Helios

Air Cooled Screw Chillers

ACHX-A 50Hz

Cooling Capacity: 80 to 282 TR (281 to 992 kW)

R134a

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.

HELIOS, ACHX-A Air Cooled Screw Flooded Chillers, have a cooling capacity range from 80 to 282 TR [281 to 992 kW] in 50Hz version using environmentally sound HFC-134a refrigerant. The entire product line features energy efficiency, installation ease, control flexibility, high reliability and advanced 2020i controller.

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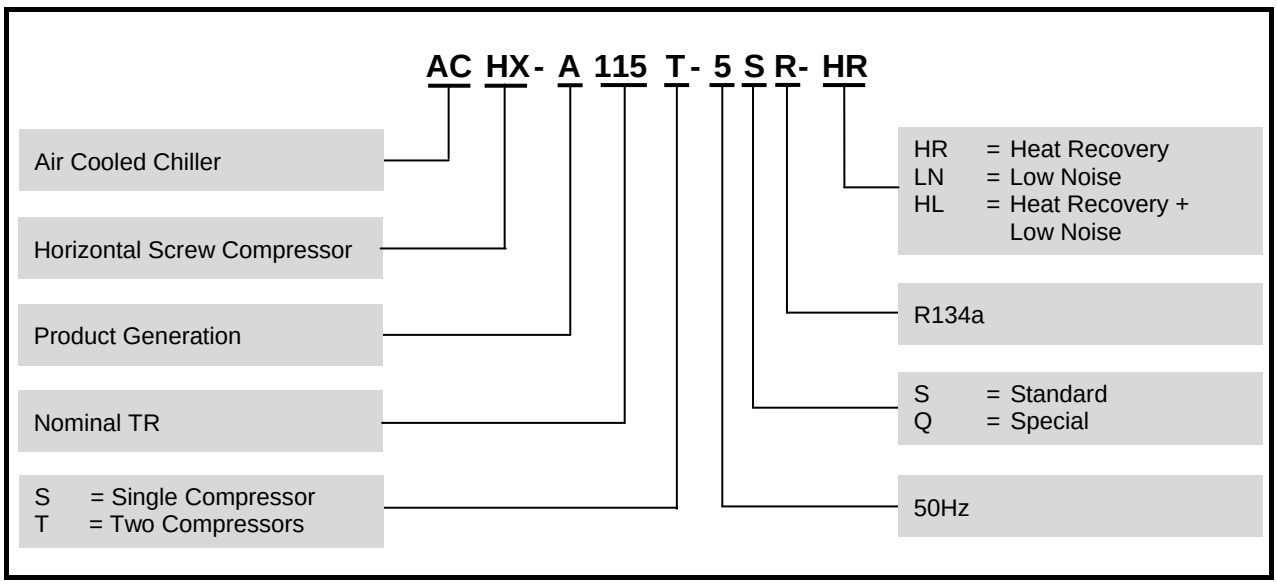
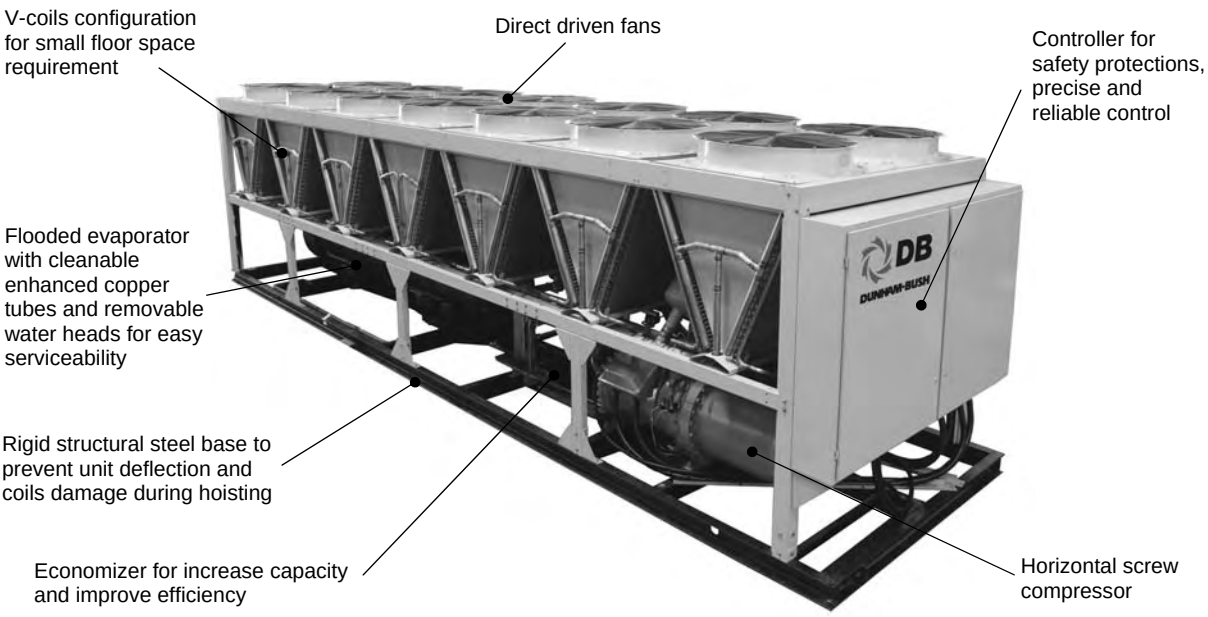
NOMENCLATURE



GENERAL CHARACTERISTICS



UNIT FEATURES

General

- 9 models from 80 to 282 TR [281 to 992 kW] in accordance with AHRI standard conditions
- Multiple compressors models with independent refrigerant system per compressor provide redundancy, and superior part load efficiency
- The unit is designed to operates with R134a, the environment friendly refrigerant with zero ***ODP*** (Ozone Depletion Potential)
- Unit operating ambient temperature, 45~125°F [7~52°C]

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
- Improved sound attenuation with double-walled, pressure-compensated rotor housing
- Integrated PTC sensor in each motor winding for thermal motor temperature monitoring
- Infinite variable capacity control with sliding valve mechanism
- Discharge service valves is provided for the ease of servicing

Evaporator

- Shell-and-tube flooded type heat exchanger
- Two pass arrangement
- Integral finned copper tubes to maximized heat transfer area
- Cleanable copper tubes for easy serviceability
- Removable water heads for service
- Victaulic groove water connection comply to ANSI/AWWA C-606
- Standard with 1" thick closed cell insulation
- Standard relief valve(s) – ¾" [19mm] FPT
- Pressure test up to 220psig for refrigerant side, and 195psig for water side
- Isolation valves for refrigerant filter dryers are provided to allow filter core replacement without pump down the chiller. This greatly improve the servicing expenses and time

Condenser and Fans

- Constructed with seamless inner-grooved copper tubes expanded into die-formed aluminum fins in staggered configuration
- Leak and pressure test at 450psig [31bar]
- "V" coil design to increases condensing surface area to maximized heat rejection
- "V" coils arrangement with internal baffle for fan cycling and staging
- IP55, Class "F" insulation fan motors for outdoor applications

UNIT FEATURES

Electronic Expansion Valve

- Advanced electronic expansion valve (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

Economizer

- All models are furnished with 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 economizer increased cooling capacity by means of increasing the sub-cooling
- Cooling capacity is increased significantly with marginal increases in kW-input, thus, unit EER is improved

Control Panel

- Weather tight electrical enclosure fabricated by heavy gauge sheet steel with powder coated baked finishing
- Single point power connection for all models
- Unit mounted reduced inrush starter for compressor motors
- Circuit breaker for compressors and condenser fan motors
- Step down transformer for power supply to control circuit
- Main power supply monitoring module. Protection on under or over voltage, phase reversal, phase losses and imbalance
- Unit mounted Remote/Off/Local (R/O/L) selector, an operation and servicing friendly feature
- Overload protection relay for compressors
- Vision 2020i – the state-of-art Dunham-Bush proactive advanced controller that adapts to any abnormal operating conditions and for safety protections

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: DB-S small, DB-M medium and DB-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 DBG1 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.

There are 15 dedicated buttons to enable the user to access information, based on the security level of the password. For more detail operation of the DBG1 Display Terminal, please refer to the Unit Operation Manual.

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

UNIT FEATURES

- 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 condenser fans motors status
- Oil Level 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
- 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
- High motor temperature
- Compressor overload

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 ACHX-A 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
- LONworks FTT 10

OPTIONS AND ACCESSORIES

- **Heat Reclaim** – The hot gas desuperheater; a shell-and-tube heat exchanger that reclaims 'waste' heat from compressor to produce hot water up to 55°C
- **Condenser Corrosion Protection –** Copper (CU) fins, Hydrophilic coated or other coated fins are available to provide better corrosion protection.
- **Hotgas Bypass** – To maintain unit operation below minimum unloaded capacity
- **Service valve** – Compressor suction service valve is supplied to further isolate the compressor from evaporator
- **Low Ambient Operation (LA 1)** – Variable frequency drive (VFD) is incorporated to the condenser fan motor to allow unit operation down to 14 ^{o}F [-10 ^{o}C] ambient temperature
- **Extra Low Ambient Operation (LA 2)** – Besides VFD at condenser fan motor, a refrigerant liquid receiver is incorporated into the refrigerant system to allow unit operation down to -20°F [-29°C] ambient temperature
- **Double Thick Insulation** – Evaporator with double thick 2" [50mm] closed cell insulation, for extra resistance to condensation
- **Evaporator Anti-Freeze Protection** – When chiller is not operating at ambient temperature 32°F [0°C] or below, the immersion heater and circulating pump will be in operation to prevent water freezing in evaporator
- **Condenser Coil Guard** – To protects condenser coil from unauthorized access
- **Evaporator Flanged Water Connection** – Flanged water connection is available as option
- **Low Noise Operation (LN)** – Reduced unit operating sound level using low noise fans. Compressor sound enclosure can be added to further reduce the sound level
- **Dual Mode Operation** – The unit with dual mode operation can deliver chilled fluid temperature down to 18 ^{o}F [-7.8 ^{o}C] during ice making mode. Units with Dual Mode Operation is used for Ice Thermal Storage System
- **Low Temp. Operation** – The unit with Low Temp. Operation can deliver chilled fluid temperature down to 18 ^{o}F [-7.8 ^{o}C] for process cooling application
- **ASME/ PED/ JKKP Compliance** – Evaporator with ASME/ PED/ JKKP approval is available
- **CE Compliance** – Unit with CE compliance is available on request
- **BMS Communication** – Various add-on communication cards provide BMS communication via common protocols: Modbus RTU RS485 / TCPIP, LONworks FTT10, BACnet over IP / MSTP / PTP

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.
- **Softstarter For Compressor Motors** – Solid State starter comes with bypass contactor to reduced mechanical stress and inrush current at compressor start-up
- **Ground Fault Interrupt (GFI)** – Provides equipment with ground fault protection
- **Ammeter/ Voltmeter** – Analog ammeter and voltmeter with 3 phase selector switch for indication, located inside the control panel
- **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
- **Ambient Temperature Monitoring** – Temperature sensor to monitor unit operating ambient temperature
- **IP55 Control Panel** – IP55 rated control panel can be supplied for harsh working environment

Factory Supplied, Field Installed By The Customer

- **Evaporator 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

OPERATING BENEFITS

EFFICIENCY AND RELIABILITY

Energy Efficiency

- Designed to provide the greatest amount of cooling for the least power input over the entire operating range of your building
- Delivers outstanding efficiency and total energy savings through the utilization of economizer cycle and advanced controller staging; to produce greater capacity with fewer compressors
- Maximized performance through computer-matched components and multiple compressors
- High efficiency oil recovery system guarantees removal of oil carried over in the refrigerant and maintains the heat exchangers at their maximum efficiency at both full and part load

Refrigerant Compatibility

- Designed to operate with environmentally sound and economically smart HFC-134a with proven efficiency and reliability
- Consult Factory for use of other HFC refrigerants.

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

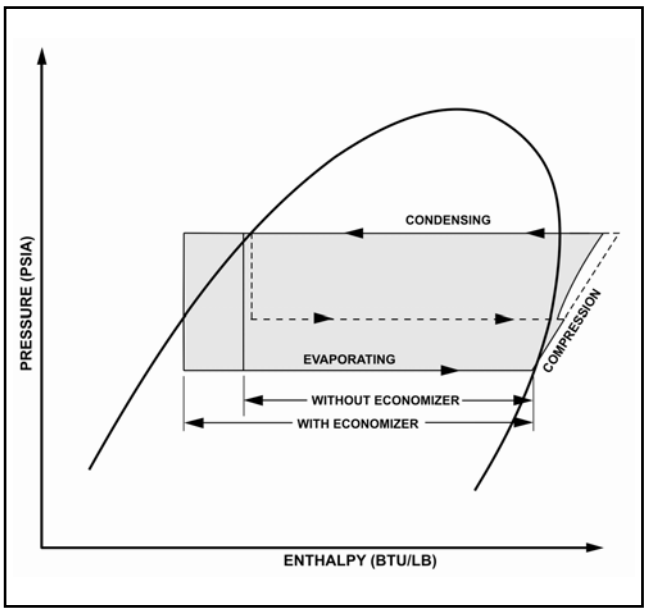
Control Flexibility

- 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 ^{o}F [0.5 ^{o}C] range for your comfort cooling, with best energy saving

REFRIGERATION CYCLE

Dunham-Bush rotary screw air cooled 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 variety of conditions.

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



OPERATING BENEFITS

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

This partially compressed gas is then combined with additional gas from the vapor injection port at an intermediate pressure. Compressed gaseous refrigerant is then discharged into the integral oil separator where oil, which is contained in the refrigerant vapor, is removed and returned to the oil sump.

Fully compressed and superheated refrigerant is then discharged into the condenser, where air is being drawn through the condenser tube by the propeller fan cools and condenses the refrigerant. The liquid refrigerant then passes through the economizer. A portion of liquid refrigerant is tapped passes through the expansion valve back into the economizer for further subcooling of main liquid refrigerant flow.

The gaseous refrigerant is then drawn out of the economizer and into the vapor injection port of the compressor. The remaining subcooled liquid refrigerant then passes through electronic expansion valve which reduces refrigerant pressure to evaporator levels where it is then distributed evenly into the evaporator.

With the additional subcooling, the enthalpy of the refrigerant flowing into the evaporator is reduced which increases the refrigeration effect and improves the efficiency of the refrigeration cycle.

Economizer/ Vapor Injection Cycle for Increase Capacity and Higher EER

The renowned Dunham-Bush screw compressor allows for economizer vapor injection cycle to be incorporated, increasing capacity by significantly with marginal increase in kW-input. Thus, unit EER is improved!

PART-LOAD PERFORMANCE

Through the use of economizer, electronic expansion valve and multiple compressors, Dunham-Bush air cooled chillers have 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 air cooled chillers combine the efficient operation of multiple compressors with an economizer cycle and advanced controller to yield the best total energy efficiency and significant operating saving under any load.

When specifying air conditioning equipment, it is important to consider the system load characteristics for the building application. In a typical city, the air conditioning load will vary according to changes in the ambient temperature. Weather data compiled over many years will predict the number of hours that equipment will operate at various load percentages.

The Air Conditioning and Refrigeration Institute (AHRI) has established a system, in AHRI Standard 550/590-2011, for measuring total chiller performance over full and part-load conditions. It defines the Integrated Part-Load Value (IPLV) as an excellent method of comparing diverse types of equipment on an equal basis. The IPLV is a single number estimate of a chiller's power use weighted for the number of hours the unit might spend at each part-load point. IPLV's are based on Standard 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 ACHX-A		80T-5SR	100T-5SR	115T-5SR	130T-5SR	150T-5SR	180T-5SR	210T-5SR	250T-5SR	280T-5SR
Unit Nominal Capacity	TR	80.2	100.9	115.3	131.6	150.3	180.8	211.4	251.0	282.1
	kW	282.1	354.9	405.5	462.8	528.6	635.8	743.5	882.8	992.1
Unit Nominal Power Input	kW	92.8	115.8	129.8	142.0	160.8	200.2	224.8	266.9	299.9
Energy Efficiency	kW/TR	1.157	1.148	1.125	1.079	1.070	1.107	1.063	1.063	1.063
COP	kW°/kWi	3.60	3.67	3.65	3.77	3.87	3.61	3.79	3.78	3.79
COMPRESSOR										
Model (Qty)		HX1311 BZ15 (2)	HX1509 BZ17 (2)	HX1511 BZ18 (2)	HX1512 BZ19 (2)	HX1709 BZ16 (2)	HX1709 BZ18 (2)	HX1711 BZ19 (2)	HX1811 BZ16 (2)	HX1813 BZ17 (2)
RPM		2900	2900	2900	2900	2900	2900	2900	2900	2900
Min. Unit Capacity	%	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5
EVAPORATOR										
Model		C2R(T)	1CR(T)	1CR(T)	1DR(T)	2ER(T)	2ER(T)	2FR(T)	JCR(T)	JAR(T)
Water Connector Size	inches	4	5	5	5	6	6	6	8	8
Nominal Water Flow Rate	USgpm	192.7	242.4	283.5	316.2	360.7	434.4	507.9	603.1	677.8
	m³/hr	43.8	55.1	64.4	71.8	81.9	98.7	115.4	137.0	153.9
Nominal Pressure Drop	ft.wg	8.0	16.4	21.8	19.7	18.4	25.7	26.7	21.1	23.4
	kPa	23.9	49.0	65.2	58.9	55.0	76.8	79.8	63.1	69.9
CONDENSER										
Total Face Area	ft²	141.2	188.2	188.2	188.2	235.3	235.3	282.3	329.4	376.4
	m²	13.1	17.5	17.5	17.5	21.9	21.9	26.2	30.6	35.0
No. of Fan		6	8	8	8	10	10	12	14	16
Fan Diameter	Inches	35.4	35.4	35.4	35.4	35.4	35.4	35.4	35.4	35.4
	mm	900	900	900	900	900	900	900	900	900
Fan Motor Power	kW	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2
Total Air Flow	CFM	98910	131880	128520	110880	151200	138600	183960	207270	236880
	m³/hr	168049	224066	218357	188386	256890	235483	312550	352154	402462
GENERAL										
Unit Length	Inches	150 1/8	195 3/8	195 3/8	195 3/8	240 1/2	240 1/2	285 3/4	330 7/8	376 1/8
	mm	3810	4960	4960	4960	6110	6110	7260	8400	9550
Unit Width	inches	88	88	88	88	88	88	88	88	88
	mm	2240	2240	2240	2240	2240	2240	2240	2240	2240
Unit Height	inches	88	88	88	88	98	98	98	98	98
	mm	2240	2240	2240	2240	2490	2490	2490	2490	2490
Approx. Shipping Weight	lbs	8704	10117	10174	10759	13289	13801	15020	19473	20928
	kg	3948	4589	4615	4880	6028	6260	6813	8833	9493
Approx. Operating Weight	lbs	8878	10315	10373	10986	13561	14072	15322	19888	21363
	kg	4027	4679	4705	4983	6151	6383	6950	9021	9690
Approx. Operating Charge R134a	lbs	207	265	300	324	364	441	507	639	677
	kg	94	120	136	147	165	200	230	290	307

Note: Nominal capacity is based on evaporator in/out fluid temperature at 54/44°F, ambient temperature 95°F, evaporator fouling factor 0.0001ft².h.°F/Btu.

ELECTRICAL DATA

Model ACHX-A	Power Supply : 400Vac-3Ph-50Hz											
	Compressor Data					Condenser Fan Motor Data			Unit Data			
	Starter Type	Qty	RLA	Starting Current	LRA	Qty	HP	FLA	RLA	MCA	MFS	Unit Starting Current
80T-5SR	Part Winding	2	84	290	485	6	3	6	205	226	300	392
100T-5SR	Part Winding	2	101	423	686	8	3	6	250	275	350	548
115T-5SR	Part Winding	2	117	472	790	8	3	6	283	312	400	613
130T-5SR	Part Winding	2	129	516	887	8	3	6	306	338	450	669
150T-5SR	Part Winding	2	147	562	890	10	3	6	353	390	500	739
180T-5SR	Part Winding	2	188	729	1114	10	3	6	436	483	630	947
210T-5SR	Star-Delta	2	217	757	1181	12	3	6	506	560	700	1010
250T-5SR	Star-Delta	2	239	586	1853	14	3	6	562	622	800	867
280T-5SR	Star-Delta	2	263	650	2029	16	3	6	622	688	800	961

Note: RLA - Running Load Amps At 115 ^{o}F Ambient Temperature
MCA - Minimum Circuit Ampacity
MFS - Maximum Fuse Size
LRA - Lock Rotor Amp

SOUND PRESSURE DATA

Model ACHX-A	Octave Band (Hz)								Total dB (A)
	63	125	250	500	1K	2K	4K	8K	
80T-5SR	46	45	51	52	58	56	51	43	62
100T-5SR	47	46	51	53	59	56	52	44	63
115T-5SR	47	46	52	54	59	57	53	45	63
130T-5SR	48	46	52	53	59	57	52	44	63
150T-5SR	49	48	53	54	61	58	54	45	65
180T-5SR	50	49	54	55	62	59	54	46	65
210T-5SR	51	50	55	55	63	60	55	46	66
250T-5SR	53	51	57	57	65	62	57	47	68
280T-5SR	53	51	57	57	65	62	57	48	68

Note: Unit Sound Pressure Level (Lp) @ 33 ft [10m] (free field), ± 2 dB tolerance.

PERFORMANCE DATA

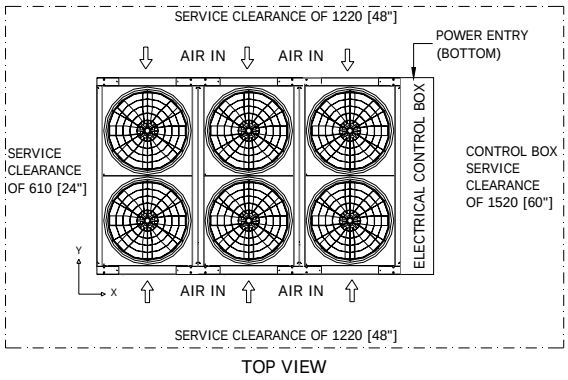
LWT °F	Model ACHX-A	Ambient Temperature, °F														
		85.0			95.0			105.0			115.0			125.0		
		TR	kW^O	kW^I	TR	kW^O	kW^I	TR	kW^O	kW^I	TR	kW^O	kW^I	TR	kW^O	kW^I
40.0	80T-5SR	78.1	274.9	67.4	74.4	261.7	76.2	70.0	246.4	86.1	65.4	229.9	97.4	60.0	211.0	106.7
	100T-5SR	98.4	346.1	83.5	94.0	330.6	94.2	88.9	312.7	106.3	83.1	292.2	120.4	76.5	269.2	131.7
	115T-5SR	114.8	403.7	97.6	110.0	387.1	110.4	104.5	367.5	124.4	98.2	345.4	139.9	90.8	319.3	152.7
	130T-5SR	127.9	450.1	106.7	122.6	431.2	120.0	116.7	410.4	135.4	109.6	385.6	153.2	101.5	357.1	167.9
	150T-5SR	145.6	512.2	117.6	140.1	493.0	133.5	134.0	471.4	151.8	126.6	445.4	172.9	117.8	414.5	192.5
	180T-5SR	175.5	617.5	151.7	168.2	591.9	171.6	160.1	563.2	195.0	150.8	530.5	222.2	140.6	494.7	245.1
	210T-5SR	205.1	721.7	169.0	196.8	692.4	191.0	187.5	659.6	216.3	177.3	623.8	245.6	165.8	583.2	274.5
	250T-5SR	244.7	860.9	202.4	233.8	822.6	228.0	221.2	778.3	256.7	206.9	728.0	288.7	190.8	671.1	323.0
	280T-5SR	274.9	967.1	227.7	262.8	924.4	255.2	249.0	875.9	284.7	233.3	820.9	317.7	216.0	759.9	356.8
42.0	80T-5SR	81.0	284.9	68.5	77.2	271.6	77.2	72.7	255.7	87.2	67.8	238.6	98.7	62.2	218.9	108.1
	100T-5SR	102.0	358.9	84.5	97.4	342.8	95.4	92.2	324.2	107.6	86.2	303.2	121.9	79.3	279.1	133.4
	115T-5SR	118.9	418.3	99.0	114.0	401.1	112.0	108.2	380.8	126.2	101.7	357.9	142.0	94.0	330.8	154.9
	130T-5SR	132.7	466.7	108.0	127.1	447.1	121.4	121.0	425.6	137.0	113.5	399.4	155.0	105.3	370.3	169.8
	150T-5SR	150.7	530.0	119.0	145.0	510.2	135.1	138.7	487.8	153.7	131.0	461.0	175.0	121.9	429.0	194.9
	180T-5SR	182.1	640.6	153.4	174.4	613.6	173.8	166.0	584.0	197.5	156.3	550.0	225.1	145.8	512.9	248.2
	210T-5SR	212.5	747.7	171.1	203.9	717.4	193.4	194.3	683.4	219.1	183.7	646.3	248.7	171.8	604.2	277.9
	250T-5SR	253.5	891.9	204.9	242.2	852.2	230.8	229.2	806.3	259.8	214.4	754.2	292.3	197.5	694.8	326.4
	280T-5SR	284.9	1002.3	230.5	272.3	958.1	258.3	257.9	907.3	288.0	241.8	850.8	321.5	223.9	787.6	361.1
44.0	80T-5SR	84.1	296.0	69.6	80.2	282.1	78.4	75.5	265.7	88.6	70.5	247.9	100.2	64.6	227.4	109.8
	100T-5SR	105.6	371.6	85.6	100.9	355.0	96.6	95.4	335.7	109.0	89.2	314.0	123.4	82.1	289.0	135.1
	115T-5SR	123.1	433.0	100.4	118.0	415.1	113.6	112.0	394.1	128.0	105.3	370.5	144.0	97.3	342.4	157.1
	130T-5SR	137.4	483.3	109.2	131.6	463.0	122.8	125.3	440.7	138.6	117.7	414.0	156.8	109.0	383.5	171.8
	150T-5SR	155.9	548.6	120.3	150.1	528.1	136.5	143.5	504.9	155.3	135.6	477.1	176.8	126.2	444.0	196.9
	180T-5SR	188.6	663.6	155.8	180.8	636.1	176.2	172.1	605.3	200.2	162.0	570.1	228.2	151.1	531.6	251.7
	210T-5SR	220.3	775.1	173.4	211.4	743.7	196.0	201.4	708.4	222.0	190.4	670.0	252.0	178.0	626.4	281.7
	250T-5SR	262.7	924.1	207.1	251.0	883.0	233.3	237.5	835.5	262.6	222.1	781.5	295.4	204.8	720.4	330.5
	280T-5SR	295.1	1038.2	233.4	282.1	992.4	261.5	267.3	940.3	291.7	250.5	881.3	325.6	231.9	815.8	365.7
46.0	80T-5SR	87.1	306.3	70.7	83.0	292.0	79.6	78.2	275.0	90.0	72.9	256.6	101.7	66.9	235.4	111.5
	100T-5SR	109.3	384.4	86.6	104.4	367.1	98.0	98.7	347.3	110.6	92.3	324.7	125.2	85.0	298.9	137.1
	115T-5SR	127.4	448.3	101.6	122.2	429.8	115.0	116.0	408.0	129.6	109.0	383.6	145.8	100.8	354.5	159.1
	130T-5SR	142.3	500.6	110.6	136.3	479.5	124.4	129.8	456.5	140.4	121.9	428.8	158.8	112.9	397.2	174.0
	150T-5SR	161.4	567.8	121.7	155.4	546.6	138.2	150.3	528.7	159.6	140.4	493.9	178.9	130.6	459.6	199.3
	180T-5SR	195.5	687.7	157.9	187.4	659.1	178.6	178.3	627.3	202.9	168.1	591.2	231.4	156.6	550.9	255.1
	210T-5SR	228.1	802.5	175.7	218.9	770.0	198.6	208.5	733.5	224.9	197.2	693.7	255.3	184.6	649.4	285.8
	250T-5SR	271.9	956.4	209.6	259.8	913.9	236.2	245.8	864.6	265.8	229.9	808.8	299.0	211.9	745.6	334.5
	280T-5SR	305.7	1075.4	236.1	292.2	1028.0	264.6	276.9	974.1	295.1	259.5	912.9	329.4	240.2	845.1	370.0
48.0	80T-5SR	90.2	317.4	71.7	86.0	302.6	80.8	81.0	284.9	91.3	75.6	265.8	103.3	69.3	243.9	113.2
	100T-5SR	113.1	397.8	87.9	108.0	379.9	99.2	102.2	359.4	111.9	95.5	336.1	126.7	87.9	309.3	138.7
	115T-5SR	131.8	463.6	103.1	126.3	444.5	116.6	119.9	421.9	131.4	112.8	396.7	147.8	104.2	366.6	161.3
	130T-5SR	147.2	517.8	112.0	141.0	496.0	126.0	134.2	472.2	142.2	126.1	443.6	160.9	116.8	410.9	176.2
	150T-5SR	167.1	587.8	123.0	160.8	565.8	139.6	153.8	541.0	158.7	145.3	511.2	180.8	135.2	475.7	201.3
	180T-5SR	202.3	711.7	160.0	193.9	682.2	181.0	184.5	649.2	205.7	173.8	611.4	234.4	162.1	570.2	258.5
	210T-5SR	236.1	830.6	177.8	226.5	796.9	201.0	215.8	759.1	227.7	204.5	719.4	258.8	190.8	671.2	288.8
	250T-5SR	281.4	990.0	211.8	268.9	946.0	238.6	254.4	895.0	268.6	238.0	837.2	302.2	219.4	771.8	338.0
	280T-5SR	316.3	1112.6	239.0	302.3	1063.6	267.9	286.5	1007.8	298.8	268.5	944.4	333.5	248.5	874.3	374.5
50.0	80T-5SR	93.6	329.2	72.6	89.2	313.8	81.8	84.0	295.4	92.4	78.5	276.2	104.6	71.9	252.9	114.6
	100T-5SR	117.1	411.9	89.0	111.8	393.4	100.4	105.8	372.1	113.3	98.9	348.0	128.3	91.0	320.3	140.4
	115T-5SR	136.3	479.6	104.3	130.7	459.8	118.0	124.1	436.5	133.0	116.6	410.3	149.6	107.8	379.3	163.2
	130T-5SR	152.3	535.8	113.5	145.9	513.2	127.6	138.9	488.5	144.0	130.5	458.9	162.9	120.8	425.1	178.5
	150T-5SR	172.7	607.7	124.4	166.3	584.9	141.2	159.0	559.3	160.6	150.2	528.5	182.9	139.8	491.8	203.7
	180T-5SR	209.1	735.8	162.5	200.5	705.2	183.8	190.8	671.1	208.8	179.7	632.1	238.0	167.6	589.5	262.5
	210T-5SR	244.3	859.3	180.3	234.4	824.5	203.8	223.2	785.4	230.8	211.1	742.8	262.0	197.4	694.4	292.9
	250T-5SR	291.0	1023.7	214.5	278.0	978.1	241.7	263.1	925.5	272.1	246.1	865.7	306.0	226.8	798.0	342.4
	280T-5SR	327.2	1151.2	241.7	312.8	1100.5	270.9	296.4	1042.7	302.2	277.8	977.2	337.3	258.1	907.9	380.0

Notes:
1.) Ratings based on 10°F water range in evaporator and .0001ft².h.°F/Btu fouling factor.
2.) Interpolation between ratings is permissible but extrapolation is NOT.
3.) kW° is for cooling capacity. kW^I is for compressor motor input.
4.) Unit is running on part load for ambient temperature of 115°F and above due to current limiter.

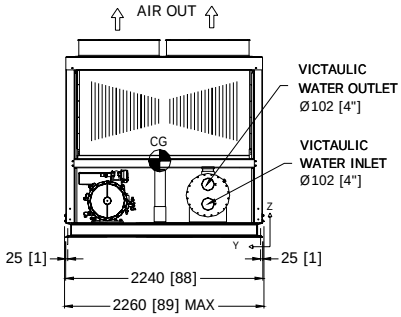
DIMENSIONAL DATA

ACHX-A 80T-5SR

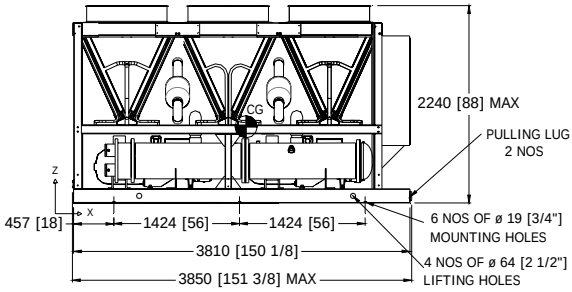
NOTES:
1. ALL DIMENSIONS ARE IN INCHES AND MILLIMETERS.
2. ALLOW 1520mm [60"] CLEARANCE AT CONTROL PANEL END OF UNIT FOR SERVICE.
3. USE MINIMUM 914mm [36"] FLEXIBLE CONDUIT TO CONTROL BOX TO ISOLATE UNIT.
4. WATER PIPING TO BE SUPPORTED TO MINIMIZE LOAD ON UNIT.



TOP VIEW



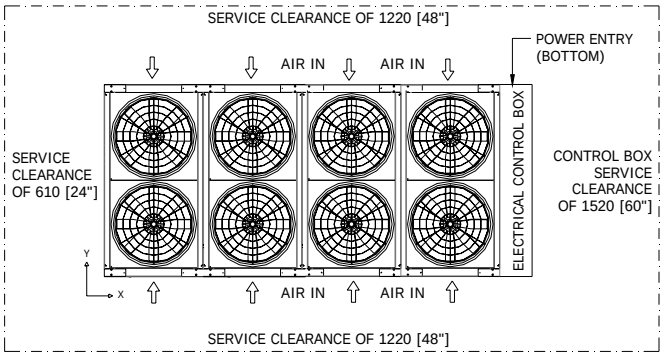
LEFT VIEW



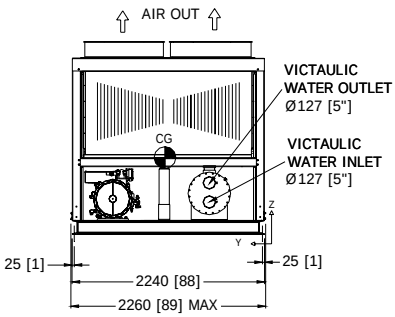
FRONT VIEW

ACHX-A 100T-5SR, 115T-5SR, 130T-5SR

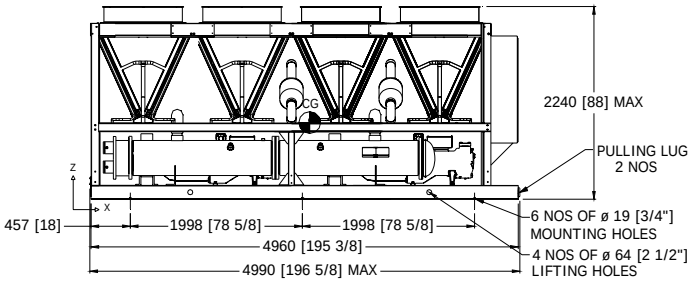
NOTES:
1. ALL DIMENSIONS ARE IN INCHES AND MILLIMETERS.
2. ALLOW 1520mm [60"] CLEARANCE AT CONTROL PANEL END OF UNIT FOR SERVICE.
3. USE MINIMUM 914mm [36"] FLEXIBLE CONDUIT TO CONTROL BOX TO ISOLATE UNIT.
4. WATER PIPING TO BE SUPPORTED TO MINIMIZE LOAD ON UNIT.



TOP VIEW



LEFT VIEW

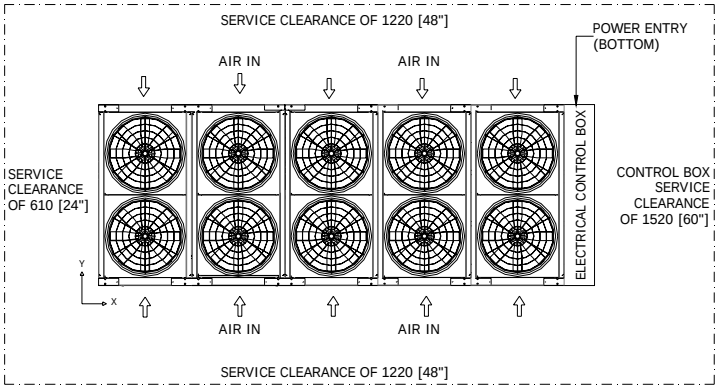


FRONT VIEW

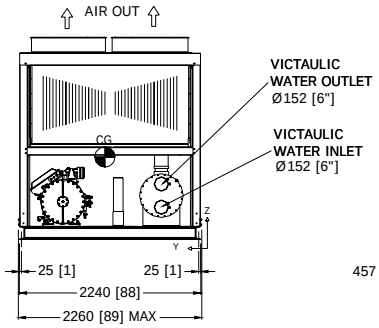
DIMENSIONAL DATA

ACHX-A 150T-5SR, 180T-5SR

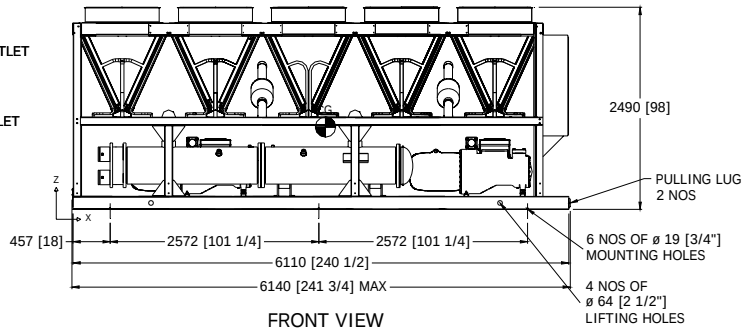
NOTES:
1. ALL DIMENSIONS ARE IN INCHES AND MILLIMETERS.
2. ALLOW 1520mm [60"] CLEARANCE AT CONTROL PANEL END OF UNIT FOR SERVICE.
3. USE MINIMUM 914mm [36"] FLEXIBLE CONDUIT TO CONTROL BOX TO ISOLATE UNIT.
4. WATER PIPING TO BE SUPPORTED TO MINIMIZE LOAD ON UNIT.



TOP VIEW



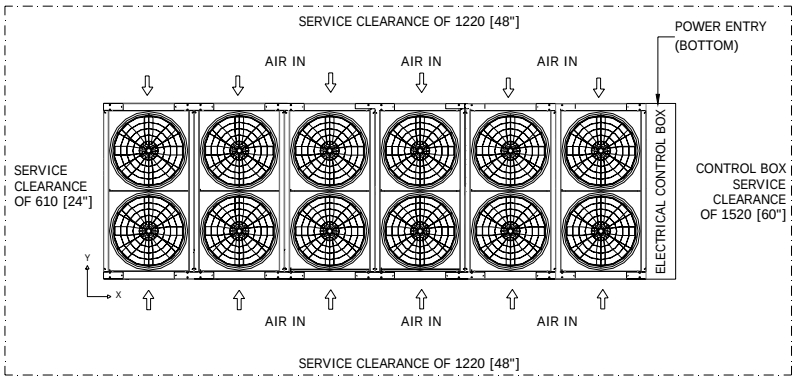
LEFT VIEW



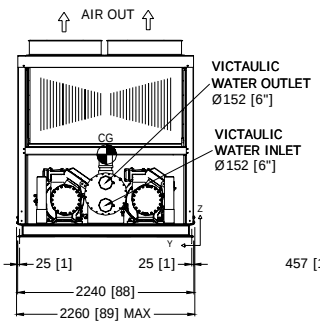
FRONT VIEW

ACHX-A 210T-5SR

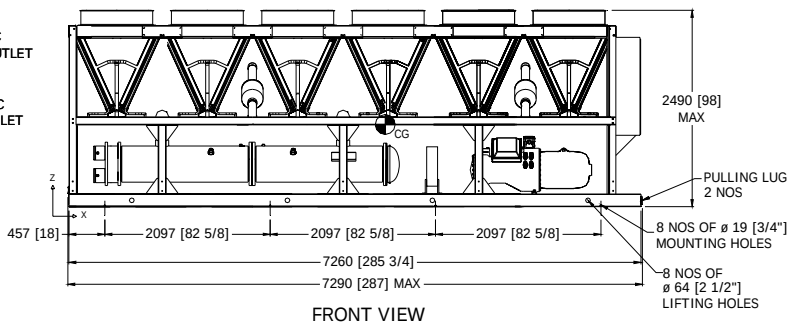
NOTES:
1. ALL DIMENSIONS ARE IN INCHES AND MILLIMETERS.
2. ALLOW 1520mm [60"] CLEARANCE AT CONTROL PANEL END OF UNIT FOR SERVICE.
3. USE MINIMUM 914mm [36"] FLEXIBLE CONDUIT TO CONTROL BOX TO ISOLATE UNIT.
4. WATER PIPING TO BE SUPPORTED TO MINIMIZE LOAD ON UNIT.



TOP VIEW



LEFT VIEW

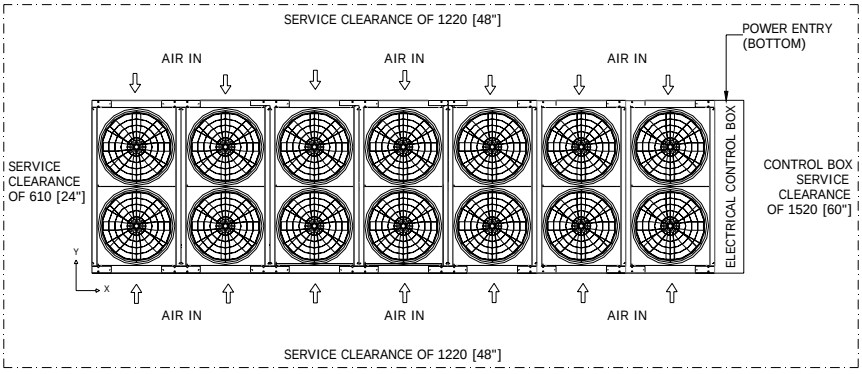


FRONT VIEW

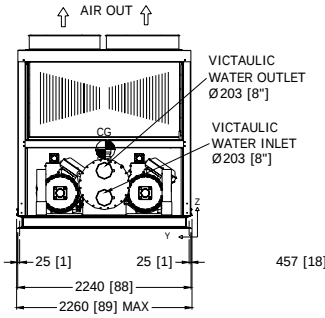
DIMENSIONAL DATA

ACHX-A 250T-5SR

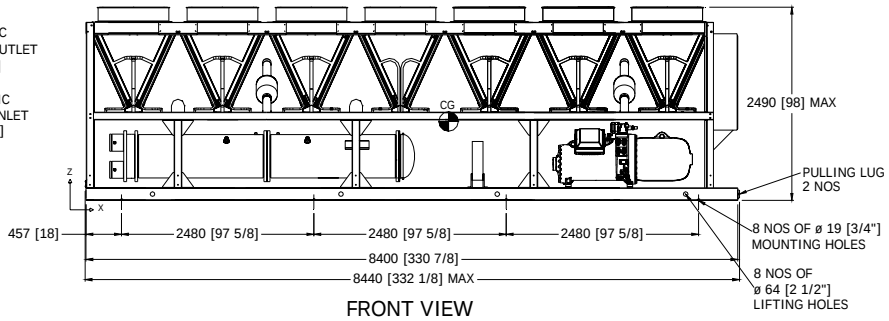
NOTES:
1. ALL DIMENSIONS ARE IN INCHES AND MILLIMETERS.
2. ALLOW 1520mm [60"] CLEARANCE AT CONTROL PANEL END OF UNIT FOR SERVICE.
3. USE MINIMUM 914mm [36"] FLEXIBLE CONDUIT TO CONTROL BOX TO ISOLATE UNIT.
4. WATER PIPING TO BE SUPPORTED TO MINIMIZE LOAD ON UNIT.



TOP VIEW



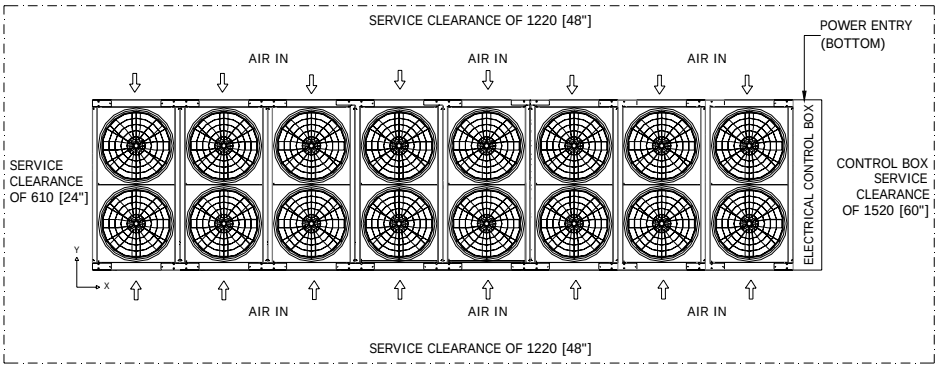
LEFT VIEW



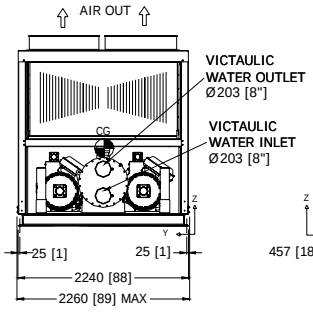
FRONT VIEW

ACHX-A 280T-5SR

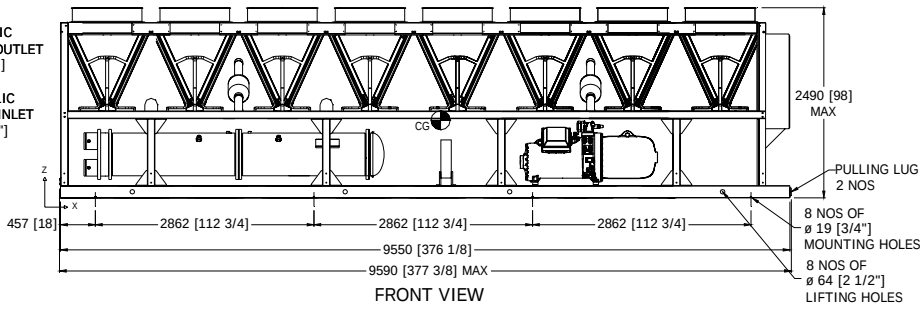
NOTES:
1. ALL DIMENSIONS ARE IN INCHES AND MILLIMETERS.
2. ALLOW 1520mm [60"] CLEARANCE AT CONTROL PANEL END OF UNIT FOR SERVICE.
3. USE MINIMUM 914mm [36"] FLEXIBLE CONDUIT TO CONTROL BOX TO ISOLATE UNIT.
4. WATER PIPING TO BE SUPPORTED TO MINIMIZE LOAD ON UNIT.



TOP VIEW



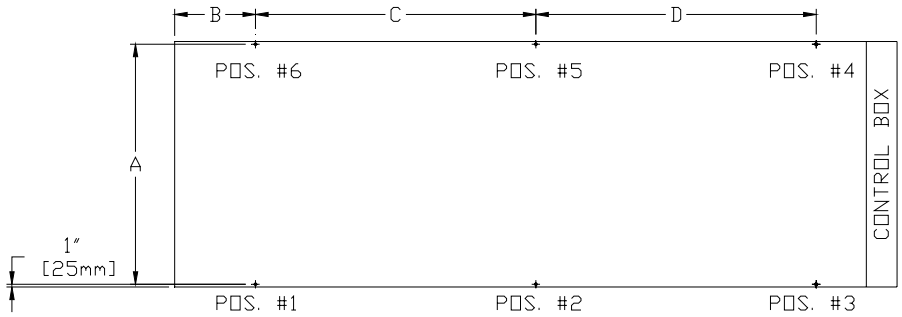
LEFT VIEW



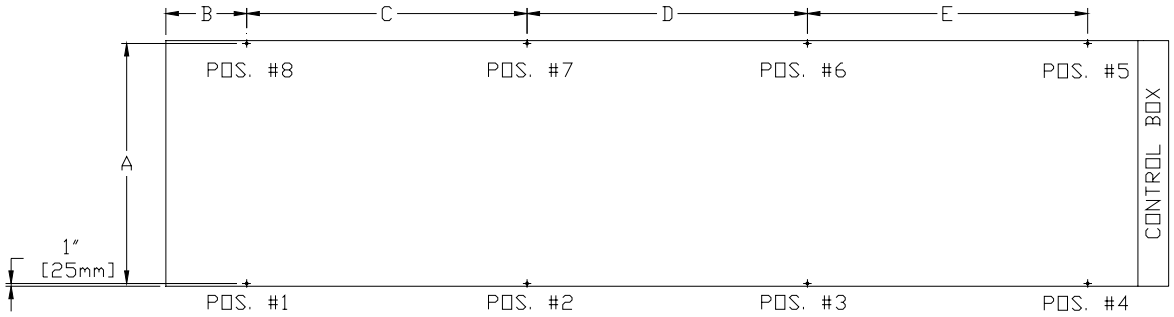
FRONT VIEW

FLOOR LOADING DIAGRAM

ACHX-A 80T-5SR, 100T-5SR, 115T-5SR, 130T-5SR, 150T-5SR, 180T-5SR,



ACHX-A 210T-5SR, 250T-5SR, 280T-5SR



a.) Point Load Location – inches [mm]

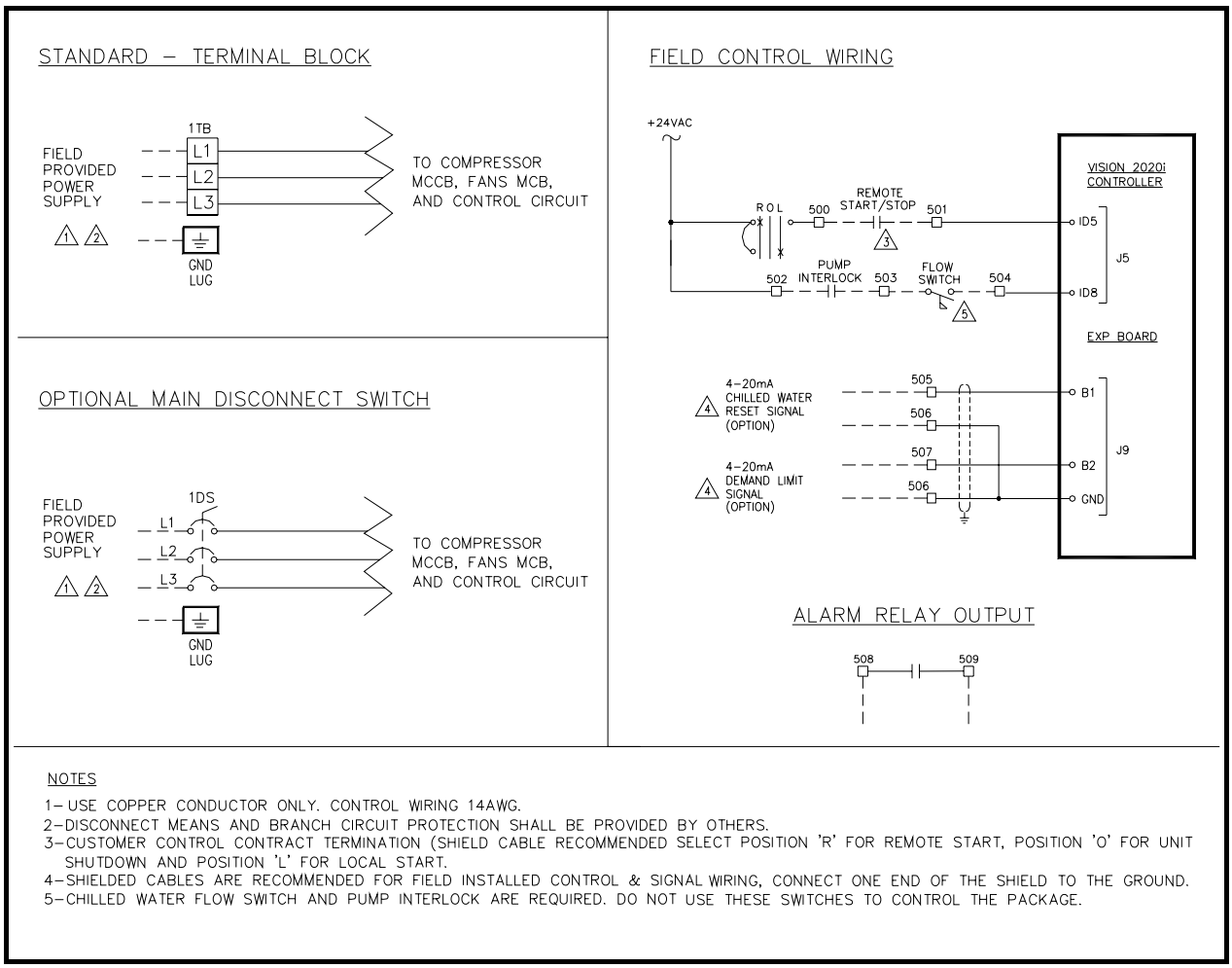
Model ACHX-A	A Dim.	B Dim.	C Dim.	D Dim.	E Dim.
80T-5SR	86 [2184]	18 [457]	56 1/16 [1424]	56 1/16 [1424]	-
100T-5SR	86 [2184]	18 [457]	78 21/32 [1998]	78 21/32 [1998]	-
115T-5SR	86 [2184]	18 [457]	78 21/32 [1998]	78 21/32 [1998]	-
130T-5SR	86 [2184]	18 [457]	78 21/32 [1998]	78 21/32 [1998]	-
150T-5SR	86 [2184]	18 [457]	101 1/4 [2572]	101 1/4 [2572]	-
180T-5SR	86 [2184]	18 [457]	101 1/4 [2572]	101 1/4 [2572]	-
210T-5SR	86 [2184]	18 [457]	82 9/16 [2097]	82 9/16 [2097]	82 9/16 [2097]
250T-5SR	86 [2184]	18 [457]	97 5/8 [2480]	97 5/8 [2480]	97 5/8 [2480]
280T-5SR	86 [2184]	18 [457]	112 11/16 [2862]	112 11/16 [2862]	112 11/16 [2862]

b.) Point Load Data – lbs [kg]

Model ACHX-A	Pos. #1	Pos. #2	Pos. #3	Pos. #4	Pos. #5	Pos. #6	Pos. #7	Pos. #8	Total Operating Weight
80T-5SR	1348 [611]	1416 [642]	1483 [673]	1626 [738]	1544 [700]	1461 [663]	-	-	8878 [4027]
100T-5SR	1652 [750]	1668 [757]	1684 [764]	1903 [863]	1771 [803]	1638 [743]	-	-	10316 [4679]
115T-5SR	1660 [753]	1676 [760]	1692 [767]	1915 [869]	1782 [808]	1649 [748]	-	-	10374 [4705]
130T-5SR	1770 [803]	1778 [806]	1786 [810]	2013 [913]	1884 [854]	1755 [796]	-	-	10985 [4983]
150T-5SR	2188 [992]	2146 [973]	2104 [954]	2549 [1156]	2375 [1077]	2201 [998]	-	-	13562 [6151]
180T-5SR	2275 [1032]	2229 [1011]	2183 [990]	2633 [1194]	2462 [1117]	2291 [1039]	-	-	14072 [6383]
210T-5SR	1709 [775]	1861 [844]	2012 [913]	2163 [981]	2123 [963]	1970 [894]	1818 [825]	1665 [755]	15321 [6950]
250T-5SR	2207 [1001]	2407 [1092]	2607 [1183]	2807 [1273]	2767 [1255]	2566 [1164]	2364 [1072]	2163 [981]	19888 [9021]
280T-5SR	2585 [1172]	2656 [1205]	2727 [1237]	2798 [1269]	2758 [1251]	2685 [1218]	2613 [1185]	2541 [1153]	21363 [9690]

FIELD POWER & CONTROL WIRING SCHEMATIC

TYPICAL FIELD WIRING DIAGRAM



APPLICATION DATA

UNIT OPERATION AMBIENT TEMPERATURE

The units are designed to operate at ambient temperature, 45~125°F [7~52°C]. If the unit requires to be operated at lower ambient temperature, the optional Low Ambient Operation (***LA 1***), or Extra Low Ambient Operation (***LA 2***) shall be incorporated for stable operation.

For unit installation with minimum ambient temperature at 32°F [0°C] or below, ***Evaporator Anti-Freeze Protection*** is recommended to prevent freezing of water in evaporator when the chiller is not in operation.

If wind velocity in the area is over 5 mph [8 kmph], wind barrier is recommended.

Operating Limits – Ambient Temperature

Operating Ambient Temperature	SR, standard series	
	Minimum	Maximum
Standard	45°F [7°C]	125°F [52°C]
With LA 1	14°F [-10°C]	125°F [52°C]
With LA 2	-20°F [-29°C]	125°F [52°C]

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.

APPLICATION DATA

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.

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 to supply chilled fluid 38°F [3.3°C] or below, 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.

The use of glycol causes a performance derate as shown below which needs to be included in the unit selection procedure.

Operating Limits – Leaving Fluid Temperature

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

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

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 across evaporator

Correction Factor - Elevation

Elevation above Sea Level		Capacity Correction Factor	kW Correction Factor
Feet	Meters Factor		
0	0	1.00	1.00
2000	600	0.99	1.01
4000	1200	0.98	1.02
6000	1800	0.97	1.03

Correction Factor - FF

Fouling Factor		Capacity Correction Factor	kW Correction Factor
hr.ft².°F/BTU	m².°C/kW		
0.00010	0.018	1.000	1.000
0.00025	0.044	0.990	0.995
0.00050	0.088	0.970	0.990

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

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

Demand Charge: ***ITES*** allows some of the peak demand to be shifted to low-demand nighttime periods, thus reducing demand charges for the entire year.

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

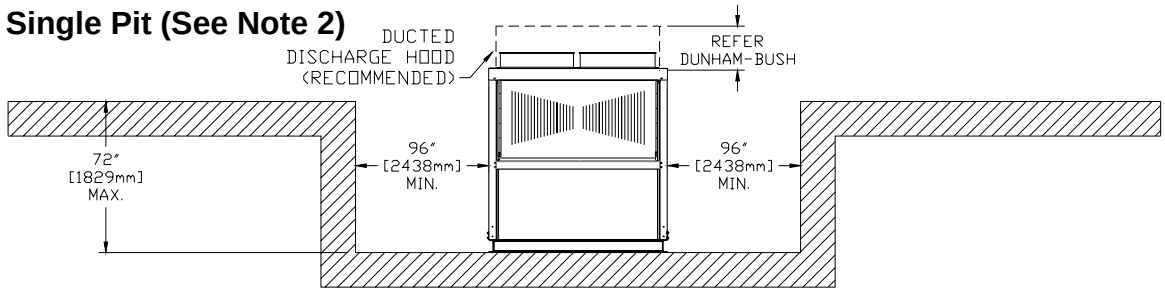
Rebates: ***ITES*** usually qualifies for rebates offered by electric utilities or governments for equipment that shift peak loads to off-peak hours

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

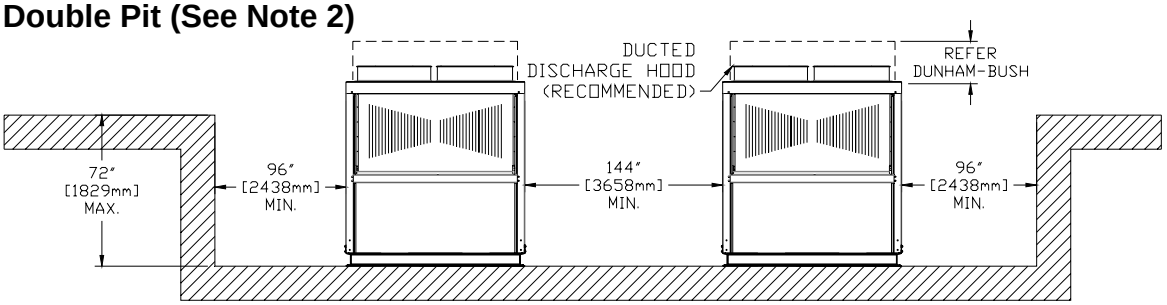
Standby Cooling Capacity: Energy stored in ***ITES*** can be utilized to cater peak or unexpected loads which exceeded total cooling capacity available from the installed chillers. This is savior to the regions which having difficulties on power generation plants expansion, where with ***ITES***, will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

MINIMUM CLEARANCE REQUIREMENTS

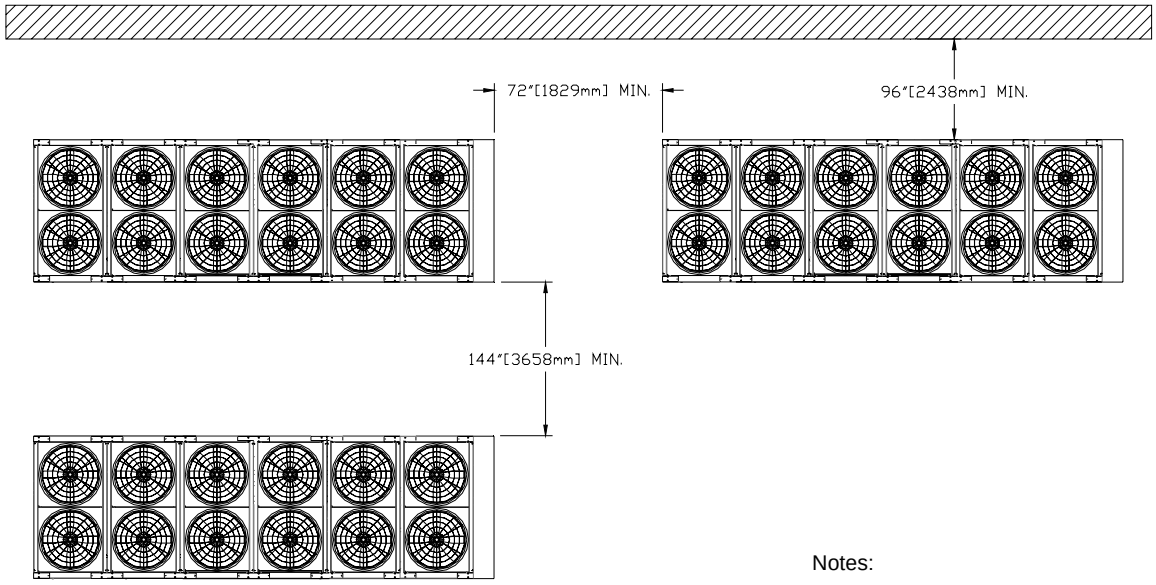
Single Pit (See Note 2)



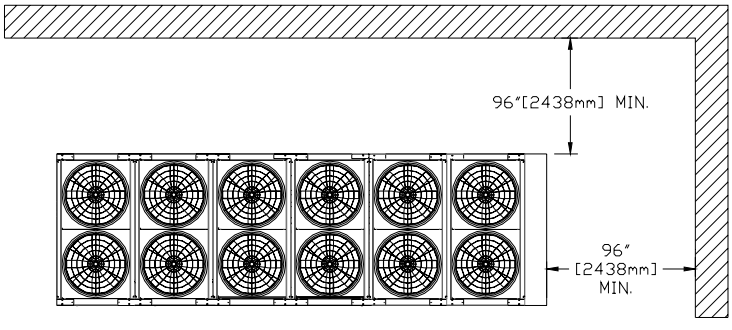
Double Pit (See Note 2)



Multi Pit



Corner Wall



Notes:

1.) All dimensions are minimal, unless otherwise noted.

2.) Pit installations are not re-commended. Re-circulation of hot condenser air in combination with surface air turbulence cannot be predicted. Hot air re-circulation will severely affect unit efficiency (EER) and can cause high pressure or fan motor temperature trips. Dunham-Bush will not be responsible for ducting fans to a higher level to alleviate the above mentioned conditions.

GUIDE SPECIFICATIONS

SCOPE

Supply and commissioning of complete factory assembled Air cooled rotary screw chiller(s). The rotary screw chiller(s) shall contain rotary screw compressor(s), evaporator, Air cooled condenser with coil and fan, interconnecting refrigerant piping, electronic expansion valve, control panel, chilled liquid 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 run 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 12.5% of cooling (refrigeration) capacity when operating at design leaving chilled water temperature and design ambient air temperatures, without the use of hot gas bypass.

Heat transfer surfaces shall be selected to reflect the incorporation of a fouling factor of 0.0001 hr.sq.ft.°F/BTU [0.0000176m².°C/W] for evaporator. Water pressure drop at design conditions shall not exceed _____ feet of water through the evaporator.

QUALITY ASSURANCE

- Chiller performance shall be rated in accordance to AHRI 550/590 standard latest edition.
- 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] ASHRAE Standard 15 safety code for mechanical refrigeration
- [Optional] JKKP code for vessels required in Malaysia market place.
- [Optional] PED certification required in Europe market place
- Manufacturer shall have experience of minimum 15 years in manufacturing Air 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 230V/1ph/50Hz.

COMPRESSOR AND MOTOR

The packaged chiller shall be furnished with Semi-hermetic rotary twin-screw compressor(s) as required, driven by a 2900 RPM 2 pole motor. Each compressor shall include oil sump. The oil differential pressure shall be controlled during operation to maintain proper oil lubrication throughout the lubrication system. An electric oil heater shall be provided in each compressor to maintain required oil temperature during shutdown period. The heater shall be energized when the chiller is switched off. Each compressor shall have a sight glass, suction filter, a discharge check valve and a discharge service valve. 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, type, shall be able to carry both radial and thrust loads.

The compressor motor shall be semi-hermetic refrigerant gas cooled, 2 pole, squirrel cage induction type with class F insulation. Motor winding shall have thermistors embedded in the motor windings to protect motor from overheating. 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. A baffle plates shall be provided above the tube bundle at the top 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 shall ensure 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 is not acceptable.

All low temperature surfaces shall be factory insulated with 25mm thk Polyethylene resin having K factor of 0.26 btu-in / hr – ft² – °F

CONDENSER

Condenser shall be Air cooled type, shall be tube/fin coil design. The coil shall be constructed of seamless inner-grooved copper tube and aluminum fins having self spacing collars in staggered configuration. Copper tubes shall be mechanically expanded into the fins. The coil construction shall be of V configuration in order to increase heat transfer area and condenser divider baffles shall fully separate each condenser fan section to control the air flow by fan cycling and fan staging to maintain optimum head pressure. Tube sheet shall be of galvanized steel and divider baffles shall be made of galvanized steel with powder coating.

The fan shall be direct drive propeller type, made of heavy duty Aluminum fan blades, in order to have higher resistance for dust and sand abrasion. Fan shall be protected with powder coated galvanized fan guard.

The motor shall be 3-phase, TEAO, squirrel cage induction type with IP55 enclosure and class F insulation. The motor bearing shall be permanently lubricated. Motor shall have internal thermal protection.

The fan and the motor assembly shall be rigidly secured to the casing with a heavy gauge steel powder coated fan brackets with air discharge upward.
The coils shall be pneumatic leaked and pressure tested at 450psi [31bar].

The condenser shall be sized for full pump down capacity.

Pre-coated Aluminum fin/ Copper tube coil (Optional)

Copper tube / Pre-coated Al fin construction shall be made of seamless inner grooved copper tubes mechanically expanded into pre-coated aluminum fins. The tube sheet shall be of galvanized steel and the divider baffles shall be of galvanized steel with powder coating

Copper tube/ Copper fin coil (Optional)

Copper/Copper construction shall be made of seamless inner grooved copper tubes mechanically expanded into copper fins. The tube sheet shall be of galvanized steel or stainless steel and the divider baffles shall be of galvanized steel with powder coating.

Post-coated Aluminum fin coil (Optional)

Copper tube / Aluminum fin coil construction shall be made of seamless inner grooved copper tubes mechanically expanded into Aluminum fins. The tube sheet shall be of galvanized steel. The entire coil shall be coated with anti corrosive coating after the coil fabrication. The divider baffles shall be made of galvanized steel with powder coating.

REFRIGERANT CIRCUIT

The refrigerant circuit shall include liquid line shut-off valve and discharge service valves on compressor which facilitate isolation of compressor and evaporator and allow condenser to be used as a pump down receiver during servicing. It shall also include oil filter, replaceable filter drier, and sight glass, Plate type heat exchanger as economizer, pressure relief valves on the cooler and on compressor body, 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, refrigerant liquid level control and improve efficiency by optimizing the discharge superheat while protecting compressor. Fixed orifice control systems will not be acceptable. (Option- Hot gas bypass shall be factory installed for operation below standard min load of 12.5% of full load.)

GUIDE SPECIFICATIONS

OIL MANAGEMENT

The chiller package shall ensure proper lubrication during the operation in order to have prolonged compressor life as well as maintaining system efficiency. An efficient pressure differential lubrication system shall be provided. The lubrication system shall consist of efficient oil separator, 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. There shall be an efficient oil recovery and oil return system in order to recover oil which migrates to evaporator.

ECONOMIZER

In order to maximize energy efficiency, the packaged chiller shall be equipped with an economizer cycle. The economizer shall be a plate type heat exchanger with a necessary expansion device and a solenoid valve. Portion of the liquid refrigerant shall passes through the 1st expansion device into the economizer where the remaining main liquid flow gets sub-cooled. The gaseous refrigerant is then drawn out of the economizer and feed into the vapor injection port of the compressor. The main sub-cooled liquid refrigerant shall enter to the evaporator via the electronic expansion valve which reduces the pressure of the liquid refrigerant to evaporator pressure. This process delivers outstanding efficiency and total energy saving through the utilization of economizer cycle.

ELECTRICAL AND CONTROL PANEL

The electrical switch gears, controller, control sensors and relays shall be housed in IP54 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 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.

IP54 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 / thermal 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/ thermal external compressor over load protector, over heating protection modules, over/under voltage phase relay shall be interlocked with the compressor starter contactors to provide adequate protection to the compressor motor.

Control Panel

The packaged chiller shall be equipped with stand along proactive advance microcontroller which adapts to abnormal operation conditions. The unit algorithm program and operating parameters shall be stored in flash-memory that does not require a battery back-up. Battery back-up is not acceptable. 230V Power supply to the controller shall be provided by a control transformer provided within the panel. External power source to the controller is not acceptable.

The controller shall be equipped with a user friendly back-lit 132 x 64 pixels semi-graphic display and dedicated keys that provides easy access to the unit operating parameters, control set points and alarm history. There shall be dedicated physical buttons to 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 diagnostic test on the controller and the connected devices. An alarm messages shall be displayed automatically if any fault found.

GUIDE SPECIFICATIONS

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 temp.

The controller shall be complete with all hardware and software necessary to enable remote monitoring through the addition of an optional web card if accessing the controller via web or via a 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
- Programmable with Seven day operation cycle
- [Optional] chilled liquid and condenser water pump on/off control
- [Optional] dual mode operation to produce Ice at 21F-26F for Ice thermal energy systems.

Automatic Controls

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

Refrigerant Flow Controls

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

Indicator Lights

- Control power
- Compressor run
- 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
- Entering Chilled water temperature
- Rate of change of chilled water leaving temperature.
- Compressor discharge temperature & superheat
- Evaporator pressure
- Condenser pressure
- Compressor amps draw for each compressor
- Operating supply Voltage [optional]
- Compressor elapsed run time of each compressor
- Compressor status
- No of starts of each compressor
- Condenser fan motor status
- Oil level sensor status
- Water temperature re-set value [optional]
- Water flow switch status
- Remote start/stop command status
- Percentage of compressor capacity (% of FLA)
- Electronic expansion valve percentage of opening.

Safety Protections

- Short circuit protection.
- Compressor motor over load protection (3 phase)
- Compressor over current
- Compressor motor overheat protection
- Compressor Anti-recycle
- 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
- Power loss
- Sensor error
- Refrigerant loss (by low pressure)
- 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.

REMOTE MONITORING AND CONTROL (OPTION)

Chiller plant manager (option)

Control and monitor chillers; pumps; VFDs; motorized valves; bypass modulating valves etc Field Devices such as flow meters; sensors & transducers can be interfaced. Plant manager shall sequence chillers and pumps as well as able to carry out lead-lag; duty-standby and alarm change over operations.

Master-Slave Sequencing Control (option)

Each chiller controller shall be able to be connected each other via a communication bus and form a network without additional controller to enable Master-Slave Sequencing Control of the chiller system. Master-Slave control shall stage up or stage down the chillers in operation to match the building cooling capacity. It shall have control function such as Lead-lag; duty/standby and alarm changeover control. The Master-Slave network shall be able to connect upto 8 numbers of chillers.

Building Management System (BMS) Communication (option)

The chiller controller shall be able to communicate to BMS via a communication card using one of the below industry common communication protocols as specified.

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

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 an 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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