIZER

- The economizer circuit consists of plate type heat exchanger, expansion valve and solenoid valve on a dedicated models
- Refrigerant is sub-cooled at economizer before entering the evaporator; the flash refrigerant from economizer is fed into compressor at intermediate pressure and increase the cooling capacity significantly

CONTROL PANEL

- Electrical enclosure fabricated by heavy gauge sheet steel with powder coated baked finishing.
- Single point power connection for all models
- Main incoming isolator for compressor motor
- Unit mounted reduced inrush starter for compressor
- Compressor overload protection
- Step down transformer for control circuit
- Main power supply monitoring module provide protection on under or over voltage, phase reversal, phase losses and imbalance
- Vision 2020i – the state-of-art Dunham-Bush proactive advanced controller that adapts to any abnormal operating conditions and for safety protections
- Emergency stop button

VISION 2020i CONTROLLER

Vision 2020i a flexible and advance programmable microprocessor controller designed specifically for the application and precise control of Dunham-Bush Rotary Screw compressor chillers.

The controller is provided with a set of terminals that connect to various devices such as temperature sensors, pressure and current transducers, solenoid valves, compressors and fans starters, control relays, etc. Three sizes of controller boards are provided to handle different number of input and output requirements: DB5-S small, DB5-M medium and DB5-L large board.

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 terminal with a semi-graphic display and dedicated keys that provides easy access to the unit operating conditions, control set points and alarm histories.

Each unit's controller can be configured and connected to the Dunham-Bush DBLAN network that allows multiple chillers sequencing control without additional controller or panel. Dunham-Bush DBLAN is the local area network made up of several chillers' controller.

Display and User Terminal

The Vision 2020i controller is designed to work with a user friendly back-lit 132 by 64 pixels PGDE Semi-Graphic Display panel connected with the controller through a telephone cable. The terminal display allows carrying out of the unit operations, and also allows the unit working conditions, compressor run times and alarm history to be displayed. Set points and other parameters can be modified via the user terminal. The display has an automatic self-test of the controller on system start-up. Multiple messages will be displayed automatically by scrolling from each message to the next. All of these messages are spelled out in English on the display terminal.

UNIT FEATURES

Easily accessible measurements include:

- Leaving and entering chilled water temperature
- Rate of Change for leaving chilled water temperature
- Evaporator and 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 and water status
- Oil Flow Status, Water Flow Switch Status, Remote Start/Stop Command Status

Capacity Control

Leaving chilled water temperature control is accomplished by entering the water temperature setpoint and placing the controller in automatic control. Vision 2020i monitors all control functions and moves the compressors slide valve to the required position to match the building cooling load demand.

The compressor ramp (loading) cycle is programmable and may be set for specific building requirements. Remote adjustment of the leaving chilled water setpoint is accomplished 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
- Compressor oil flow
- Compressor run error
- Power loss
- Chilled water flow loss
- Sensor error
- Compressor over current
- Compressor Anti-recycle
- High motor temperature

The controller can retain 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, the leader of HVAC solution provider understands the arising focus 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.

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, 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 and pumps 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.

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.

Building Management System (BMS) Communication

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

- Modbus RTU RS485, ModBus TCPIP
- BACnet over IP, MS/TP, or PTP

OPTIONS AND ACCESSORIES

- LONworks FTT10
- **Compressor Isolation Valve (Suction & Discharge)** – For the ease of servicing
- **Evaporator and Condenser Flanged Connection** – Flanged connection is available on request
- **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
- **Hotgas Bypass** – To maintain unit operation below minimum unloaded capacity
- **ASME / Compliance** – Evaporator and condenser with ASME approval is available on request
- **Extended Warranty Period for Compressors** – Extended compressor warranty is available on request

Electrical Options And Controls

- **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 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 vision 2020i controller for enhanced safety operation
- **Condenser Water Pump Control** – Condenser water pump is controlled by chiller for enhanced stable operation
- **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
- **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 by Customer

- **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 1, 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 plantroom automation

OPERATING BENEFITS

ECONOMICAL AND RELIABLE

- Optimization on the unit design to deliver a requirements needed without compromise on the quality and reliability
- Maximized performance through computer-matched components and multiple compressors

Refrigerant Compatibility

- Designed to operate with environmentally sound and economically smart HFC-134a with proven efficiency and reliability

Flooded Evaporator

- Flooded evaporator design that fully utilized and maximized the heat transfer area available in the evaporator; operates with lower suction superheat, smaller evaporator approach. These have greatly improved efficiency of chiller with flooded evaporator.
- Flooded evaporator water heads 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 to be ensured, thus maintaining system efficiency

Operational Advantages

- Dramatic payback in reduced maintenance and overhaul costs both in downtime and in labor expenditures
- Ease of troubleshooting through controller retention of monitored functions

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

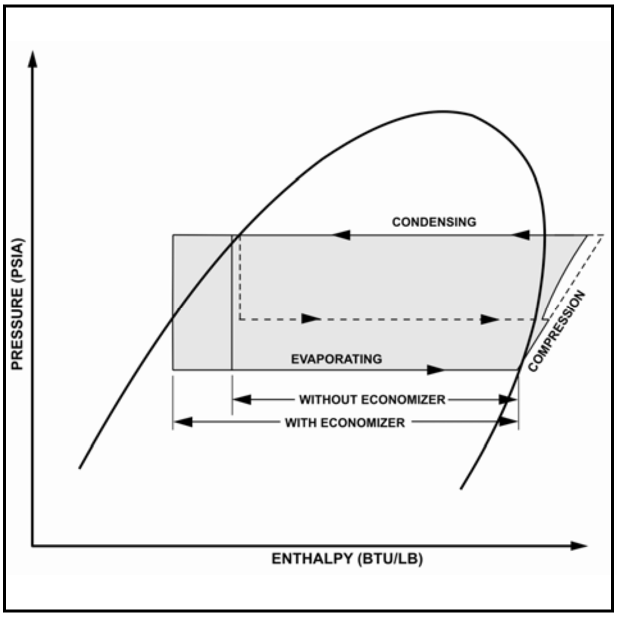
- Controller-based with DDC controller (direct digital control) features precise push button control over every aspect of operation with built-in standard features that maximized energy savings on start-up and throughout the life of your equipment
- Ensured uniform compressor loading and optimal energy efficiency through controller to 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 anticipates problems and takes corrective action before they occur. Controls will unload compressor(s) if head or suction pressure approach limits. This will enable unit to stay on line while warning operator of potential problems
- Stable and efficient operation with precise chilled water temperature control. Chilled water temperature is controlled at ±0.8 °F [0.5 °C] range for your comfort cooling, with best energy saving

REFRIGERATION CYCLE

Dunham-Bush WCHX-A 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.



OPERATING BENEFITS

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 internal oil separator, to separate lubrication oil from the gaseous refrigerant.

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 in further sub-cooled condition by the economizer on a dedicated chiller models.

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.

PART LOAD PERFORMANCE

Through the use of multiple compressors and economizer on a dedicated model, Dunham-Bush WCHX-A Chillers offer a performances meeting most of the industrial requirements 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 WCHX-A 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

Model		90S	110S	120T	140S	160S	170T	190S	200T	210S
Nominal Capacity	TR	85.0	110.0	116.0	135.0	160.0	165.0	187.0	195.0	205.0
	kW	298.9	386.9	408.0	474.8	562.7	580.3	657.7	685.8	721.0
Nominal Power Input	kW	51.6	65.6	69.4	81.6	96.5	99.4	108.0	117.1	121.1
Energy efficiency	kW/TR	0.606	0.596	0.598	0.604	0.603	0.602	0.577	0.601	0.591
	COP	5.80	5.90	5.88	5.82	5.83	5.84	6.09	5.85	5.95
Min % Unit Capacity	%	25	25	12.5	25	25	12.5	25	12.5	25
No Of Refrigerant Circuit		1	1	2	1	1	2	1	2	1
Power Supply		400V/ 3Ph/ 50Hz								
Compressor										
Model (Qty)		1612 (1)	1616 (1)	1315 (2)	1912 (1)	1915 (1)	1612 (2)	1917 (1)	1612 (1) 1616 (1)	1917 (1)
Evaporator										
Model		D7B	G7B	G8B	G8B	G9B	J3B	K5B	J4B	K6B
Water Flow Rate	USgpm	202.8	262.5	276.9	322.2	381.7	394.3	446.3	465.4	489.2
	L/s	12.8	16.6	17.5	20.3	24.1	24.9	28.2	29.4	30.9
Pressure Drop	Psig	3.4	3.8	2.7	3.6	4.2	7.3	4.1	8.2	3.8
	kPa	23.2	25.9	18.3	25.1	29.2	50.1	28.4	56.5	26.0
Design Press. Water Side	Psig[kPa]	150 [1034]								
Water Connection Size	Inch	5	5	5	5	5	5	6	5	6
Condenser										
Model		D9R	D7R	HDR	HER	FCR	AHR	GCR	AHR	GBR
Water Flow Rate	Usgpm	257.5	332.5	350.9	408.9	484.4	500.1	562.8	590.1	618.9
	L/s	16.3	21.0	22.1	25.8	30.6	31.6	35.5	37.2	39.1
Pressure Drop	Psig	4.4	4.8	3.6	4.7	8.9	9.7	6.2	12.1	6.0
	kPa	30.5	32.8	24.8	32.1	61.6	67.2	43.0	83.3	41.5
Design Press. Water Side	Psig[kPa]	150 [1034]								
Water Connection Size	Inch	6	6	8	8	8	8	10	8	10
General										
Unit Length	Inch	124 1/4	117 1/2	130 1/16	123 3/4	117 3/4	155 1/2	124 1/4	155 3/4	124 1/4
	mm	3160	2980	3300	3140	2990	3950	3160	3960	3160
Unit Width	Inch	44	45 7/16	47 3/8	49 3/16	47 3/8	51 1/2	47 3/8	51 1/2	47 3/8
	mm	1120	1150	1200	1250	1200	1310	1200	1310	1200
Unit Height	Inch	78	80	78	84	86	78	88	82	88
	mm	1980	2030	1980	2130	2180	1980	2240	2080	2240
Unit Shipping Weight	Lbs	5206	5794	7357	7009	7532	9061	8276	9235	8470
	kg	2361	2628	3336	3179	3416	4109	3753	4188	3841
Unit Operating Weight	Lbs	5640	6316	7995	7653	8169	9839	9077	10026	9327
	kg	2558	2864	3626	3471	3705	4462	4117	4547	4230
Approx. R134a Charge	Lbs	255	291	307	357	423	437	495	516	542
	kg	102	132	139	162	192	198	225	234	246

Model		220T	240T	250S	270S	280T	300T	330T	370T	400T
Nominal Capacity	TR	215.0	240.0	245.0	268.0	275.0	297.0	328.5	370.0	400.0
	kW	756.2	844.1	861.7	942.6	967.2	1044.5	1155.3	1301.3	1406.8
Nominal Power Input	kW	128.0	142.7	147.4	155.7	162.6	175.6	186.0	209.7	226.5
Energy efficiency	kW/TR	0.595	0.594	0.602	0.581	0.591	0.591	0.566	0.567	0.566
	COP	5.91	5.92	5.85	6.05	5.95	5.95	6.21	6.21	6.21
Min % Unit Capacity	%	12.5	12.5	25	25	12.5	12.5	12.5	12.5	12.5
No Of Refrigerant Circuit		2	2	1	1	2	2	2	2	2
Power Supply		400V/ 3Ph/ 50Hz								
Compressor										
Model (Qty)		1616 (2)	1616 (2)	2214 (1)	2214 (1)	1616 (1) 1912 (1)	1912 (1) 1915 (1)	1915 (2)	1917 (2)	1917 (1), 2212 (1)
Evaporator										
Model		M1B	R3B	R3B	R4B	S2B	W4B	W5B	Z5B	3BB
Water Flow Rate	USgpm	513.0	572.7	584.6	639.6	656.2	708.6	783.8	882.8	954.3
	L/s	32.4	36.1	36.9	40.4	41.4	44.7	49.4	52.5	56.9
Pressure Drop	Psig	8.2	6.4	7.1	6.1	8.1	4.2	4.3	3.9	3.9
	kPa	56.8	44.0	49.0	41.9	55.9	29.0	29.3	27.9	27.2
Design Press. Water Side	Psig[kPa]	150 [1034]								
Water Connection Size	Inch	6	8	8	8	8	8	8	8	10
Condenser										
Model		AJR	BLR	QDR	QFR	T7R	U6R	JDR	JER	JFR
Water Flow Rate	USgpm	649.7	725.1	741.5	807.2	830.3	896.5	985.6	1110.0	1200.0
	L/s	41.0	45.8	46.8	50.9	52.4	56.5	62.1	66.8	72.6
Pressure Drop	Psig	13.4	10.4	11.6	9.8	12.9	4.5	3.7	4.0	3.9
	kPa	92.3	71.4	80.0	67.5	88.7	30.9	25.6	23.4	22.5
Design Press. Water Side	Psig[kPa]	150 [1034]								
Water Connection Size	Inch	8	8	10	10	10	10	10	10	10
General										
Unit Length	Inch	156 13/16	150 13/16	157 1/4	157 1/4	165 1/4	164 1/2	164 3/4	164 3/4	183
	mm	3980	3830	3990	3990	4200	4180	4180	4180	4650
Unit Width	Inch	51 1/2	51 1/2	66	66	62 3/4	68	70	75	75
	mm	1310	1310	1680	1680	1590	1730	1780	1910	1910
Unit Height	Inch	81	87	81	81	86 1/2	88	91	91	93
	mm	2060	2210	2060	2060	2200	2240	2310	2310	2360
Unit Shipping Weight	Lbs	9338	10624	10768	11106	12031	14340	15325	16462	17579
	kg	4235	4818	4883	5037	5456	6504	6950	7466	7972
Unit Operating Weight	Lbs	10202	11706	11938	12399	13268	15844	17041	18385	19690
	kg	4627	5309	5414	5623	6017	7185	7728	8338	8930
Approx. R134a Charge	Lbs	569	635	648	709	728	786	869	979	1058
	kg	258	288	294	322	330	357	395	444	481

Notes: 1. The above data are for premium 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 Temperature 85°F [29.4°C]; Cooling Water Flow Rate 3Usgpm/ton [0.054 l/s.kW]; Evaporator fouling factor 0.0001hr.ft².°F/Btu [0.000018 m².°C/W]; condenser fouling factor 0.00025hr.ft².°F/Btu [0.0000144 m².°C/W]; 2-pass evaporator and condenser.
2. To consult nearest Dunham-Bush sales office for computer selections other than above operating conditions.

ELECTRICAL DATA

Model WCHX-A	Unit			Compressor		
	Power Supply	Max. Fuse Size	Min. Circuit Ampacity	Model (Qty)	RLA (Qty)	LRA (Qty)
90S	400V/3Ph/50Hz	200A	121A	1612 (1)	97A (1)	858A (1)
110S		225A	138A	1616 (1)	110A (1)	1038A (1)
120T		200A	144A	1315 (2)	64A (2)	485A (2)
140S		300A	171A	1912 (1)	137A (1)	1326A (1)
160S		350A	204A	1915 (1)	163A (1)	1444A (1)
170T		300A	216A	1612 (2)	96A (2)	858A (2)
190S		400A	230A	1917 (1)	184A (1)	1591A (1)
200T		300A	230A	1612 (1) 1616 (1)	96A (1) 107A (1)	858A (1) 1038A (1)
210S		400A	246A	1917 (1)	197A (1)	1591A (1)
220T		350A	243A	1616 (2)	108A (2)	1038A (2)
240T		350A	261A	1616 (2)	116A (2)	1038A (2)
250S		500A	305A	2214 (1)	244A (1)	2283A (1)
270S		500A	321A	2214 (1)	257A (1)	2283A (1)
280T		450A	326A	1616 (1) 1912 (1)	116A (1) 145A (1)	1038A (1) 1326A (1)
300T		450A	336A	1912 (1) 1915 (1)	161A (1) 135A (1)	1326A (1) 1444A (1)
330T		500A	362A	1915 (2)	161A (2)	1444A (2)
370T		500A	414A	1917 (2)	184A (2)	1591A (2)
400T		600A	450A	1917 (1) 2212 (1)	213A (1) 184A (1)	1591A (1) 1912A (1)

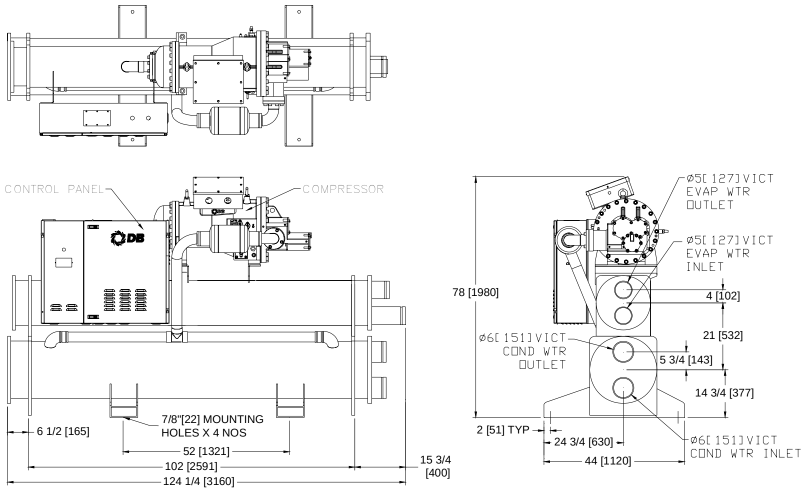
SOUND PRESSURE DATA

Model WCHX-A	Octave Band (Hz)								Total dB (A)
	63	125	250	500	1K	2K	4K	8K	
90S	69	58	64	69	76	73	73	55	80
110S	69	58	64	69	76	73	73	55	80
120T	73	58	62	70	78	75	65	56	81
140S	69	58	64	69	76	73	73	55	80
160S	69	58	64	69	76	73	73	55	80
170T	73	61	65	73	81	78	68	59	84
190S	69	59	64	68	76	73	74	56	81
200T	72	61	66	72	80	77	73	58	83
210S	70	61	65	69	78	75	74	59	82
220T	71	60	66	71	78	75	75	57	82
240T	71	60	66	71	78	75	75	57	82
250S	72	63	67	71	80	77	76	61	83
270S	72	63	67	71	80	77	76	61	83
280T	71	60	66	71	78	75	75	57	82
300T	71	60	66	71	78	75	75	57	81
330T	70	59	65	70	77	74	74	56	81
370T	72	63	67	71	80	77	76	61	84
400T	73	64	68	72	81	78	77	62	85

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

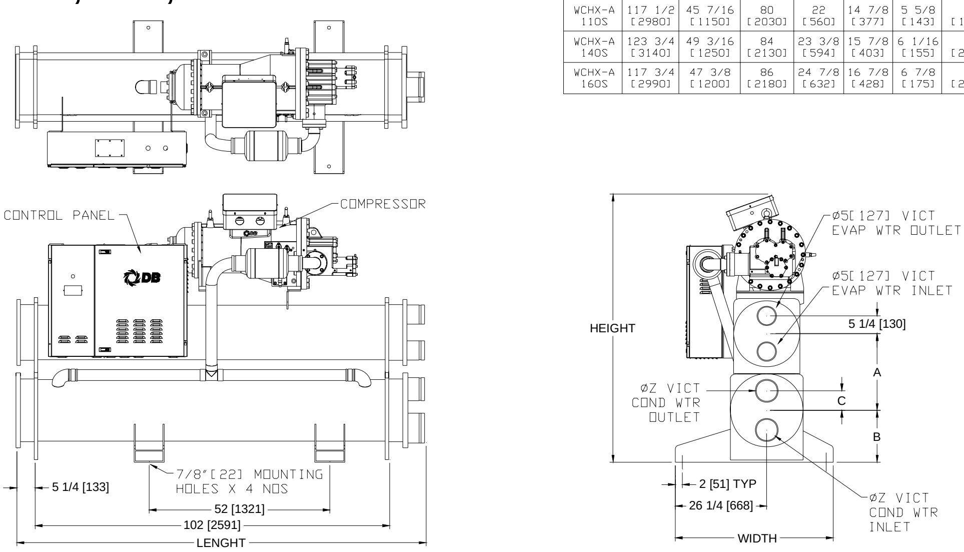
DIMENSIONAL DATA

WCHX-A 90S

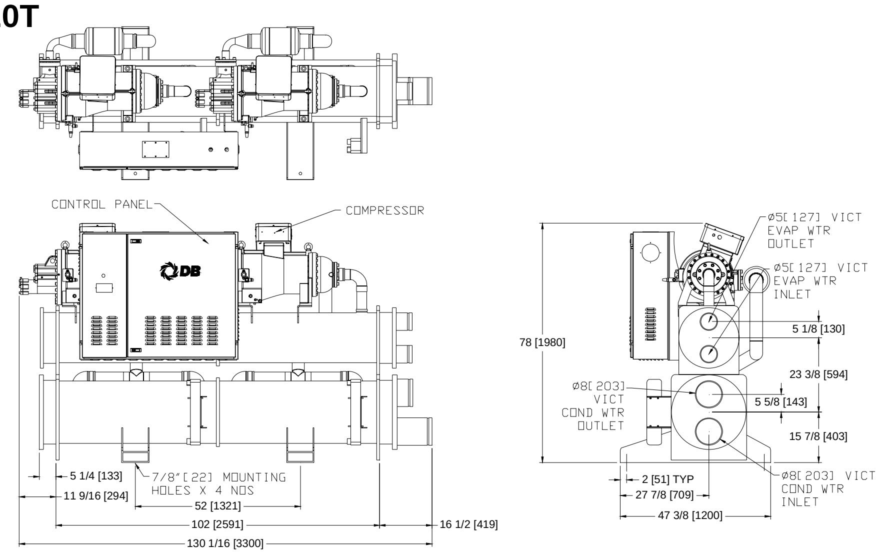


WCHX-A 110S, 140S, 160S

MODEL	LENGTH	WIDTH	HEIGHT	A	B	C	ØZ
WCHX-A 110S	117 1/2 [2980]	45 7/16 [1150]	80 [2030]	22 [560]	14 7/8 [377]	5 5/8 [143]	6 [152]
WCHX-A 140S	123 3/4 [3140]	49 3/16 [1250]	84 [2130]	23 3/8 [594]	15 7/8 [403]	6 1/16 [155]	8 [203]
WCHX-A 160S	117 3/4 [2990]	47 3/8 [1200]	86 [2180]	24 7/8 [632]	16 7/8 [428]	6 7/8 [175]	8 [203]



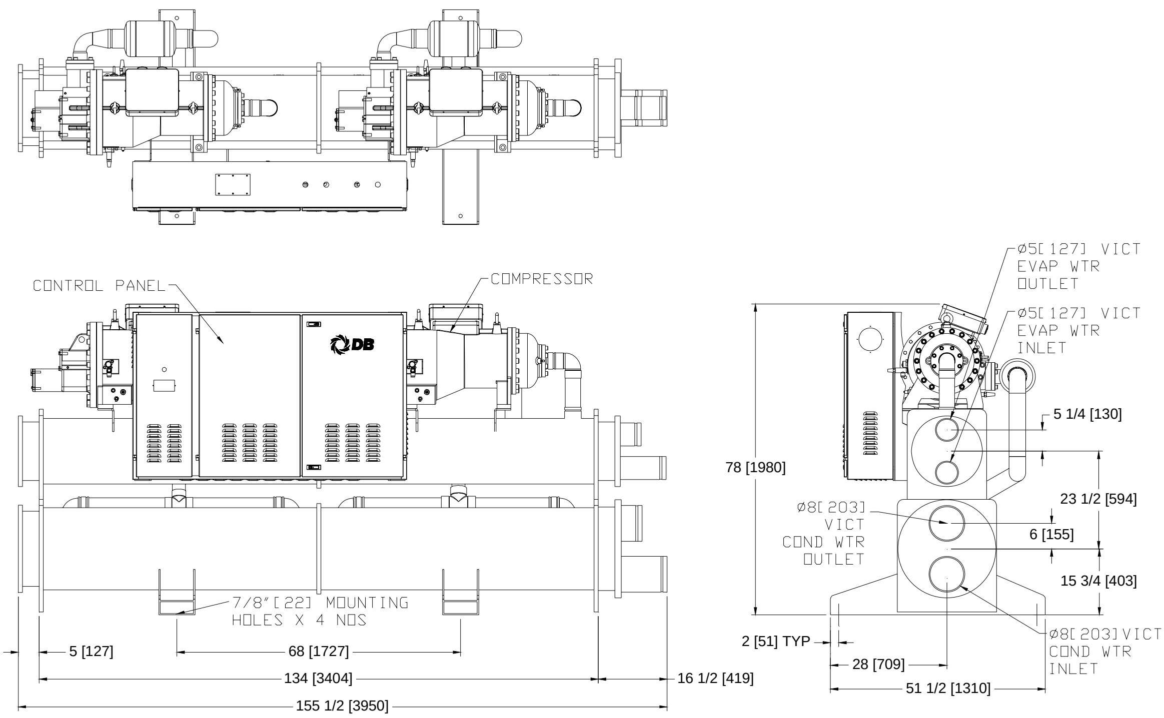
WCHX-A 120T



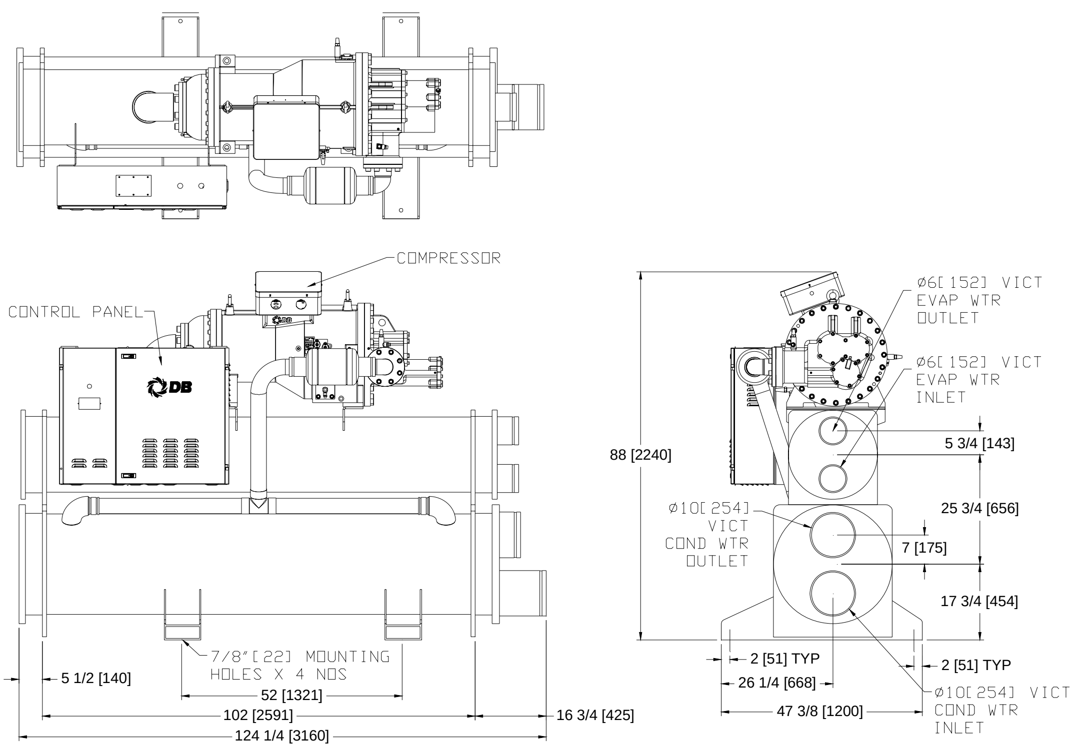
Note: All dimensions are in inches[mm].

DIMENSIONAL DATA

WCHX-A 170T



WCHX-A 190S

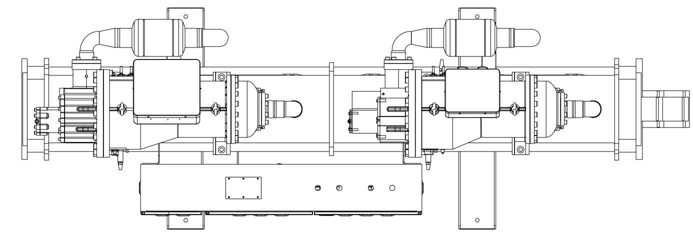


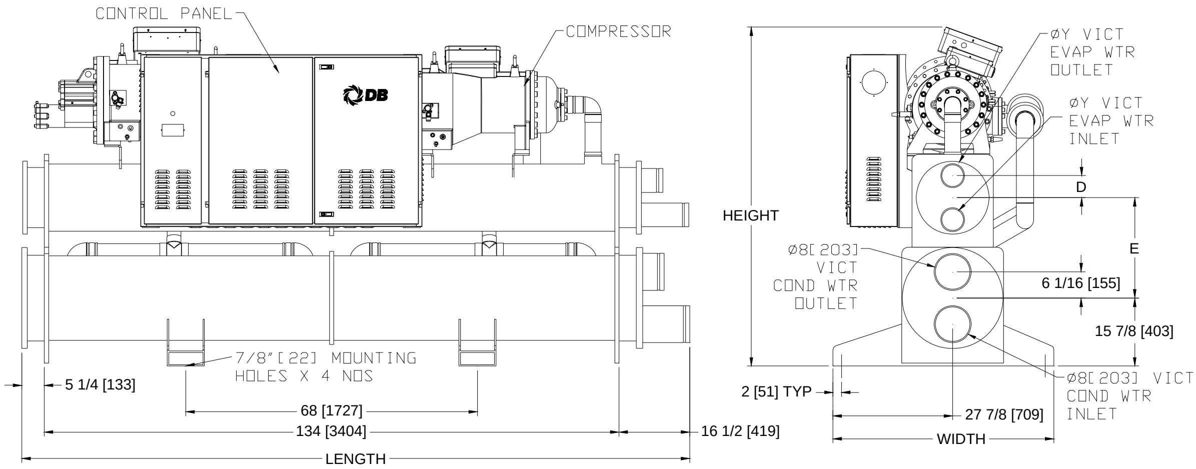
Note: All dimensions are in inches[mm].

DIMENSIONAL DATA

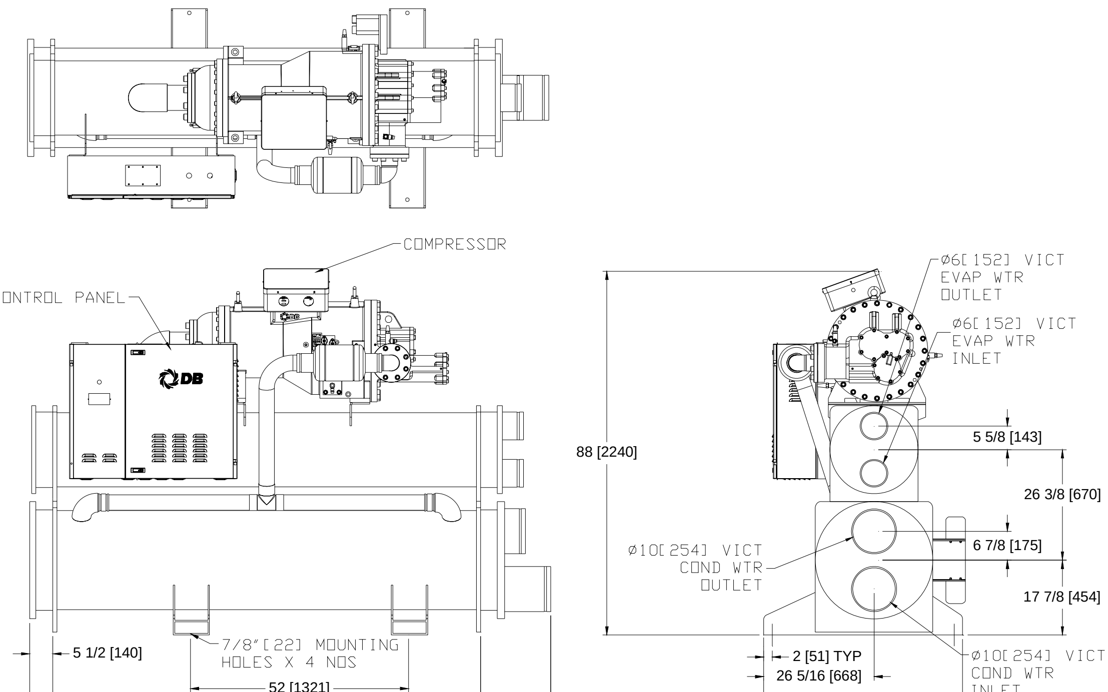
WCHX-A 200T, 220T

MODEL	LENGTH	WIDTH	HEIGHT	D	E	ØY
WCHX-A 200T	155 3/4 [3960]	51 1/2 [1310]	82 [2080]	5 1/8 [130]	23 3/8 [594]	5 [127]
WCHX-A 220T	156 13/16 [3980]	51 1/2 [1310]	81 [2060]	5 5/8 [143]	23 5/8 [601]	6 [152]





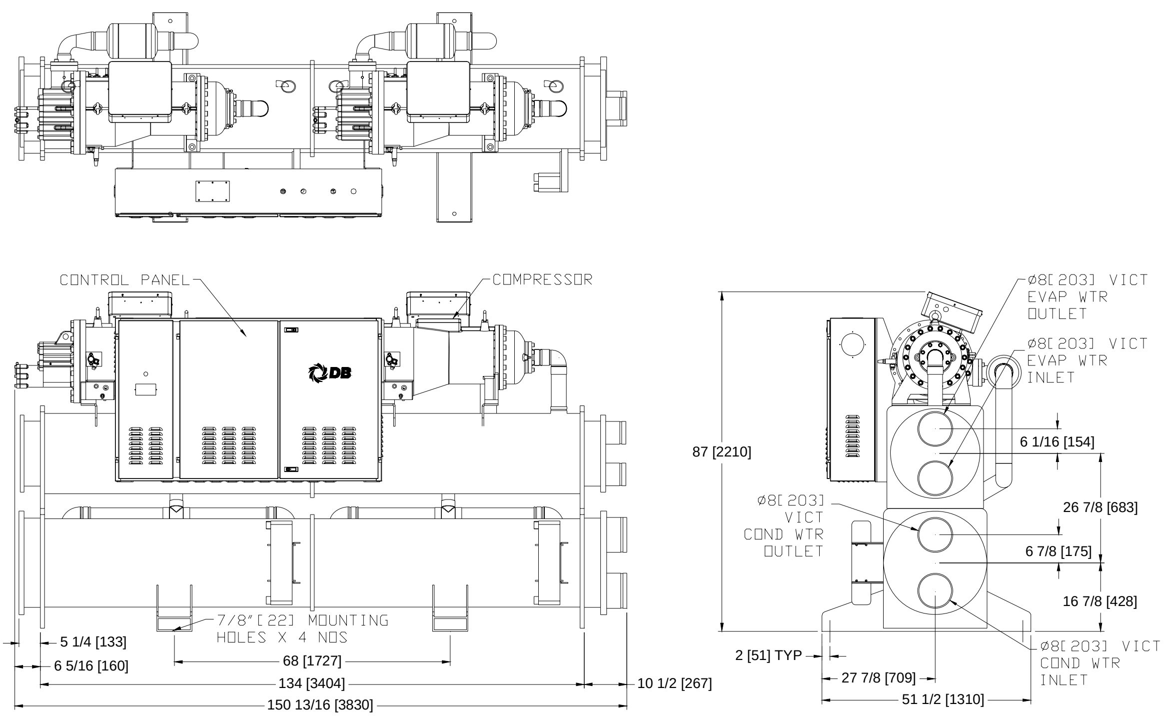
WCHX-A 210S



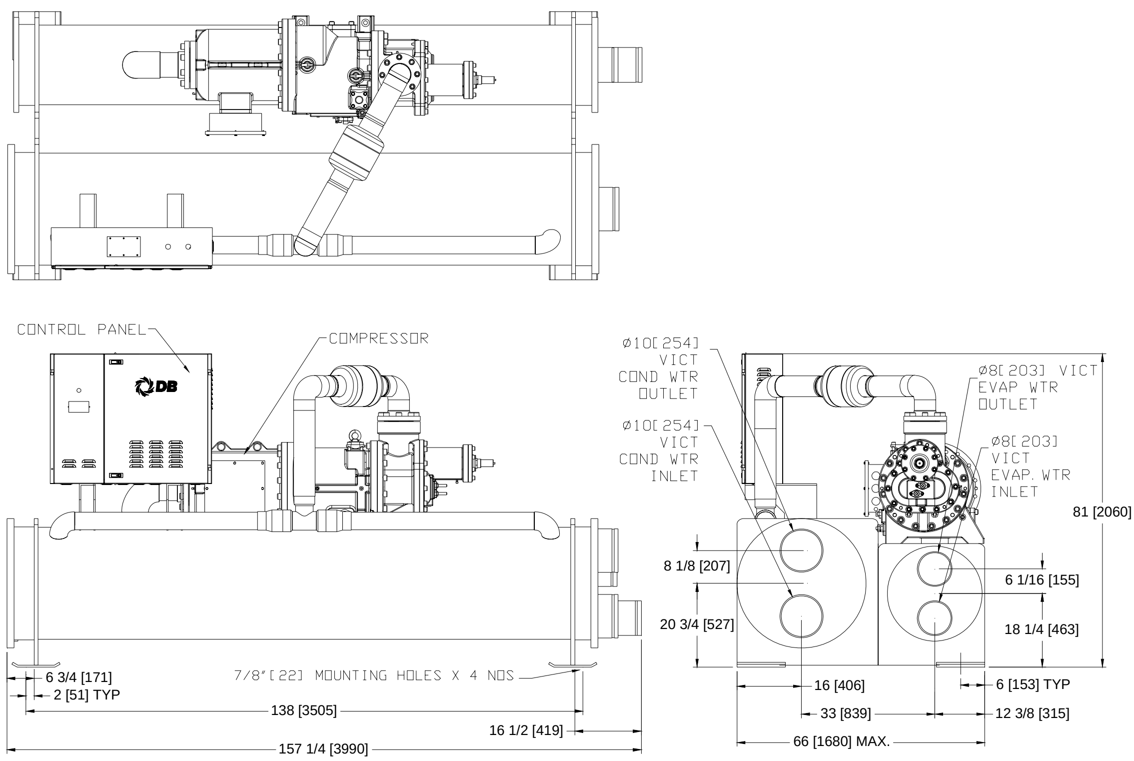
Note: All dimensions are in inches[mm].

DIMENSIONAL DATA

WCHX-A 240T



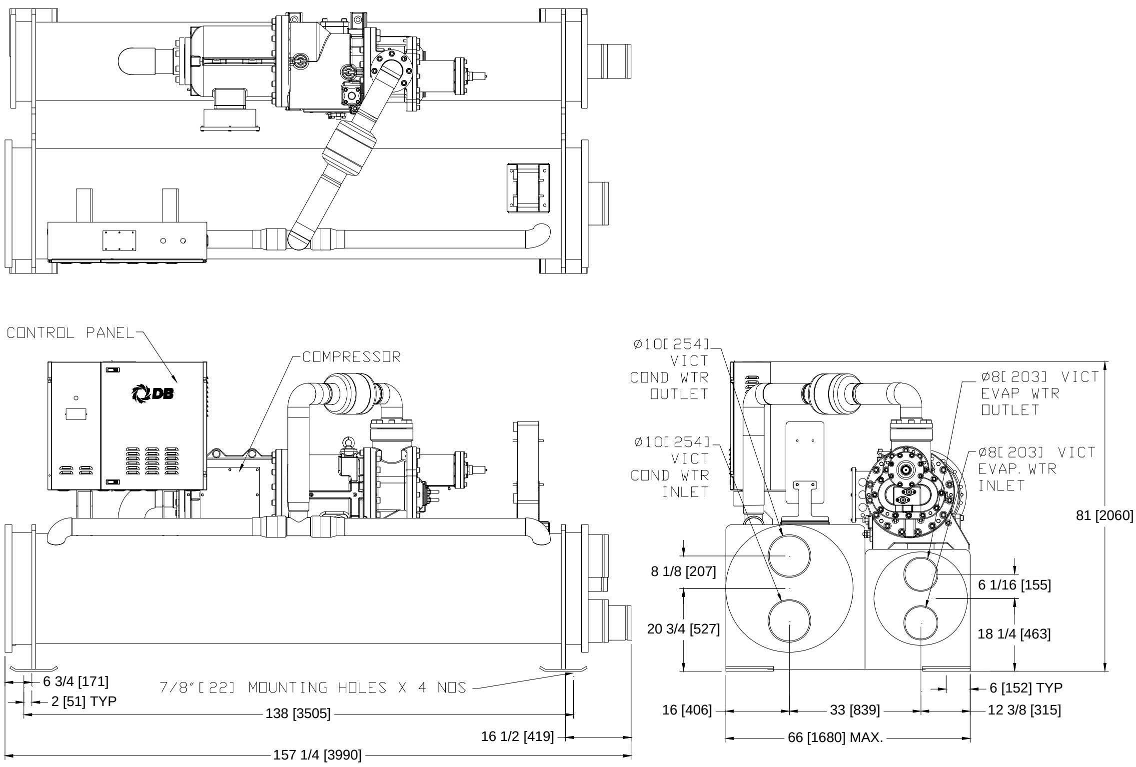
WCHX-A 250S



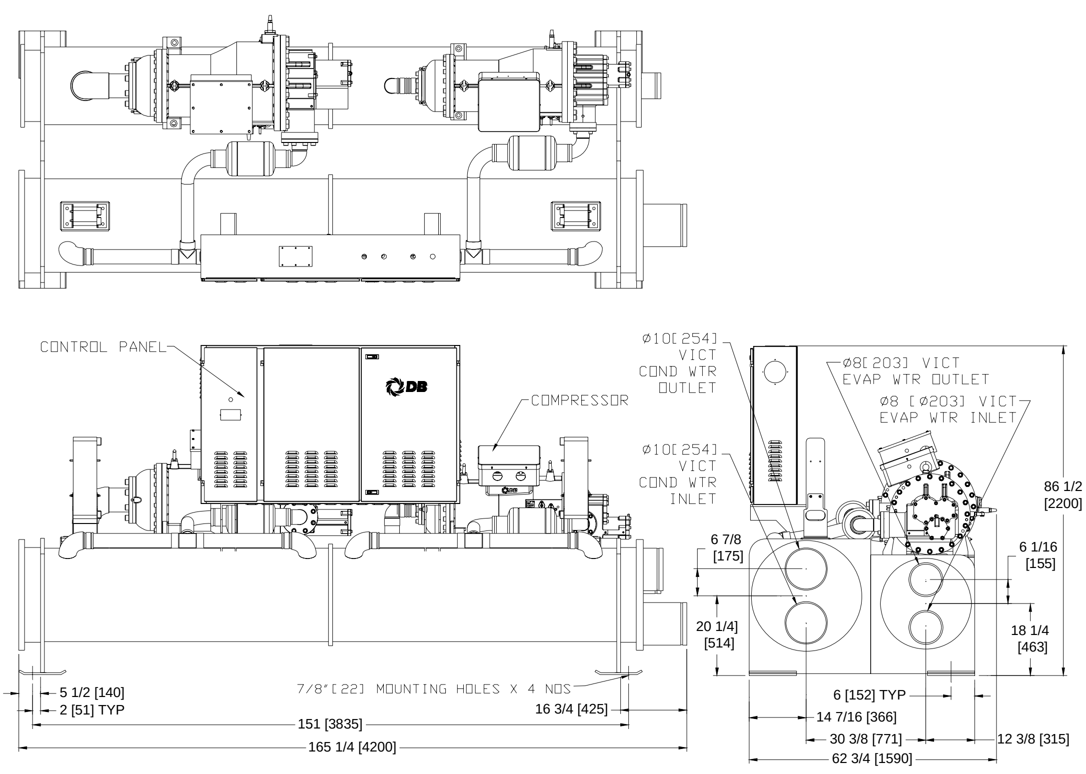
Note: All dimensions are in inches[mm].

DIMENSIONAL DATA

WCHX-A 270S



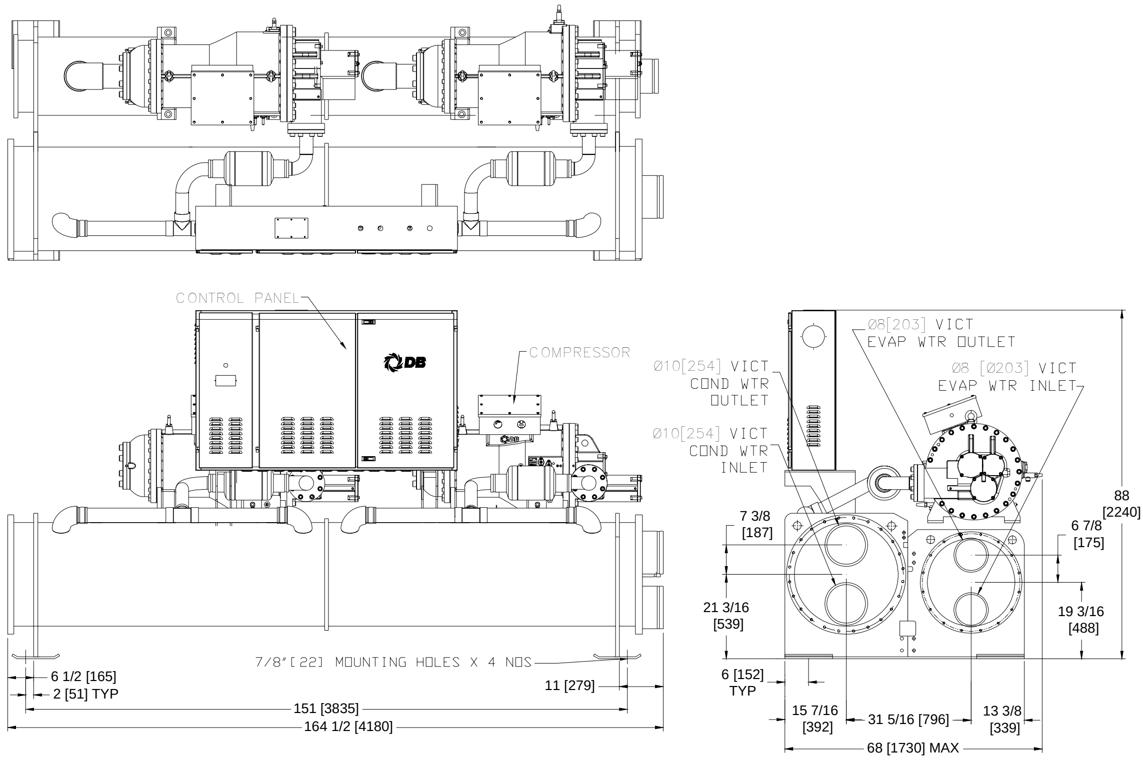
WCHX-A 280T



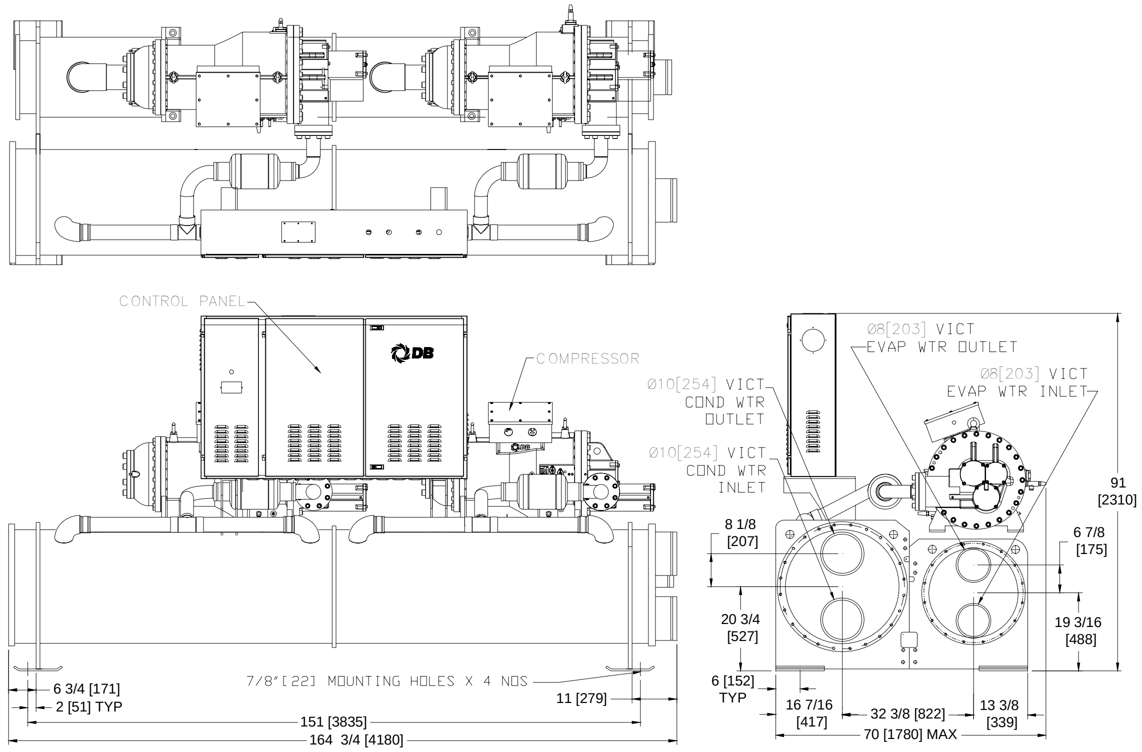
Note: All dimensions are in inches[mm].

DIMENSIONAL DATA

WCHX-A 300T



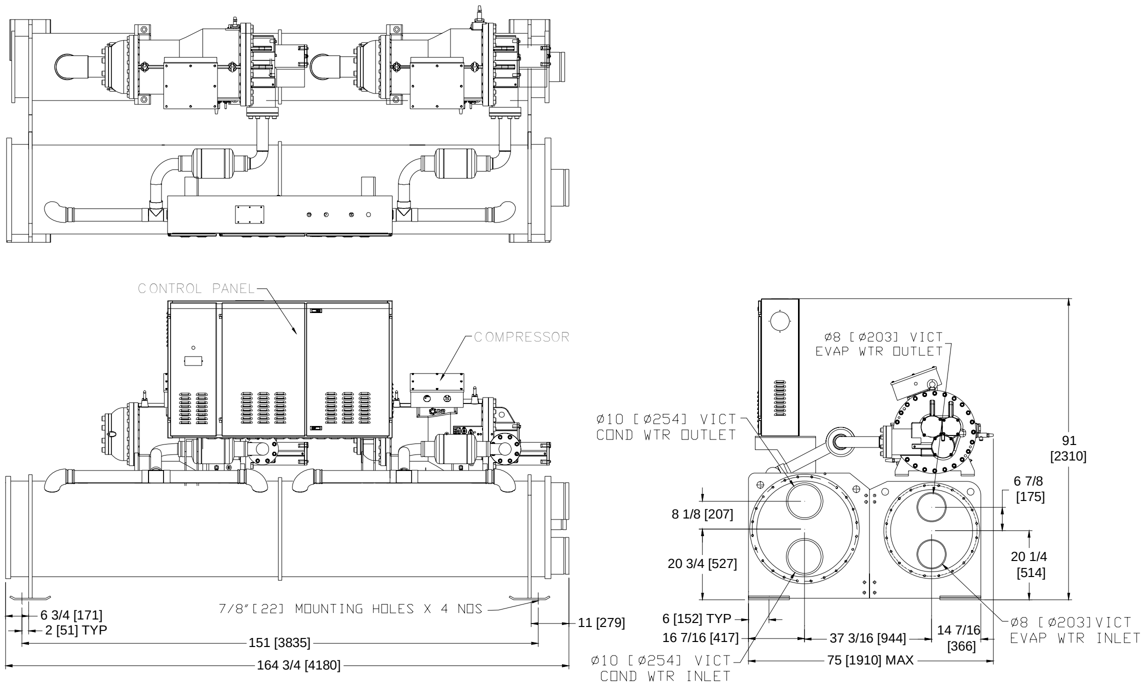
WCHX-A 330T



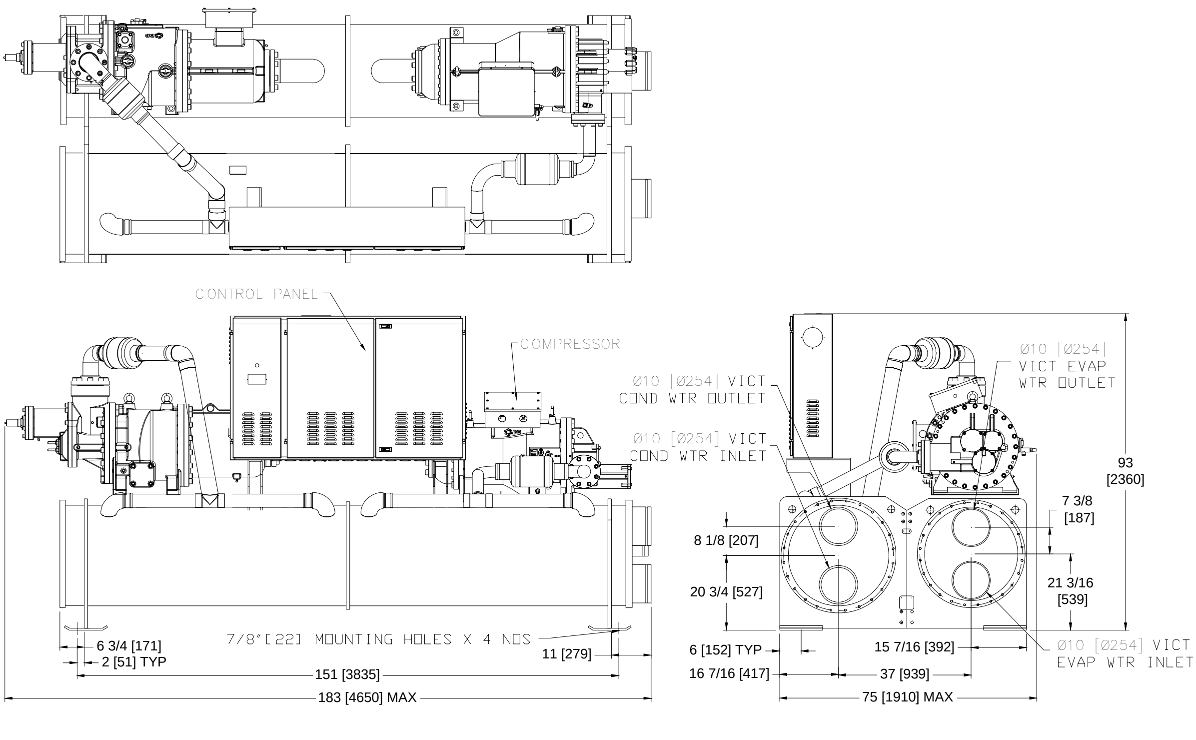
Note: All dimensions are in inches[mm].

DIMENSIONAL DATA

WCHX-A 370T



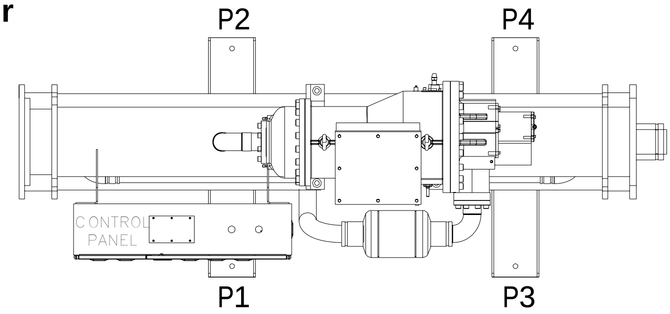
WCHX-A 400T



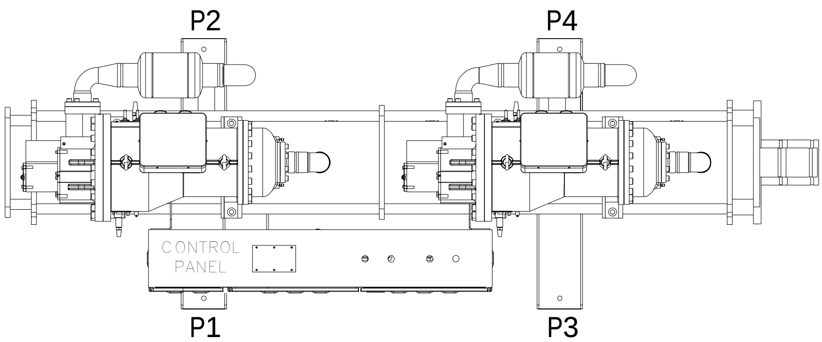
Note: All dimensions are in inches[mm].

FLOOR LOADING DIAGRAM

Single Compressor



Two Compressors



POINT LOAD DATA

Model WCHX-A	P1	P2	P3	P4	Operating Weight
	Lbs [kg]	Lbs [kg]	Lbs [kg]	Lbs [kg]	Lbs [kg]
90S	1366 [620]	1444 [655]	1281 [581]	1549 [720]	5640 [2558]
110S	1604 [727]	1880 [853]	1224 [555]	1608 [729]	6316 [2864]
120T	2349 [1065]	2391 [1084]	1451 [658]	1804 [818]	7995 [3626]
140S	2337 [1014]	2276 [1032]	1495 [678]	1645 [746]	7653 [3471]
160S	2314 [1050]	2567 [1164]	1496 [679]	1792 [813]	8169 [3705]
170T	2577 [1169]	2670 [1211]	2130 [966]	2461 [1116]	9839 [4462]
190S	2660 [1206]	2952 [1339]	1579 [716]	1887 [856]	9077 [4117]
200T	2621 [1189]	2728 [1237]	2171 [985]	2506 [1137]	10026 [4547]
210S	2623 [1190]	3154 [1431]	1541 [699]	2009 [911]	9327 [4230]
220T	2744 [1245]	2834 [1285]	2135 [968]	2489 [1129]	10202 [4627]
240T	3110 [1410]	3241 [1470]	2476 [1123]	2880 [1306]	11706 [5309]
250S	2953 [1339]	3046 [1381]	2846 [1291]	3093 [1403]	11938 [5414]
270S	3053 [1385]	3143 [1425]	2997 [1359]	3206 [1454]	12399 [5623]
280T	3216 [1459]	3319 [1505]	3281 [1488]	3452 [1566]	13268 [6017]
300T	3996 [1812]	3650 [1655]	4161 [1887]	4038 [1831]	15844 [7185]
330T	4317 [1958]	3884 [1762]	4499 [2040]	4341 [1969]	17041 [7728]
370T	4517 [2049]	4334 [1965]	4701 [2132]	4834 [2192]	18385 [8338]
400T	5024 [2279]	5360 [2431]	4672 [2119]	4634 [2101]	19690 [8930]

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.

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.

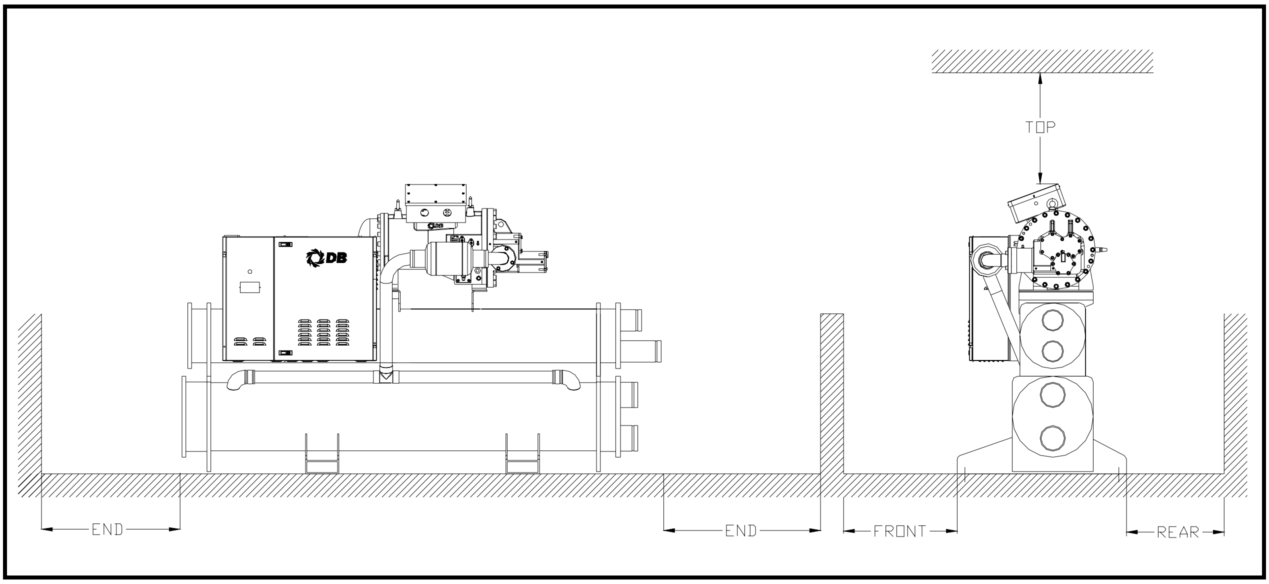
Front – 45” [1143mm]

Rear – 18” [457mm]

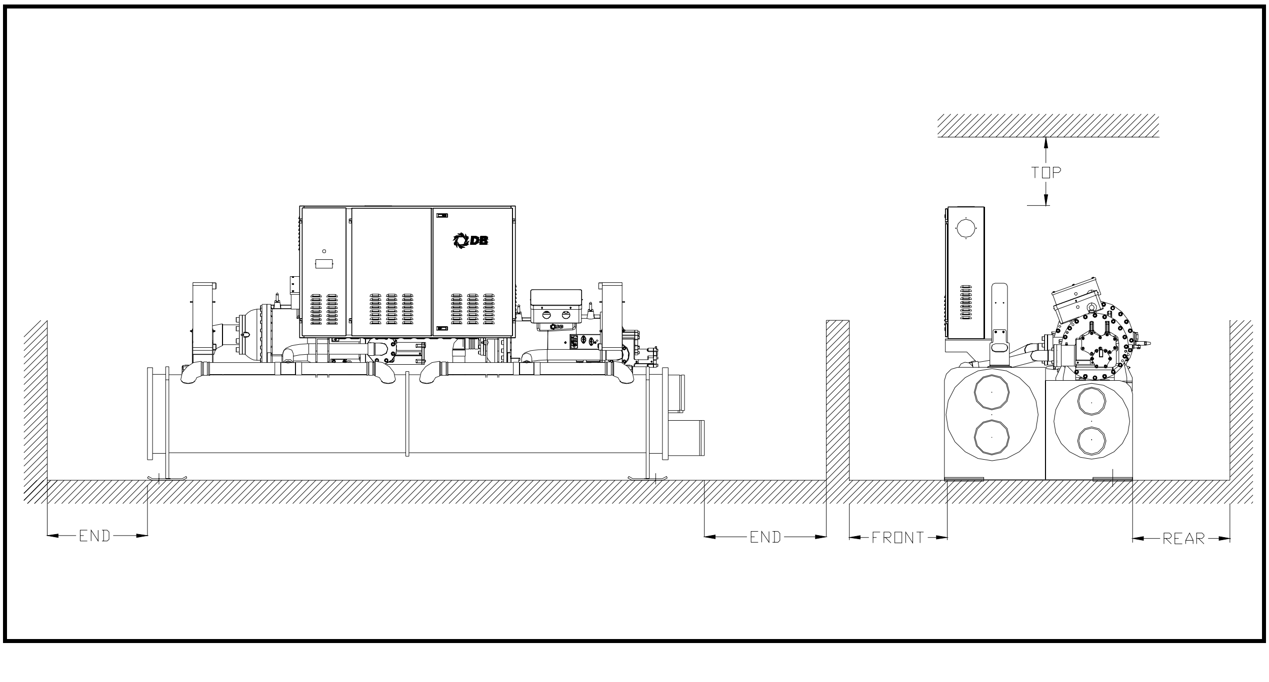
Top – 18” [457mm]

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

Single Compressor (Side-By-Side Construction)

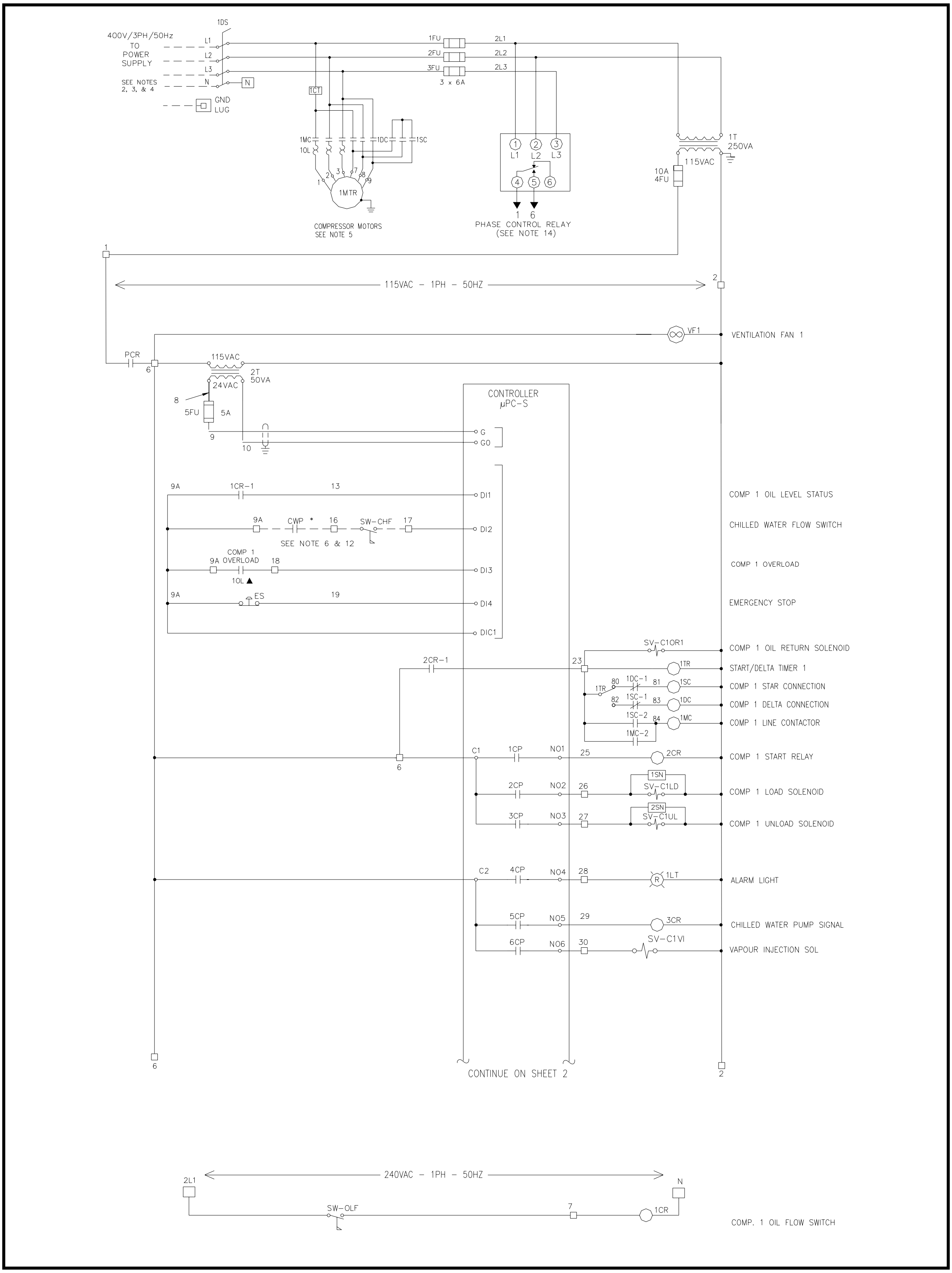


Two Compressors (Base Construction)

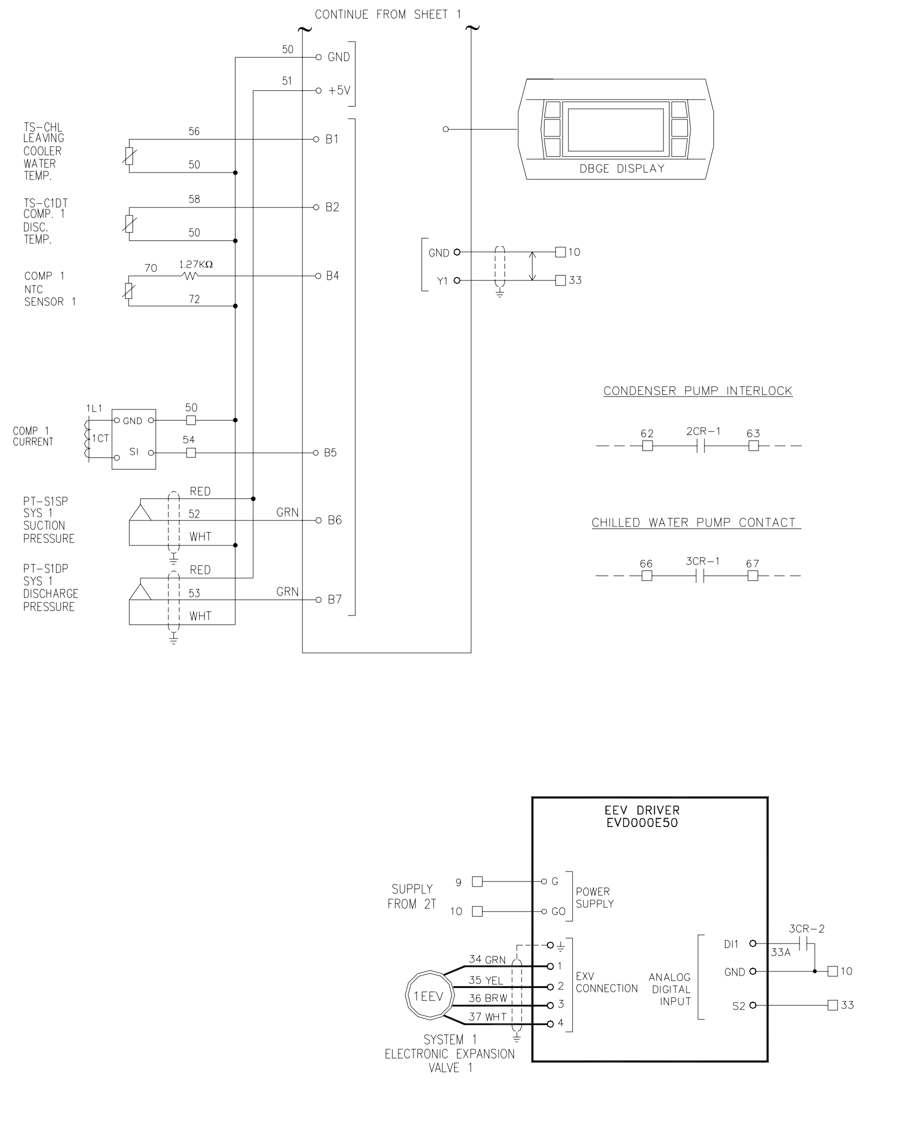


TYPICAL WIRING SCHEMATIC

One Compressors Unit

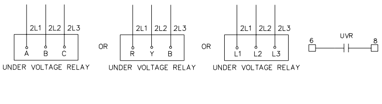


TYPICAL WIRING SCHEMATIC



NOTES

1- FUSES SHALL BE TIME DELAY TYPE.
2- ALL FIELD WIRING SHALL COMPLY WITH LOCAL, STATE AND NATIONAL CODES.
3- USE COPPER CONDUCTORS ONLY. CONTROL WIRING 14AWG.
4- DISCONNECT MEANS AND BRANCH CIRCUIT PROTECTION SHALL BE PROVIDED BY INSTALLER.
5- IF POWER SUPPLY HAS BEEN INTERRUPTED FOR A PROLONGED PERIOD, OIL SUMP HEATERS MUST BE ENERGIZED FOR 24 HOURS MINIMUM BEFORE STARTING COMPRESSORS.
6- CHILLED WATER FLOW SWITCH AND PUMP INTERLOCK ARE REQUIRED. DO NOT USE THESE SWITCHES TO CONTROL THE PACKAGE.
7- DO NOT RUN CT WIRES IN WIRE BUNDLES.
8- BMS CONTROL CONTACTS MUST BE WIRED BETWEEN TERMINALS 14 & 15. SELECT POSITION 'R' FOR REMOTE START, POSITION 'O' FOR UNIT SHUT DOWN AND POSITION 'L' FOR LOCAL START. JUMPER BOTH TERMINALS IF BMS USING ONLY HIGH LEVEL CONTROL.
9- IF 4-20mA CWR IS USED, SET SETPOINT TO RESET DESIRED AT 20mA INPUT. **CAUTION : DO NOT** SUPPLY OVER 20mA TO INPUT TERMINAL.
10- 10TR TIMER JUMPER WIRE IS A CUSTUMER OPTION TO TAKE OUT OR KEEP IN.
11- THE SHIELDED CABLES ARE RECOMMENDED FOR FIELD INSTALLED CONTROL & SIGNAL WIRING, CONNECT ONE END OF THE SHIELD TO GROUND.
12- TO RESET 12TAS HOLD PB FOR 5 SECONDS.
13- IF UNDER VOLTAGE RELAY (UVR) IS USED INSTEAD OF PHASE CONTROL RELAY THE CONNECTION DIAGRAM WILL BE AS BLOW :-



LEGEND

AI	ANALOG INPUT
AM	AMMETER
CB	CIRCUIT BREAKER
COMP	COMPRESSOR
CP	CONTROL POINT
CPR	CAPACITOR
CR	CONTROL RELAY
CT	CURRENT TRANSFORMER
CTR	CONTACTOR
CWFS	CHILLED WATER FLOW SWITCH
CWP	CHILLED WATER PUMP
CWR	CHILLED WATER RESET
DI	DIGITAL INPUT
DS	DISCONNECT SWITCH
FS	FLOAT SWITCH
FU	FUSE
GND	GROUND
H-O-T	HIGH OIL TEMP
HMT	HIGH MOTOR TEMP
HTR	HEATER
I/O	INPUT/OUTPUT
LD	LEAK DETECTOR
LS	LEVEL SENSOR
LT	LIGHT
M	CONTACTOR
MCS	MOLDED CASE SWITCH
MOV	METAL OXIDE VARISTOR
MTR	MOTOR
NC	NORMALLY CLOSED
NO	NORMALLY OPEN
OL	OVERLOAD
PB	PUSH BUTTON
PT	PRESSURE TRANSDUCER
RES	RESISTOR
R-O-L	REMOTE-OFF-LOCAL
RLY	RELAY
S5	PUMP DOWN SWITCH
SC	STARTS COUNTER
SH	SHIELD
SN	SNUBBER
SOL	SOLENOID
TAS	THERMOSTAT
TB	TERMINAL BLOCK
TLW	TEMP LEAVING WATER
TR	TIMER
TS	TEMP. SENSOR
UVR	UNDERVOLTAGE RELAY
VM	VOLTMETER
ZD	ZENOR DIODE
▲	MANUAL RESET
□	FACTORY TERMINAL
— —	FIELD WIRING
*	FIELD SUPPLIED

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 °C]	50 °F [10 °C]
With Dual Mode Operation	18 °F [-7.8 °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

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
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

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

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

APPLICATION DATA

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 WCHX-A 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.

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. 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”

GUIDE SPECIFICATIONS

- 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 50Hz with unit rated voltage +/-10%. Control Voltage shall be 115V/1ph/50Hz.

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 2 pole motor. The oil differential pressure shall be controlled during operation to maintain proper oil lubrication throughout the lubrication system. Each compressor shall have a suction filter. Compressor capacity control shall be obtained by an electrically initiated, hydraulically actuated slide valve within each compressor. The bearing shall be heavy duty, anti-friction tapered roller type, anti-reverse, shall be able to carry both radial and thrust loads.

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 diameter 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 up to 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 diameter 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 oil filter, replaceable filter drier on oil return line, sight glass on liquid line, 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. 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

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.

ELECTRICAL POWER PANEL

The chiller manufacturer shall provide suitable 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
- Compressor motor over current protection module for each phase
- Compressor motor overheat protection
- Under/over voltage phase reversal and imbalance relay

The compressor starter contactors shall be wired securely to the main incoming terminal block. External compressor over load protector, over heating protection, 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, 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

- Compressor over current
- Compressor anti-recycle
- Programmable with Seven day operation cycle
- [Optional] chilled liquid and condenser water pump on/off control

AUTOMATIC CONTROLS

- Compressor motor increment contactors
- Start delay timer
- Anti-recycle timer
- Oil flow interlock

GUIDE SPECIFICATIONS

REFRIGERANT FLOW CONTROLS

- Refrigerant flow control shall be carried out electronically by a precision electronic expansion valve
- Compressor loading and unloading solenoid valves

INDICATOR LIGHTS

- 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 flow status
- Water temperature re-set value [optional]
- Water flow switch status
- External start/stop command status
- Percentage of compressor capacity
- Electronic expansion valve percentage of opening

SAFETY PROTECTIONS

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