



# ACHELOUS

Air Cooled Screw Chillers

AVX-A 50Hz

Cooling Capacity: 95 to 530 TR (334 to 1864 kW)



# 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.

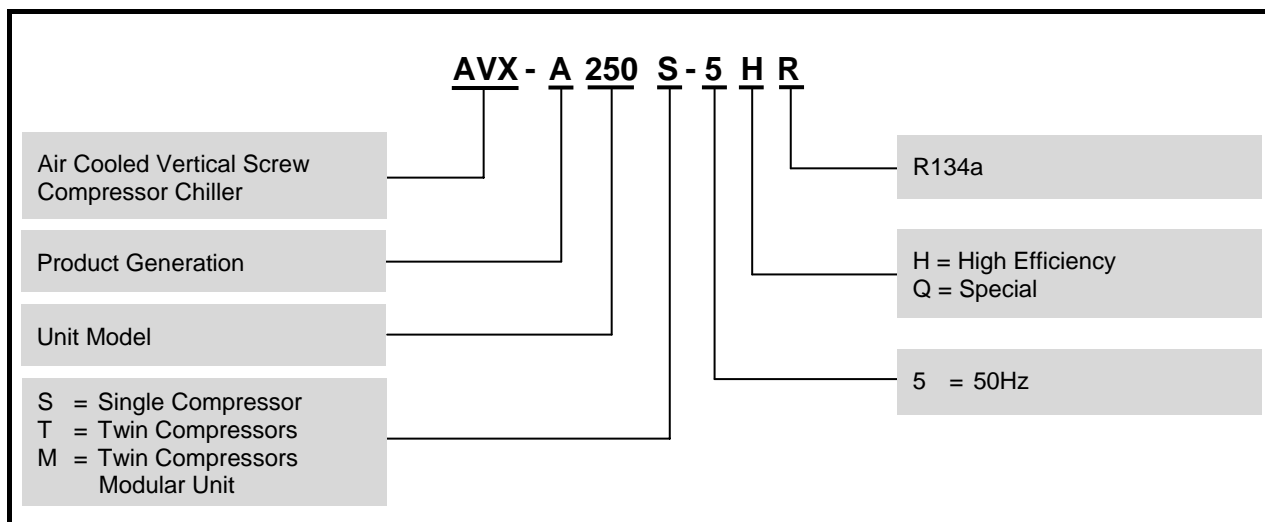
The Dunham-Bush name is synonymous worldwide with the Rotary Screw Compressor Chillers technology. With over 45 years of proven experience and track records in manufacturing and installation of Rotary Screw Compressors and chillers, thousands of our Chillers have clocked more than 100,000 operating hours 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 Air Cooled Rotary Screw Flooded Chillers with unsurpassed performance and reliability.

**ACHELOUS**, AVX-A Air Cooled Screw Flooded Chillers, have a cooling capacity range from 95 to 530 TR [334 to 1864 kW] in 50Hz version using environmentally sound R134a refrigerant. The entire product line features high energy efficiency, installation ease, control flexibility, high reliability and advanced Vision 2020i controller. The AVX-A series are certified to AHRI Standard 550/590 and meets ASHRAE Standard 90.1-2015.

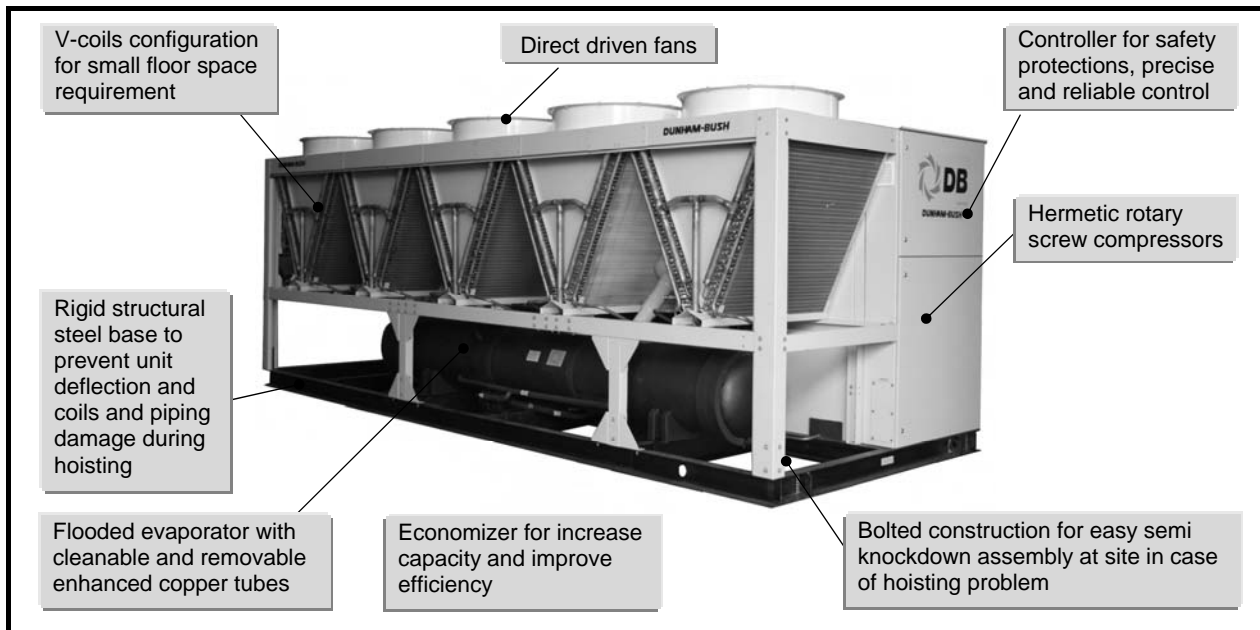
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# NOMENCLATURE



# GENERAL CHARACTERISTICS



## UNIT FEATURES

### General

- ✱ 21 models from 95 to 530 TR [334 to 1864 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 operate with R134a, the environment friendly refrigerant with zero **ODP** (Ozone Depletion Potential)
- ✱ Standard unit operating ambient temperature, 45~125°F [7~52°C]

### Compressor

- ✱ New generation of Dunham-Bush MSC Vertical Screw Compressors with Unique Patented Twin Screw compressor technology, offers further improved reliability and stability, with lower sound level
- ✱ Optimized oil management with up to 2 integral oil separators. Multi-layered mesh element effectively separates oil from the gas stream
- ✱ No external oil pump required
- ✱ Patented screw profile design which is specially made for R134a application, to assure operation at highest efficiencies
- ✱ Optimized volume ratio, VI port position and geometry for best efficiency
- ✱ Consistent loading and unloading with hydraulically actuated slide valve mechanism; a rugged and trouble-free design
- ✱ Hermetic design eliminates casing leakage, with no requirement for internal parts service, no periodic compressor tear down and overhaul

- ✱ Direct driven design eliminates gear set; improve efficiency and reliability
- ✱ Discharge service valves is provided to each compressor for the ease of servicing

### Evaporator

- ✱ Shell-and-tube flooded type heat exchanger
- ✱ Integral finned copper tubes to maximized heat transfer area
- ✱ Cleanable copper tubes for maintaining high efficiency
- ✱ Removable water heads for easy service
- ✱ Victaulic groove water connection comply to ANSI/AWWA C-606
- ✱ Standard with 1" thick closed cell insulation
- ✱ Standard relief valve(s) – 3/4" [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 slit 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
- ✱ Evaporation of liquid refrigerant in evaporator is controlled at precise level for optimum performance

## Economizer

- ✱ The economizer circuit consists of plate type heat exchanger, expansion valve and solenoid valve
- ✱ Liquid refrigerant is sub-cooled at economizer before entering the evaporator; the flash refrigerant from economizer is fed into vapor injection port of the compressor
- ✱ The economizer increased cooling capacity by means of 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, except models AVX-A 450M and 520M which are modular units with dual power connection points as standard
- ✱ 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
- ✱ Chilled water pump control

## 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 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
- ✱ Ambient temperature
- ✱ Current drawn by each compressor

# UNIT FEATURES

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- ✱ 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 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 TCP/IP
- ✱ BACnet over IP, MS/TP, or PTP
- ✱ LONworks FTT 10

# OPTIONS AND ACCESSORIES

- ✱ **Heat Recovery** – 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 or Hydrophilic coated fins are provided to give better corrosion protection. **DB-COAT**, the post-coated solution for condenser coil to provide extensive corrosion protection which withstand not less than 5000 hours salt spray testing as per ASTM B-117
- ✱ **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
- ✱ **Flanged Semi-hermetic Compressor** – Semi hermetic compressor is available on request
- ✱ **Low Ambient Operation (LA 1)** – Variable frequency drive (VFD) is incorporated to the condenser fan motor to allow unit operation down to 14 °F [-10 °C] ambient temperature
- ✱ **Extra Low Ambient Operation (LA 2)** – Add-on low ambient kit 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
- ✱ **Protective Grille for Condenser Coil** – To protect condenser coil from unauthorized access
- ✱ **Evaporator Flanged Water Connection** – Flanged water connection is available as option
- ✱ **250 PSIG Working Pressure Vessel** – Evaporator with 250 psig working pressure on water side
- ✱ **Low Noise Operation (LN)** – To reduced unit operating sound level. 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°F [-7.8°C] during ice making mode. Units with Dual Mode Operation is used for Ice Thermal Storage System
- ✱ **Low Temp. Operation** – The unit with Low Temp. Operation can deliver chilled fluid temperature down to 18°F [-7.8°C] for process cooling application
- ✱ **ASME/ PED/ 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 / TCP/IP, 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.
- ✱ **Single Power Connection Point** – Quick and easy field installation with one main power supply termination. (Applicable to Models AVX-A 450M and 520M only)
- ✱ **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
- ✱ **IP55 Control Panel** – IP55 rated control panel can be supplied for harsh working environment

## Factory Supplied, Field Installed By Customer

- ✱ **Evaporator Water Flow Switch** – Flow switch to be installed at evaporator outlet piping as safety interlock to evaporator 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 leveraging 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

## 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 optimized components matching 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

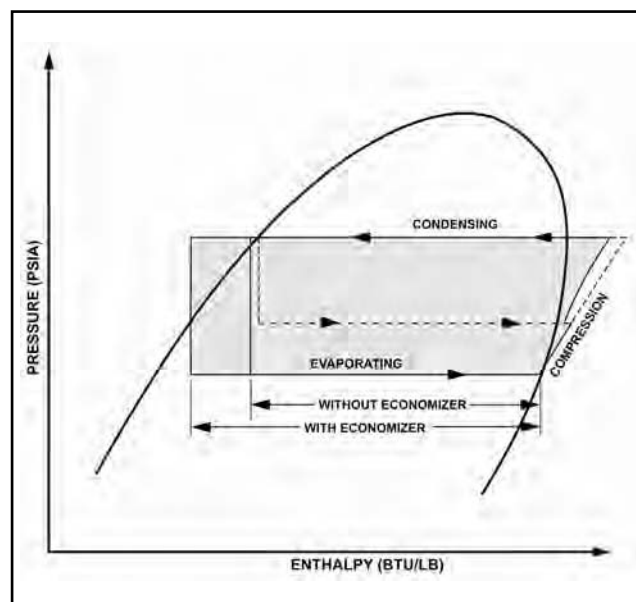
### Control Flexibility

- ✿ 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  $\pm 0.8^\circ\text{F}$  [ $0.5^\circ\text{C}$ ] 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 compressor 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, 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 AVX-A	95S-5HR	115S-5HR	135T-5HR	140S-5HR	170S-5HR	170T-5HR	185T-5HR	200S-5HR	220S-5HR	235T-5HR	250S-5HR
Unit Nominal Capacity TR [kW]	96.1 [338]	116.8 [411]	136.0 [478]	140.8 [495]	169.7 [597]	170.9 [601]	188.0 [661]	191.1 [672]	221.9 [780]	235.1 [827]	251.3 [884]
Unit Nominal Power Input kW	104.4	129.6	157.8	155.5	181.7	187.6	206.4	198.2	232.0	251.4	262.3
Energy Efficiency kW/TR	1.086	1.110	1.160	1.104	1.071	1.098	1.098	1.037	1.046	1.069	1.044
COP kW°/kW	3.237	3.170	3.031	3.185	3.285	3.204	3.203	3.391	3.364	3.289	3.370
COMPRESSOR											
Model (Qty)	1220 (1)	1220 (1)	1215 (2)	1222 (1)	1227 (1)	1215 (2)	1220 (2)	1230 (1)	2233 (1)	1220 (2)	2236 (1)
RPM	2950	2950	2950	2950	2950	2950	2950	2950	2950	2950	2950
Min. % Unit Capacity	25%	25%	12.5%	25%	25%	12.5%	12.5%	25%	25%	12.5%	25%
No. Of Refrigerant Circuit	1	1	2	1	1	2	2	1	1	2	1
EVAPORATOR											
Model (Qty)	C4R (1)	1CR (1)	1DRT (1)	1DR (1)	2ER (1)	2ERT (1)	2FRT (1)	2FR (1)	EBR (1)	EBRT (1)	JCR (1)
Water Connector inches[mm]	4 [101.6]	5 [127.0]	5 [127.0]	5 [127.0]	6 [152.4]	6 [152.4]	6 [152.4]	6 [152.4]	6 [152.4]	6 [152.4]	8 [203.2]
Nominal Water Flow USGpm[m³/hr]	231.0 [52.6]	281.0 [63.7]	327.0 [74.2]	338.3 [76.7]	407.7 [92.5]	410.6 [93.2]	451.7 [102.6]	459.0 [104.4]	533.1 [121.0]	564.9 [128.2]	603.8 [137.2]
Nominal Pressure Drop ft.wg[kPa]	9.2 [27.5]	21.4 [64.0]	22.6 [67.6]	22.3 [66.7]	23.0 [68.7]	22.9 [68.4]	22.2 [66.4]	22.2 [66.4]	23.8 [71.1]	23.7 [70.8]	21.1 [63.1]
Min. Water Flow USGpm[m³/hr]	141 [32.0]	117 [26.6]	138 [31.3]	138 [31.3]	163 [37.0]	163 [37.0]	188 [42.7]	188 [42.7]	211 [47.9]	211 [47.9]	252 [57.2]
Max. Water Flow USGpm[m³/hr]	472 [107.2]	389 [88.4]	461 [104.7]	461 [104.7]	543 [123.3]	543 [123.3]	625 [142.0]	625 [142.0]	702 [159.4]	702 [159.4]	840 [190.8]
Min. Water Pressure Drop ft.wg[kPa]	3.8 [11]	4.4 [13]	4.5 [13]	4.5 [13]	6.1 [18]	6.1 [18]	4.4 [13]	4.5 [13]	4.4 [13]	4.5 [13]	4.4 [13]
Max. Water Pressure Drop ft.wg[kPa]	33.4 [100]	38.6 [116]	39.3 [117]	39.3 [117]	53.0 [158]	53.0 [158]	38.7 [116]	39.0 [117]	38.7 [116]	39.0 [117]	38.4 [115]
CONDENSER											
Total Face Area ft²[m²]	117.6 [10.9]	164.0 [15.3]	188.2 [17.5]	164.0 [15.3]	211.8 [19.7]	256.7 [23.8]	256.7 [23.8]	282.3 [26.2]	282.3 [26.2]	308.0 [28.6]	333.7 [31.0]
Total Air Flow cfm [m³/hr]	68,250 [115,957]	100,695 [171,081]	119,280 [202,657]	95,550 [162,339]	134,190 [227,989]	151,200 [256,889]	143,325 [243,509]	166,320 [282,578]	166,320 [282,578]	181,440 [308,267]	196,560 [333,955]
No. Of Fan	5	7	8	7	9	10	10	11	11	12	13
Fan Diameter mm	900	900	900	900	900	900	900	900	900	900	900
Motor Power hp	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
GENERAL											
Unit Length inches[mm]	142 [3611]	187 [4761]	228 [5800]	187 [4761]	228 [5800]	273 [6934]	273 [6934]	286 [7261]	286 [7261]	318 [8077]	331 [8411]
Unit Width inches[mm]	88 [2235]	88 [2235]	88 [2235]	88 [2235]	88 [2235]	88 [2235]	88 [2235]	88 [2235]	88 [2235]	88 [2235]	88 [2235]
Unit Height inches[mm]	88 [2235]	88 [2235]	88 [2235]	88 [2235]	88 [2235]	98 [2489]	98 [2489]	98 [2489]	98 [2489]	98 [2489]	98 [2489]
Approx. Shipping Weight lbs[kg]	8042 [3648]	9112 [4133]	11576 [5251]	9623 [4365]	11277 [5115]	12725 [5772]	14270 [6473]	12815 [5813]	13946 [6326]	15137 [6866]	15148 [6871]
Approx. Operating Weight lbs[kg]	8307 [3768]	9475 [4298]	11995 [5441]	10042 [4555]	11717 [5315]	13166 [5972]	14711 [6673]	13256 [6013]	14431 [6546]	15622 [7086]	15699 [7121]
Approx. Operating Charge R134a lbs[kg]	222 [101]	270 [123]	314 [143]	325 [148]	392 [178]	395 [180]	434 [197]	441 [200]	513 [232]	543 [246]	581 [263]

Notes: 1. The above data are rated in accordance with AHRI Standard 550/590 with following conditions:  
 Evaporator leaving fluid temperature 44°F with fluid flow rate 2.4 USGpm/ton; ambient temperature at 95°F; evaporator fouling factor 0.0001hr.ft².°F/Btu  
 2. To consult nearest Dunham-Bush sales office for computer selections other than above operating conditions

# PHYSICAL SPECIFICATIONS

Model AVX-A	260T-5HR	285T-5HR	320T-5HR	340T-5HR	365T-5HR	400T-5HR	450M-5HR	450T-5HR	520M-5HR	520T-5HR
Unit Nominal Capacity TR [kW]	261.8 [921]	283.2 [996]	320.0 [1125]	341.5 [1201]	365.0 [1284]	388.7 [1367]	451.4 [1588]	451.4 [1588]	529.6 [1863]	529.6 [1863]
Unit Nominal Power Input kW	280.4	305.1	335.1	356.9	379.4	401.4	464.9	464.9	556.3	556.3
Energy Efficiency kW/TR	1.071	1.077	1.047	1.045	1.039	1.033	1.030	1.030	1.050	1.050
COP kW°/kW <sub>i</sub>	3.284	3.265	3.359	3.365	3.384	3.406	3.415	3.415	3.348	3.348
COMPRESSOR										
Model (Qty)	1220 (1) 1222 (1)	1222 (2)	1222 (1) 1227 (1)	1227 (2)	1227 (1) 1230 (1)	1230 (2)	2233 (2)	2233 (2)	2236 (2)	2236 (2)
RPM	2950	2950	2950	2950	2950	2950	2950	2950	2950	2950
Min. % Unit Capacity	12.5%	12.5%	12.5%	12.5%	12.5%	12.5%	12.5%	12.5%	12.5%	12.5%
No. Of Refrigerant Circuit	2	2	2	2	2	2	2	2	2	2
EVAPORATOR										
Model (Qty)	JCRT (1)	Q1RT (1)	S1RT (1)	S2RT (1)	S2RT (1)	2FR (2)	EBR (2)	EBR (2)	JCR (2)	JCR (2)
Water Connector inches[mm]	8 [203.2]	8 [203.2]	8 [203.2]	8 [203.2]	8 [203.2]	8 [203.2]	10 [254.0]	10 [254.0]	10 [254.0]	10 [254.0]
Nominal Water Flow USgpm[m³/hr]	629.0 [142.9]	680.5 [154.4]	768.0 [174.6]	820.5 [186.5]	877.0 [199.1]	933.9 [212.0]	1084.6 [246.2]	1084.6 [246.2]	1272.5 [289.1]	1272.5 [289.1]
Nominal Pressure Drop ft.wg[kPa]	22.7 [67.9]	23.1 [69.0]	21.7 [64.9]	19.4 [58.0]	21.9 [65.5]	27.9 [83.4]	31.2 [93.3]	31.2 [93.3]	26.1 [78.0]	26.1 [78.0]
Min. Water Flow USgpm[m³/hr]	252 [57.2]	280 [63.6]	329 [74.7]	375 [85.2]	393 [24.8]	375 [23.7]	421 [26.6]	421 [26.6]	504 [31.8]	504 [31.8]
Max. Water Flow USgpm[m³/hr]	840 [190.8]	932 [211.8]	1096 [248.9]	1250 [283.9]	1312 [82.8]	1250 [78.9]	1404 [88.6]	1404 [88.6]	1681 [106.0]	1681 [106.0]
Min. Water Pressure Drop ft.wg[kPa]	4.4 [13]	4.7 [14]	4.8 [14]	4.8 [14]	5.2 [15]	5.4 [16]	5.7 [17]	5.7 [17]	4.9 [15]	4.9 [15]
Max. Water Pressure Drop ft.wg[kPa]	38.1 [114]	40.6 [121]	41.5 [124]	41.8 [125]	45.2 [135]	47.2 [141]	49.6 [148]	49.6 [148]	43.1 [129]	43.1 [129]
CONDENSER										
Total Face Area ft²[m²]	308.0 [28.6]	359.3 [33.4]	359.3 [33.4]	410.7 [38.2]	410.7 [38.2]	462.0 [42.9]	566.4 [52.4]	577.5 [53.7]	667.4 [62.0]	577.5 [53.7]
Total Air Flow cfm [m³/hr]	171,990 [292,211]	200,655 [340,913]	200,655 [340,913]	229,320 [389,615]	229,320 [389,615]	257,985 [438,317]	332,640 [565,155]	280,665 [476,850]	393,120 [667,911]	389,340 [661,489]
No. Of Fan	12	14	14	16	16	18	22	18	26	18
Fan Diameter mm	900	900	900	900	900	900	900	900	900	860
Motor Power hp	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	7.5
GENERAL										
Unit Length inches[mm]	318 [8077]	363 [9210]	363 [9210]	408 [10360]	408 [10360]	453 [11510]	545 [13843]	453 [11510]	636 [16154]	453 [11510]
Unit Width inches[mm]	88 [2235]	88 [2235]	88 [2235]	88 [2236]	88 [2236]	88 [2235]	88 [2235]	88 [2235]	88 [2235]	88 [2235]
Unit Height inches[mm]	98 [2489]	98 [2489]	98 [2489]	98 [2489]	98 [2489]	98 [2489]	98 [2489]	121 [3073]	98 [2489]	121 [3073]
Approx. Shipping Weight lbs[kg]	15609 [7080]	19264 [8738]	19652 [8914]	21561 [9780]	21816 [9896]	23955 [10866]	27892 [12652]	27105 [12295]	30296 [13742]	28710 [13023]
Approx. Operating Weight lbs[kg]	16160 [7330]	19815 [8988]	20203 [9164]	22443 [10180]	22698 [10296]	24837 [11266]	28862 [13092]	28075 [12735]	31398 [14242]	29813 [13523]
Approx. Operating Charge R134a lbs[kg]	604 [274]	654 [297]	739 [336]	789 [359]	843 [383]	898 [408]	1043 [474]	1043 [474]	1223 [556]	1223 [556]

Notes: 1. The above data are rated in accordance with AHRI Standard 550/590 with following conditions:  
Evaporator leaving fluid temperature 44°F with fluid flow rate 2.4 USgpm/ton; ambient temperature at 95°F; evaporator fouling factor 0.0001hr.ft².°F/Btu  
2. To consult nearest Dunham-Bush sales office for computer selections other than above operating conditions

# PERFORMANCE DATA

LWT °F	M-5HRodel AVX-A	Ambient temperature °F														
		85			95			105			115			125		
		TR	kW°	kW <sup>i</sup>	TR	kW°	kW <sup>i</sup>	TR	kW°	kW <sup>i</sup>	TR	kW°	kW <sup>i</sup>	TR	kW°	kW <sup>i</sup>
40	95S-5HR	94.8	333.5	80.3	88.9	312.5	89.3	82.6	290.4	99.5	76.4	268.7	110.6	63.0	221.7	105.3
	115S-5HR	112.2	394.7	93.6	108.7	382.4	107.2	105.0	369.4	123.6	101.0	355.2	144.2	72.2	253.9	117.3
	135T-5HR	134.7	473.8	119.2	124.9	439.4	131.0	115.1	405.0	143.6	105.4	370.5	156.9	87.8	308.8	161.3
	140S-5HR	137.9	485.1	119.3	130.4	458.7	137.0	125.7	442.1	158.4	120.9	425.2	184.2	80.6	283.3	135.5
	170S-5HR	163.3	574.3	134.8	158.3	556.7	153.3	153.3	539.3	173.8	148.1	520.9	198.3	112.9	397.2	181.5
	170T-5HR	164.3	577.7	139.7	158.3	556.7	157.8	151.9	534.1	177.6	145.2	510.8	199.8	129.7	456.3	212.1
	185T-5HR	185.7	653.2	158.1	173.7	611.1	176.0	161.6	568.2	196.2	149.8	526.8	218.1	131.7	463.0	224.0
	200S-5HR	177.5	624.3	143.6	177.1	622.9	167.5	171.2	602.2	187.9	165.4	581.6	209.5	143.6	505.0	216.5
	220S-5HR	213.4	750.5	175.4	206.8	727.2	198.1	199.9	703.1	223.5	192.5	677.2	253.4	142.2	500.2	221.7
	235T-5HR	225.7	793.9	188.2	218.7	769.2	215.7	211.3	743.0	247.9	203.4	715.4	287.5	155.6	547.2	252.3
	250S-5HR	241.7	850.0	198.1	233.8	822.4	223.5	225.7	793.7	251.6	217.1	763.6	284.5	167.2	588.0	258.9
	260T-5HR	251.7	885.3	212.1	243.7	857.1	243.9	235.2	827.3	280.8	226.5	796.4	326.0	163.9	576.5	267.5
	285T-5HR	272.3	957.7	227.8	263.9	928.2	261.0	255.5	898.7	298.6	246.3	866.3	344.3	188.7	663.7	309.7
	320T-5HR	307.7	1082.0	254.9	298.0	1048.1	291.5	287.8	1012.3	334.4	277.2	975.0	385.8	193.8	681.5	308.5
	340T-5HR	328.0	1153.6	270.3	317.9	1118.1	307.9	307.4	1081.0	350.8	296.4	1042.5	402.3	218.7	769.2	347.0
	365T-5HR	351.0	1234.4	290.2	340.0	1195.6	328.6	328.2	1154.2	372.5	315.8	1110.5	424.0	219.8	773.2	343.7
	400T-5HR	373.5	1313.6	305.6	361.4	1271.2	344.9	348.8	1226.6	388.7	336.2	1182.5	434.8	219.5	856.3	368.7
	450M-5HR	434.3	1527.4	349.3	420.3	1478.2	396.6	405.9	1427.6	449.7	390.7	1374.2	511.4	272.5	958.5	408.0
	450T-5HR	434.3	1527.4	359.4	420.3	1478.2	406.7	405.9	1427.6	459.8	390.7	1374.2	521.5	272.5	958.5	418.1
	520M-5HR	509.1	1790.6	427.2	484.5	1704.0	505.5	475.5	1672.2	534.3	457.7	1609.7	599.2	354.7	1247.3	549.0
	520T-5HR	509.1	1790.6	399.1	484.5	1704.0	477.4	475.5	1672.2	506.2	457.7	1609.7	571.1	354.7	1247.3	520.9
42	95S-5HR	98.8	347.4	81.5	92.4	324.9	90.6	86.0	302.4	100.7	79.4	279.2	112.2	64.0	225.0	102.8
	115S-5HR	116.4	409.3	94.8	112.7	396.2	108.8	108.8	382.8	124.9	104.8	368.6	144.9	73.1	257.2	113.9
	135T-5HR	140.5	494.0	121.4	130.5	458.9	133.1	120.3	422.9	145.8	109.8	386.2	159.6	88.7	311.9	156.7
	140S-5HR	143.0	502.9	120.8	135.2	475.7	138.8	130.4	458.7	160.1	123.5	434.4	185.6	81.4	286.2	131.6
	170S-5HR	169.3	595.4	136.5	164.2	577.7	155.0	159.0	559.2	175.8	153.6	540.1	200.7	107.4	377.6	165.8
	170T-5HR	170.7	600.3	141.9	164.5	578.5	160.2	158.1	555.9	180.0	151.0	531.1	203.0	131.1	461.2	207.4
	185T-5HR	193.2	679.4	160.6	180.8	635.8	178.7	168.6	592.9	198.3	156.0	548.6	220.8	133.2	468.6	217.6
	200S-5HR	190.2	668.8	146.1	184.3	648.2	167.9	178.1	626.5	188.9	171.3	602.6	213.2	144.4	507.9	212.9
	220S-5HR	221.3	778.2	177.9	214.2	753.4	200.9	207.1	728.2	226.7	199.6	702.0	256.5	143.0	502.8	215.2
	235T-5HR	234.0	823.1	190.6	226.6	796.9	219.0	218.9	770.0	251.7	210.8	741.5	291.4	157.2	552.8	246.2
	250S-5HR	250.6	881.3	201.1	242.3	852.2	226.7	233.9	822.8	255.2	225.3	792.3	287.4	167.1	587.7	252.4
	260T-5HR	260.8	917.4	215.1	252.7	888.7	246.7	243.9	857.8	284.4	234.6	825.1	330.8	165.0	580.4	259.0
	285T-5HR	281.9	991.6	232.4	273.1	960.6	266.3	263.7	927.5	306.9	253.9	892.8	356.1	190.6	670.4	302.4
	320T-5HR	318.8	1121.3	258.7	308.8	1086.2	295.8	298.2	1048.9	339.3	287.2	1010.0	391.7	196.2	690.2	299.8
	340T-5HR	340.0	1195.9	274.0	329.5	1158.8	312.2	318.7	1121.0	355.7	307.2	1080.3	408.1	220.3	774.8	338.9
	365T-5HR	363.8	1279.6	294.8	352.3	1238.9	334.1	340.2	1196.4	378.1	327.2	1150.8	430.9	222.7	783.4	334.8
	400T-5HR	387.4	1362.4	311.4	375.2	1319.7	350.7	362.2	1273.7	394.8	348.1	1224.2	445.7	245.0	861.8	358.8
	450M-5HR	450.6	1584.7	355.0	436.0	1533.4	403.0	420.9	1480.4	457.0	400.5	1408.4	514.9	274.9	966.7	396.3
	450T-5HR	450.6	1584.7	365.1	436.0	1533.4	413.1	420.9	1480.4	467.1	400.5	1408.4	525.0	274.9	966.7	406.4
	520M-5HR	528.6	1858.9	433.2	511.1	1797.6	484.7	493.3	1735.1	542.2	474.6	1669.3	608.2	357.8	1258.5	535.7
	520T-5HR	528.6	1858.9	405.1	511.1	1797.6	456.6	493.3	1735.1	514.1	474.6	1669.3	580.1	357.8	1258.5	507.6
44	95S-5HR	102.6	360.8	82.8	96.1	338.0	91.8	89.5	314.8	102.0	82.8	291.1	113.3	65.6	230.8	101.3
	115S-5HR	120.6	424.2	97.7	116.8	410.8	112.0	112.7	396.2	129.4	108.5	381.7	150.0	74.9	263.3	111.8
	135T-5HR	146.4	515.0	125.6	136.0	478.3	137.6	125.6	441.6	150.7	114.7	403.5	165.0	90.0	316.6	152.8
	140S-5HR	148.1	521.0	122.7	140.8	495.2	137.9	135.0	474.9	162.6	130.6	459.5	184.8	90.4	318.1	138.9
	170S-5HR	175.3	616.4	139.3	169.7	596.8	159.0	164.1	577.3	180.8	158.2	556.3	207.5	108.6	382.0	161.3
	170T-5HR	177.1	622.9	144.1	170.9	601.1	162.4	164.3	577.7	182.9	157.2	552.9	205.8	135.0	474.6	206.8
	185T-5HR	201.0	707.0	162.9	188.0	661.2	181.2	175.4	616.9	200.8	162.2	570.4	223.4	136.0	478.2	213.6
	200S-5HR	197.1	693.1	148.4	191.1	672.1	170.5	184.6	649.3	188.2	177.9	625.7	212.1	146.9	516.5	205.1
	220S-5HR	229.3	806.3	180.5	221.9	780.4	204.3	214.5	754.5	230.0	206.5	726.4	260.8	144.7	508.8	209.7
	235T-5HR	242.5	853.0	193.1	235.1	826.8	221.2	227.0	798.4	254.4	218.3	767.7	296.0	158.7	558.3	239.8
	250S-5HR	259.7	913.2	204.0	251.3	883.8	229.5	242.3	852.2	258.8	233.1	819.9	292.1	172.0	604.8	249.6
	260T-5HR	270.3	950.5	218.1	261.8	920.8	250.2	252.8	889.1	288.1	243.1	854.8	335.7	168.5	592.7	253.6
	285T-5HR	292.6	1029.2	233.7	283.2	996.0	269.8	274.6	965.8	305.6	262.9	924.5	361.8	192.4	676.8	294.8
	320T-5HR	330.4	1162.0	262.5	320.0	1125.4	299.8	309.1	1087.0	343.9	297.4	1045.8	397.7	200.3	704.3	293.8
	340T-5HR	352.2	1238.8	278.5	341.5	1201.1	316.6	330.1	1161.0	360.7	318.1	1118.8	414.0	223.3	785.3	329.3
	365T-5HR	376.9	1325.5	299.8	365.0	1283.7	339.1	352.4	1239.3	384.5	338.7	1191.1	438.5	226.7	797.3	327.7
	400T-5HR	401.4	1411.6	316.1	388.7	1367.1	356.0	375.0	1318.9	401.4	359.3	1263.7	457.9	250.0	879.4	352.3
	450M-5HR	466.4	1640.3	361.1	451.4	1587.6	409.4	435.6	1532.0	464.3	418.5	1471.8	527.3	279.9	984.3	388.7
	450T-5HR	466.4	1640.3	371.2	451.4	1587.6	419.5	435.6	1532.0	474.4	418.5	1471.8	541.0	279.9	984.3	398.8
	520M-5HR	547.5	1925.5	439.1	529.6	1862.6	490.8	510.9	1796.8	549.5	491.4	1728.1	614.6	360.4	1267.5	523.8
	520T-5HR	547.5	1925.5	411.0	529.6	1862.6	462.7	510.9	1796.8	521.4	491.4	1728.1	588.4	360.4	1267.5	495.7

## Legend

LWT : Leaving Chilled Water Temperature      kW° : Cooling Capacity In kW      kW<sup>i</sup> : Compressor Power Input In kW      TR : Cooling Capacity In TR.

Notes: 1. Rating is based on 10°F temperature different at evaporator inlet/outlet fluid temperature, and evaporator fouling factor 0.0001hr.ft<sup>2</sup>.°F/Btu  
2. Interpolation between ratings is permissible but extrapolation is NOT.

# PERFORMANCE DATA

LWT °F	Model AVX-A	Ambient temperature °F														
		85			95			105			115			125		
		TR	kW°	kW <sup>i</sup>	TR	kW°	kW <sup>i</sup>	TR	kW°	kW <sup>i</sup>	TR	kW°	kW <sup>i</sup>	TR	kW°	kW <sup>i</sup>
46	95S-5HR	106.6	375.1	84.1	99.8	351.1	93.2	92.9	326.7	103.5	85.8	301.6	114.7	65.5	230.3	97.6
	115S-5HR	124.9	439.1	99.2	121	425.7	113.4	116.8	410.8	130.7	112.5	395.5	151.6	75.2	264.6	108.0
	135T-5HR	152.4	535.9	127.8	141.7	498.5	140	130.9	460.3	153	119.6	420.7	167.3	91.1	320.5	149.0
	140S-5HR	153.5	539.8	124.3	145.1	510.3	142.7	140	492.2	164.7	127.2	447.3	175.9	83.8	294.6	125.3
	170S-5HR	181.4	638.1	141.5	175.9	618.6	160.8	170	597.9	183.3	163.7	575.8	210.5	109.8	386.0	156.8
	170T-5HR	183.7	646.2	146.3	177.3	623.6	164.9	170.5	599.6	185.7	163.2	574	209	133.1	468.1	199.3
	185T-5HR	208.9	734.6	165.5	195.6	688.1	183.5	182.4	641.6	203.8	168.8	593.6	226.2	136.2	479.0	206.2
	200S-5HR	204.2	718.1	150.7	198.1	696.7	169.8	191.4	673.2	190.7	184.3	648.2	215.4	147.1	517.2	202.6
	220S-5HR	237.3	834.4	183.6	229.9	808.5	206.8	221.9	780.4	233.8	213.7	751.6	264.6	147.2	517.6	202.3
	235T-5HR	251.3	883.7	195.6	243.4	856.0	224.1	235.3	827.6	257.7	226.4	796.2	299.3	160.8	565.7	232.8
	250S-5HR	269.0	945.9	207.0	260.1	914.7	233.2	251.1	883.1	262.0	241.3	848.6	296.3	171.1	601.6	239.1
	260T-5HR	280.0	984.8	220.9	271.2	953.9	253.7	261.7	920.4	292.6	249.3	876.7	337.6	169.9	597.7	245.6
	285T-5HR	302.7	1064.6	238.5	293.5	1032.1	273.2	283.2	996.0	314.9	272.5	958.4	365.8	193.8	681.6	284.5
	320T-5HR	342.2	1203.5	266.3	331.4	1165.4	304.5	319.9	1125.1	349.4	298.9	1051.2	390.0	200.9	706.4	283.9
	340T-5HR	364.9	1283.3	282.4	353.7	1244.0	320.9	341.7	1201.8	366.6	329.3	1158.1	419.9	225.8	794.2	320.3
	365T-5HR	390.4	1372.9	304.5	377.9	1329.2	344.7	364.7	1282.6	391.1	346.6	1219.1	404.4	227.5	800.2	317.4
	400T-5HR	415.3	1460.8	321.6	402.4	1415.2	361.8	388.1	1364.9	408.7	364.8	1283.0	448.8	249.6	877.8	339.6
	450M-5HR	482.7	1697.6	366.9	467.1	1642.8	415.9	450.7	1585.1	472.0	356.6	1254.2	448.1	280.2	985.5	376.1
	450T-5HR	482.7	1697.6	377.0	467.1	1642.8	426.0	450.7	1585.1	482.1	356.6	1254.2	458.2	280.2	985.5	386.2
	520M-5HR	566.7	1993.1	445.5	548.2	1928.0	497.9	528.8	1859.7	556.9	508.5	1788.4	624.6	364.0	1280.3	510.4
	520T-5HR	566.7	1993.1	417.4	548.2	1928.0	469.8	528.8	1859.7	528.8	508.5	1788.4	596.5	364.0	1280.3	482.3
48	95S-5HR	110.8	389.7	85.4	103.9	365.3	94.5	96.6	339.9	104.8	89.4	314.4	116.3	66.2	232.8	94.9
	115S-5HR	129.3	454.8	100.4	125.3	440.6	115.1	120.9	425.3	132.7	114.7	403.3	153.2	76.4	268.6	105.4
	135T-5HR	158.6	557.7	130.1	147.5	518.7	142.4	136.2	479.1	155.6	124.7	438.6	170	92.0	323.7	145.0
	140S-5HR	158.9	558.7	126.2	150.1	528	144.9	144.8	509.2	167.3	96.2	338.2	134.8	84.2	296.3	121.4
	170S-5HR	187.9	661.0	143.4	182.2	640.7	163	175.9	618.6	186.3	167	587.3	212.7	110.8	389.7	152.4
	170T-5HR	190.6	670.3	148.2	183.9	646.9	167.4	176.9	622.1	188.6	169.4	595.8	212.3	134.2	472.0	195.0
	185T-5HR	217.1	763.6	167.9	203.3	715	186.4	189.7	667	206.4	175.2	616.1	229.5	138.0	485.3	200.9
	200S-5HR	211.4	743.4	153	205.1	721.3	172.4	198.3	697.4	193.7	190.9	671.4	218.9	148.0	520.6	198.6
	220S-5HR	245.7	864.0	186.2	237.9	836.6	210.2	229.7	807.8	237.2	221.2	777.9	268.8	147.3	518.0	198.9
	235T-5HR	260.2	915.1	198.1	252.1	886.7	226.9	243.6	856.8	261.0	234.2	823.9	303.8	161.5	568.1	224.8
	250S-5HR	278.4	979.0	210.4	269.4	947.4	236.6	259.8	913.6	266.3	249.8	878.4	300.5	173.7	610.8	233.9
	260T-5HR	290.0	1019.8	224.3	280.9	987.8	257.0	271.1	953.5	296.4	253.0	889.9	332.8	171.9	604.7	239.0
	285T-5HR	313.4	1102.2	241.6	303.7	1068.3	277.4	293.3	1031.4	319.0	281.9	991.6	372.2	197.2	693.7	277.7
	320T-5HR	354.2	1245.8	270.5	343.1	1206.6	308.9	331.3	1165.0	354.2	301.9	1061.8	378.9	202.4	711.8	275.6
	340T-5HR	377.7	1328.5	286.9	366.1	1287.7	326.1	353.7	1244.0	371.7	335.6	1180.3	425.3	228.1	802.4	311.3
	365T-5HR	404.6	1422.9	309.6	391.2	1375.9	350.5	377.6	1328.1	396.9	343.0	1206.4	418.3	229.3	806.3	308.6
	400T-5HR	429.7	1511.4	326.7	416.5	1464.7	367.9	401.7	1412.7	415.0	373.7	1314.2	449.1	251.7	885.3	330.5
	450M-5HR	499.3	1756.1	373.1	483.9	1701.9	423.4	466.6	1641.0	480.7	358.8	1262.0	439.0	282.3	992.9	366.0
	450T-5HR	499.3	1756.1	383.2	483.9	1701.9	433.5	466.6	1641.0	490.8	358.8	1262.0	449.1	282.3	992.9	376.1
	520M-5HR	586.4	2062.5	452.0	567.4	1995.6	504.6	547.2	1924.4	564.8	525.9	1849.4	633.9	368.1	1294.7	498.2
	520T-5HR	586.4	2062.5	423.9	567.4	1995.6	476.5	547.2	1924.4	536.7	525.9	1849.4	605.8	368.1	1294.7	470.1
50	95S-5HR	115.0	404.3	86.8	107.8	379.2	95.9	100.5	353.3	106.2	93.0	327.1	117.8	67.2	236.5	92.7
	115S-5HR	136.3	479.4	102.6	132.2	464.9	117.3	127.5	448.5	135.5	116.8	410.8	146.1	76.7	269.9	100.1
	135T-5HR	164.9	580.1	132.4	153.7	540.4	144.6	142	499.3	157.9	130.3	458.1	172.2	92.7	326.0	140.8
	140S-5HR	167.4	588.9	129.2	158.3	556.7	148.3	152.5	536.5	171.7	129.5	455.6	165.4	85.4	300.3	116.1
	170S-5HR	198.1	696.7	146.8	192	675.4	166.9	185.5	652.5	190.5	169.7	596.8	203.6	111.4	391.7	145.0
	170T-5HR	197.6	695.1	150.4	190.8	671	169.9	183.7	646.2	191.1	175.8	618.4	215.9	135.4	476.1	190.8
	185T-5HR	225.4	792.7	170.6	211.3	743.3	188.9	196.9	692.4	209.5	182.4	641.6	231.9	138.4	486.9	194.5
	200S-5HR	222.9	784.0	156.5	216.4	761.2	176.5	209	735.1	199	201.4	708.3	224.5	151.5	532.8	183.6
	220S-5HR	258.8	910.3	191.1	250.6	881.5	215.3	242.0	851.2	243.2	222.6	783.0	260.4	149.9	527.2	191.8
	235T-5HR	269.1	946.6	201.1	260.8	917.4	230.4	251.9	886.0	265.4	242.5	853.0	308.0	164.1	577.1	219.3
	250S-5HR	293.5	1032.4	215.5	283.9	998.6	242.2	273.7	962.7	272.9	263.0	924.9	308.1	176.3	620.0	224.7
	260T-5HR	300.0	1055.2	227.2	290.6	1022.1	260.9	280.4	986.3	301.1	256.5	902.2	323.9	173.2	609.2	231.9
	285T-5HR	324.5	1141.3	244.6	314.4	1105.9	280.9	303.7	1068.3	323.6	291.8	1026.2	377.4	197.9	696.1	268.1
	320T-5HR	366.6	1289.2	274.4	355.0	1248.5	313.4	342.5	1204.7	360.3	310.7	1092.6	352.1	205.0	721.0	268.9
	340T-5HR	391.0	1375.2	290.8	379.0	1332.9	330.6	366.1	1287.7	377.4	339.8	1195.1	414.3	230.0	808.8	302.5
	365T-5HR	418.1	1470.3	314.7	404.8	1423.7	356.0	390.7	1374.0	404.2	345.7	1215.8	409.9	232.0	816.1	301.3
	400T-5HR	444.5	1563.4	332.2	430.7	1514.6	374.3	415.7	1461.9	422.2	376.0	1322.2	441.4	255.1	897.0	323.0
	450M-5HR	516.3	1815.9	379.7	499.7	1757.5	429.5	481.7	1694.1	487.7	362.4	1274.7	428.6	285.1	1002.7	356.9
	450T-5HR	516.3	1815.9	389.8	499.7	1757.5	439.6	481.7	1694.1	497.8	362.4	1274.7	438.7	285.1	1002.7	367.0
	520M-5HR	606.6	2133.4	458.5	587.0	2064.3	512.2	565.9	1990.1	573.0	538.4	1893.7	638.6	371.2	1305.6	485.3
	520T-5HR	606.6	2133.4	430.4	587.0	2064.3	484.1	565.9	1990.1	544.9	538.4	1893.7	610.5	371.2	1305.6	457.2

## Legend

LWT : Leaving Chilled Water Temperature      kW° : Cooling Capacity In kW      kW<sup>i</sup> : Compressor Power Input In kW      TR : Cooling Capacity In TR.

Notes: 1. Rating is based on 10°F temperature different at evaporator inlet/outlet fluid temperature, and evaporator fouling factor 0.0001hr.ft<sup>2</sup>.°F/Btu  
2. Interpolation between ratings is permissible but extrapolation is NOT.

# ELECTRICAL DATA

Model AVX-A	Compressor Data					Cond. Fan Motor Data			Unit Electrical Data			
	Model	Qty	RLA	Maximum Operating Amp	LRA	Qty	HP	FLA	FLA	MCA	MFS	Max Inrush
95S-5HR	1220	1	189	327	949	5	3	6	219	266	400	566
115S-5HR	1220	1	244	327	949	7	3	6	286	347	500	566
135T-5HR	1215	2	147	244	927	8	3	6	342	379	500	619
140S-5HR	1222	1	304	327	1230	7	3	6	346	422	700	566
170S-5HR	1227	1	339	392	1321	9	3	6	393	478	800	694
170T-5HR	1215	2	176	244	927	10	3	6	412	456	600	654
185T-5HR	1220	2	186	327	949	10	3	6	432	479	600	772
200S-5HR	1230	1	351	458	1784	11	3	6	417	505	800	920
220S-5HR	2233	1	430	545	2357	11	3	6	496	604	1000	1076
235T-5HR	1220	2	241	327	949	12	3	6	554	614	800	843
250S-5HR	2236	1	484	630	2743	13	3	6	562	683	1100	1252
260T-5HR	1220	1	244	327	949	5	3	6	620	696	1000	912
	1222	1	304	327	1230	7	3	6				
285T-5HR	1222	2	295	327	1230	14	3	6	674	748	1000	903
320T-5HR	1222	1	304	327	1230	6	3	6	734	821	1100	1034
	1227	1	346	392	1321	8	3	6				
340T-5HR	1227	2	339	392	1321	16	3	6	774	859	1100	1081
365T-5HR	1227	1	346	392	1321	7	3	6	814	907	1250	1308
	1230	1	372	458	1784	9	3	6				
400T-5HR	1230	2	379	458	1784	18	3	6	866	961	1250	1353
450M-5HR	2233	1	430	545	2357	11	3	6	496	604	1000	1076
	2233	1	430	545	2357	11	3	6	496	604	1000	1076
450M-5HR*	2233	2	430	545	2357	22	3	6	992	1000	1500	1572
450T-5HR	2233	2	451	545	2357	18	3	6	1010	1123	1500	1581
520M-5HR	2236	1	484	630	2743	13	3	6	562	683	1100	1252
	2236	1	484	630	2743	13	3	6	562	683	1100	1252
520M-5HR*	2236	2	484	630	2743	26	3	6	1124	1245	1600	1814
520T-5HR	2236	2	495	630	2743	18	7.5	11.5	1197	1321	1600	1851

\* Modular unit with single power entry.

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

# SOUND PRESSURE DATA

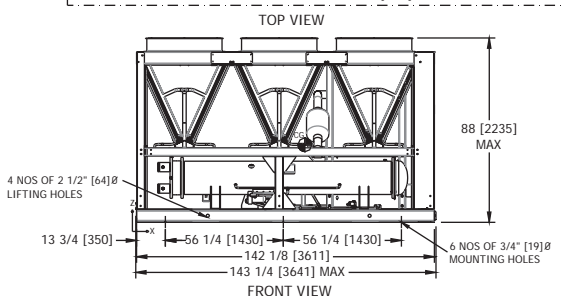
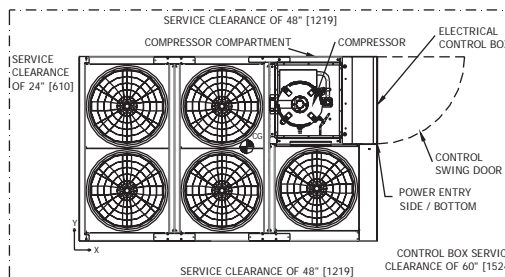
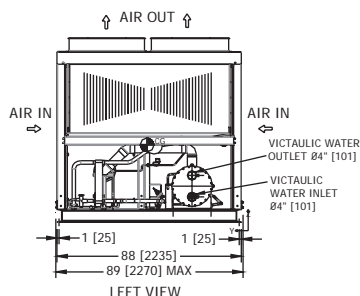
Model AVX-A	Octave Band (Hz)								Total dB (A)
	63	125	250	500	1K	2K	4K	8K	
95S-5HR	57	45	48	50	63	57	47	38	65
115S-5HR	57	45	48	50	63	57	47	39	65
135T-5HR	53	44	46	54	61	61	53	45	65
140S-5HR	57	45	48	50	63	57	47	39	65
170S-5HR	56	45	48	51	63	57	47	40	65
170T-5HR	53	44	46	54	62	62	54	46	66
185T-5HR	53	45	46	54	62	62	54	46	66
200S-5HR	56	45	48	51	62	57	48	40	65
220S-5HR	50	45	45	54	61	61	54	46	65
235T-5HR	53	43	46	55	62	62	54	46	66
250S-5HR	50	45	46	54	61	62	55	46	66
260T-5HR	53	44	46	55	62	62	54	46	66
285T-5HR	52	40	48	56	63	63	55	47	67
320T-5HR	52	40	48	56	63	63	55	47	67
340T-5HR	59	47	50	53	65	59	50	42	67
365T-5HR	53	41	48	56	63	63	56	47	67
400T-5HR	59	47	50	53	65	59	50	42	67
450M-5HR	53	45	48	57	64	64	57	49	68
450T-5HR	53	45	47	55	63	63	56	47	67
520M-5HR	53	45	49	57	64	65	58	49	69
520T-5HR	53	51	57	60	64	63	63	54	69

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

# DIMENSIONAL DATA

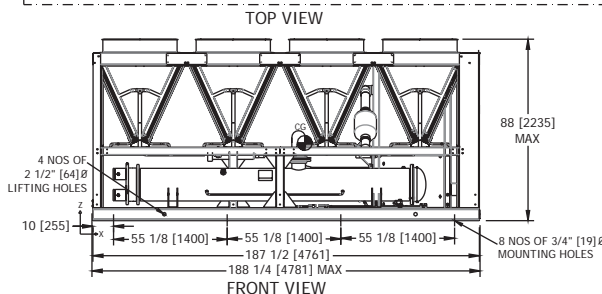
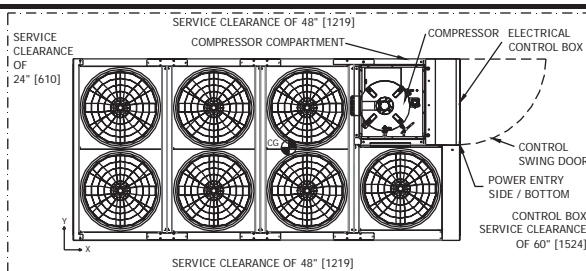
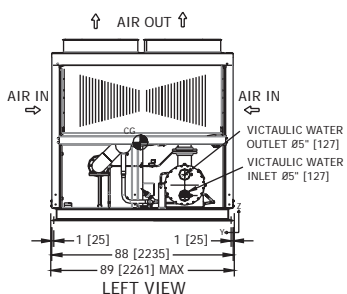
## AVX-A 95S-5HR

- NOTES:
1. ALL DIMENSIONS ARE IN INCHES AND MILLIMETERS.
  2. ALLOW 60" [1524mm] CLEARANCE AT CONTROL PANEL END OF UNIT FOR SERVICE.
  3. USE MINIMUM 36" [914mm] FLEXIBLE CONDUIT TO CONTROL BOX TO ISOLATE UNIT.
  4. WATER PIPING TO BE SUPPORTED TO MINIMIZE LOAD ON UNIT.



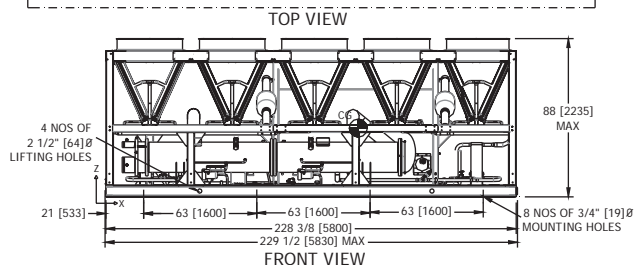
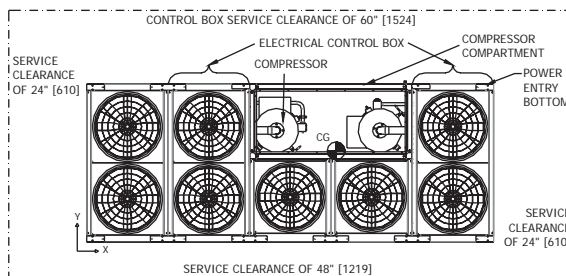
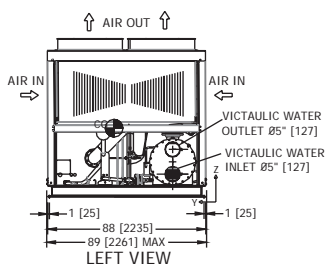
## AVX-A 115S-5HR, 140S-5HR

- NOTES:
1. ALL DIMENSIONS ARE IN INCHES AND MILLIMETERS.
  2. ALLOW 60" [1524mm] CLEARANCE AT CONTROL PANEL END OF UNIT FOR SERVICE.
  3. USE MINIMUM 36" [914mm] FLEXIBLE CONDUIT TO CONTROL BOX TO ISOLATE UNIT.
  4. WATER PIPING TO BE SUPPORTED TO MINIMIZE LOAD ON UNIT.



## AVX-A 135T-5HR

- NOTES:
1. ALL DIMENSIONS ARE IN INCHES AND MILLIMETERS.
  2. ALLOW 60" [1524mm] CLEARANCE AT CONTROL PANEL END OF UNIT FOR SERVICE.
  3. USE MINIMUM 36" [914mm] FLEXIBLE CONDUIT TO CONTROL BOX TO ISOLATE UNIT.
  4. WATER PIPING TO BE SUPPORTED TO MINIMIZE LOAD ON UNIT.

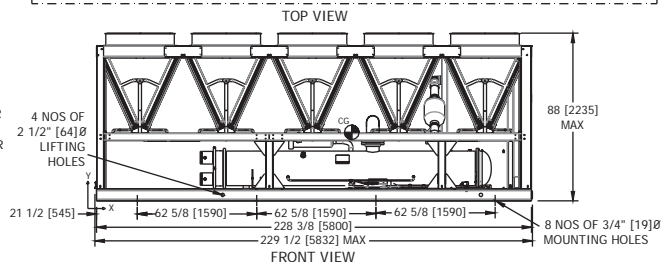
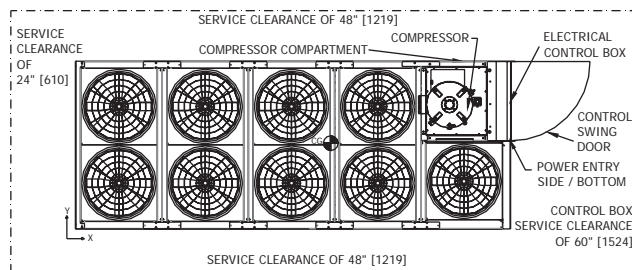
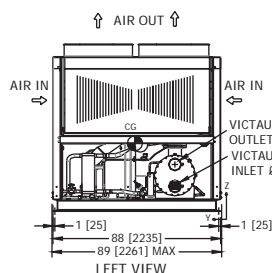


# DIMENSIONAL DATA

## AVX-A 170S-5HR

### NOTES:

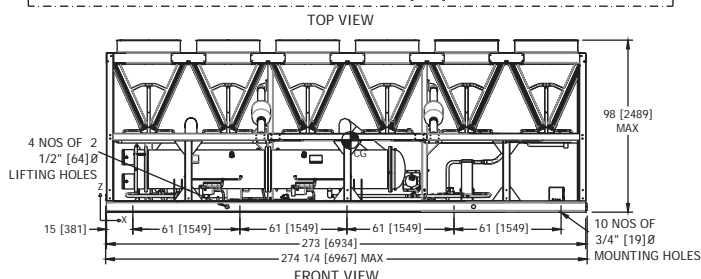
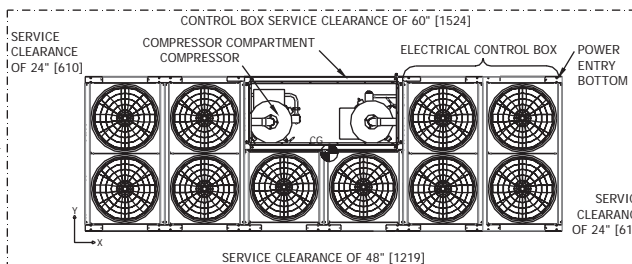
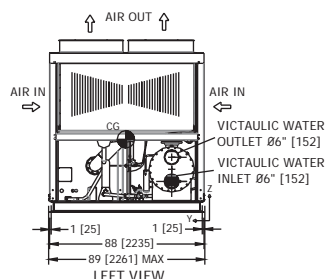
1. ALL DIMENSIONS ARE IN INCHES AND MILLIMETERS.
2. ALLOW 60" [1524mm] CLEARANCE AT CONTROL PANEL END OF UNIT FOR SERVICE.
3. USE MINIMUM 36" [914mm] FLEXIBLE CONDUIT TO CONTROL BOX TO ISOLATE UNIT.
4. WATER PIPING TO BE SUPPORTED TO MINIMIZE LOAD ON UNIT.



## AVX-A 170T-5HR, 185T-5HR

### NOTES:

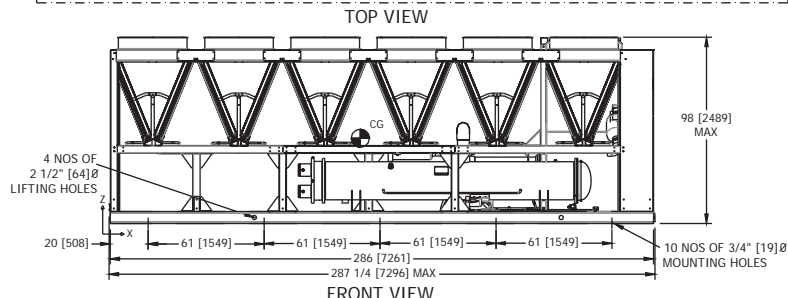
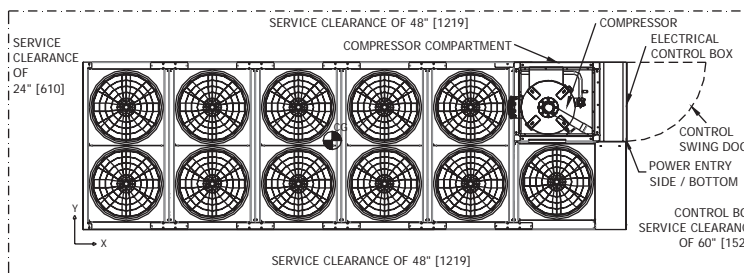
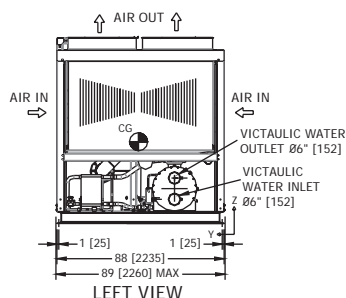
1. ALL DIMENSIONS ARE IN INCHES AND MILLIMETERS.
2. ALLOW 60" [1524mm] CLEARANCE AT CONTROL PANEL END OF UNIT FOR SERVICE.
3. USE MINIMUM 36" [914mm] FLEXIBLE CONDUIT TO CONTROL BOX TO ISOLATE UNIT.
4. WATER PIPING TO BE SUPPORTED TO MINIMIZE LOAD ON UNIT.



## AVX-A 200S-5HR, 220S-5HR

### NOTES:

1. ALL DIMENSIONS ARE IN INCHES AND MILLIMETERS.
2. ALLOW 60" [1524mm] CLEARANCE AT CONTROL PANEL END OF UNIT FOR SERVICE.
3. USE MINIMUM 36" [914mm] FLEXIBLE CONDUIT TO CONTROL BOX TO ISOLATE UNIT.
4. WATER PIPING TO BE SUPPORTED TO MINIMIZE LOAD ON UNIT.

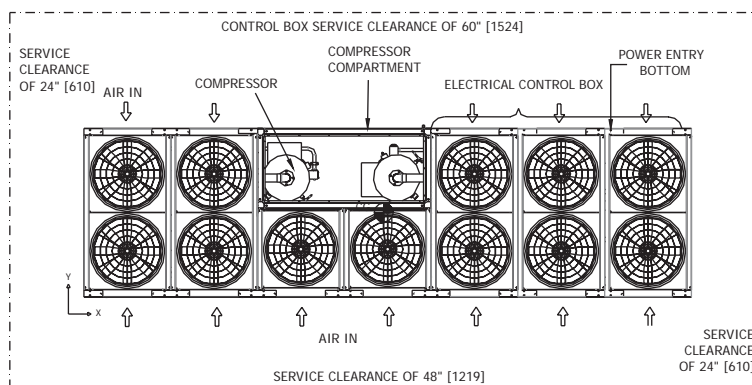


# DIMENSIONAL DATA

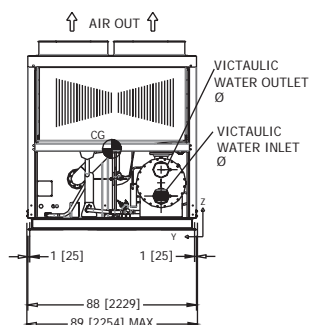
## AVX-A 235T-5HR, 260T-5HR

MODEL	WATER INLET/OUTLET Ø
AVX-A 235T-5HR	6" [152]
260T-5HR	8" [203]

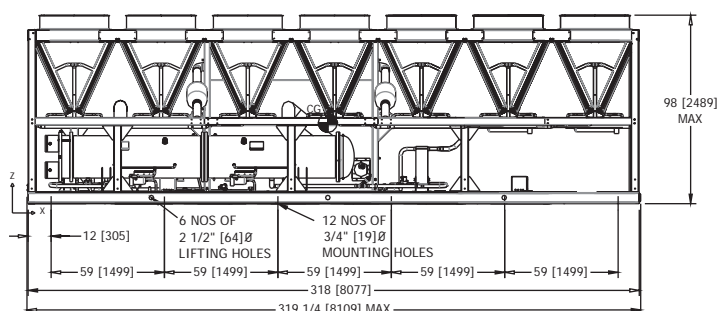
- NOTES:**
1. ALL DIMENSIONS ARE IN INCHES AND MILLIMETERS.
  2. ALLOW 60" [1524mm] CLEARANCE AT CONTROL PANEL END OF UNIT FOR SERVICE.
  3. USE MINIMUM 36" [914mm] FLEXIBLE CONDUIT TO CONTROL BOX TO ISOLATE UNIT.
  4. WATER PIPING TO BE SUPPORTED TO MINIMIZE LOAD ON UNIT.



TOP VIEW



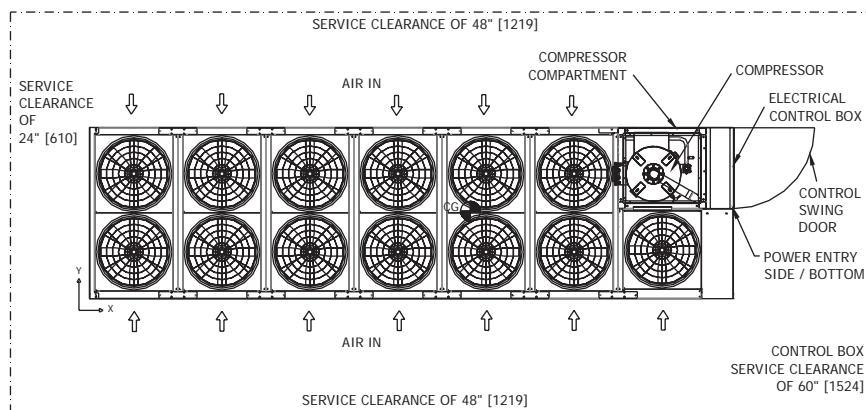
LEFT VIEW



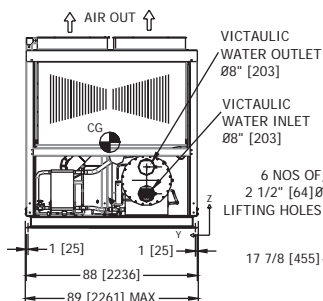
FRONT VIEW

## AVX-A 250S-5HR

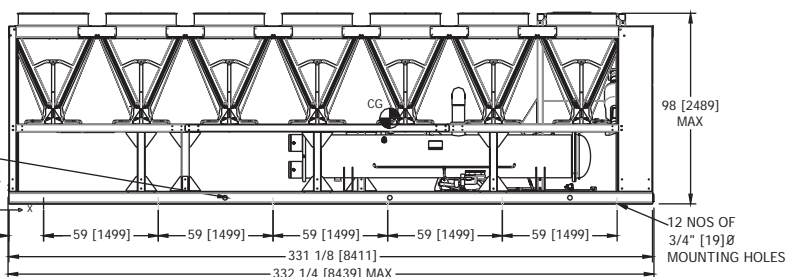
- NOTES:**
1. ALL DIMENSIONS ARE IN INCHES AND MILLIMETERS.
  2. ALLOW 60" [1524mm] CLEARANCE AT CONTROL PANEL END OF UNIT FOR SERVICE.
  3. USE MINIMUM 36" [914mm] FLEXIBLE CONDUIT TO CONTROL BOX TO ISOLATE UNIT.
  4. WATER PIPING TO BE SUPPORTED TO MINIMIZE LOAD ON UNIT.



TOP VIEW



LEFT VIEW



FRONT VIEW

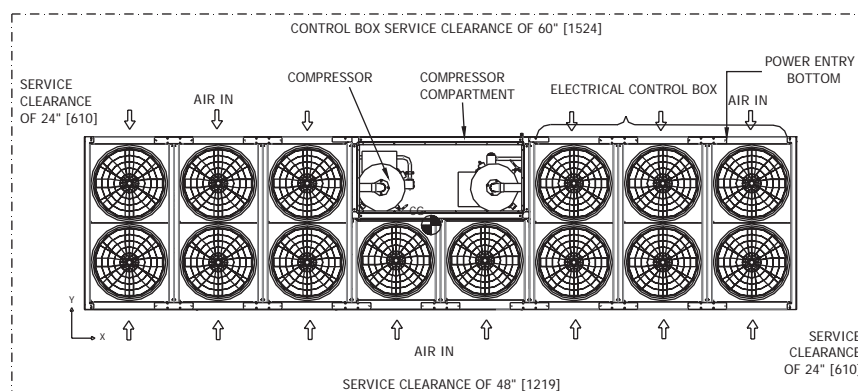


# DIMENSIONAL DATA

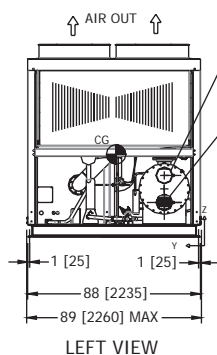
## AVX-A 285T-5HR, 320T-5HR

### NOTES:

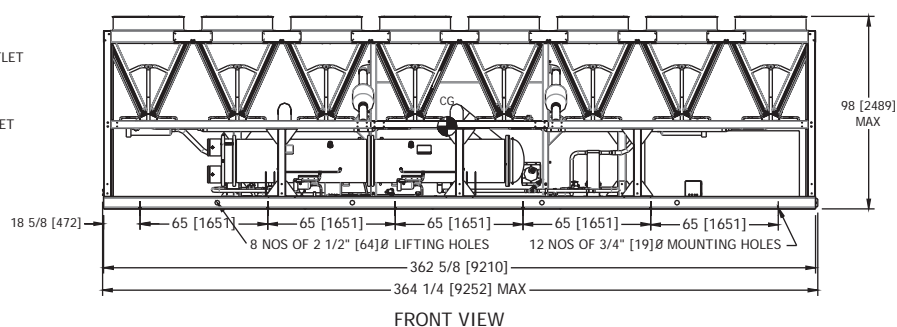
1. ALL DIMENSIONS ARE IN INCHES AND MILLIMETERS.
2. ALLOW 60" [1524mm] CLEARANCE AT CONTROL PANEL END OF UNIT FOR SERVICE.
3. USE MINIMUM 36" [914mm] FLEXIBLE CONDUIT TO CONTROL BOX TO ISOLATE UNIT.
4. WATER PIPING TO BE SUPPORTED TO MINIMIZE LOAD ON UNIT.



TOP VIEW



LEFT VIEW

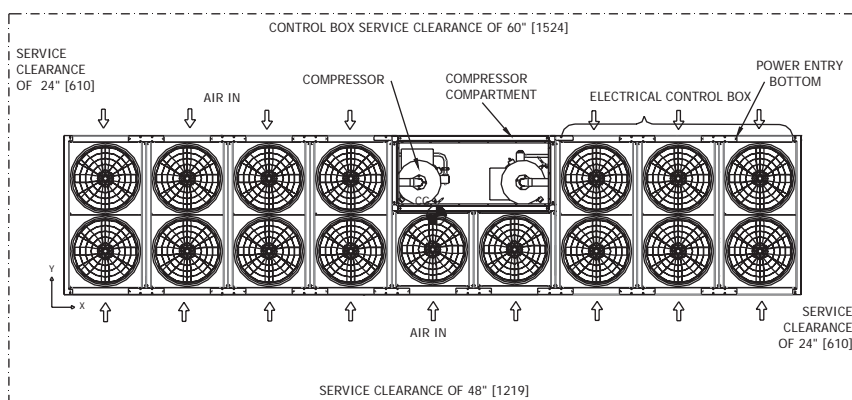


FRONT VIEW

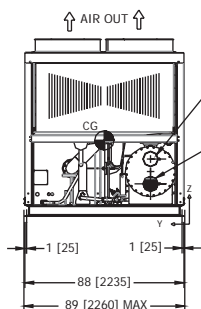
## AVX-A 340T-5HR, 365T-5HR

### NOTES:

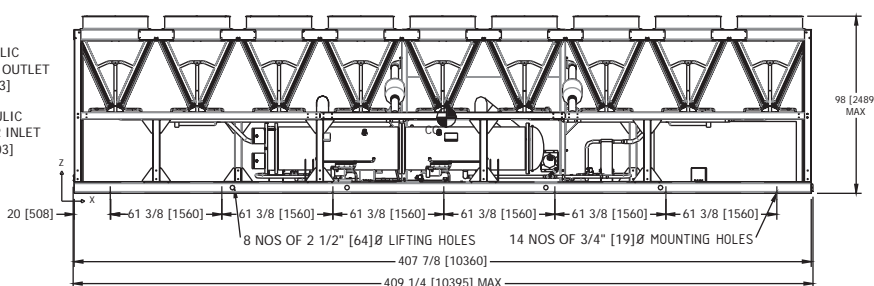
1. ALL DIMENSIONS ARE IN INCHES AND MILLIMETERS.
2. ALLOW 60" [1524mm] CLEARANCE AT CONTROL PANEL END OF UNIT FOR SERVICE.
3. USE MINIMUM 36" [914mm] FLEXIBLE CONDUIT TO CONTROL BOX TO ISOLATE UNIT.
4. WATER PIPING TO BE SUPPORTED TO MINIMIZE LOAD ON UNIT.



TOP VIEW



LEFT VIEW



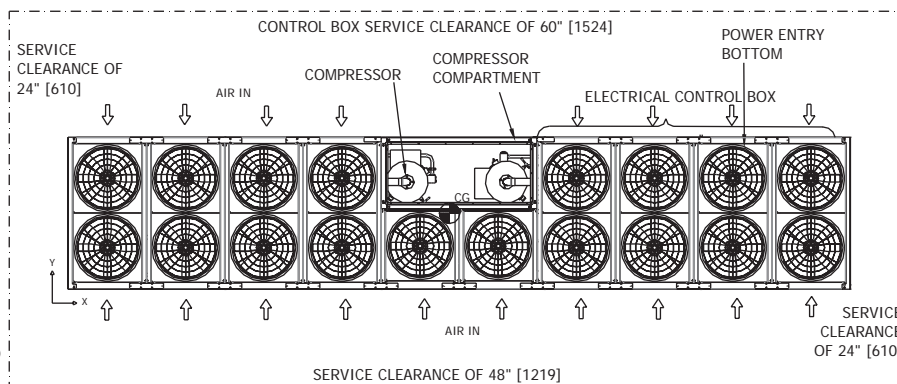
FRONT VIEW

# DIMENSIONAL DATA

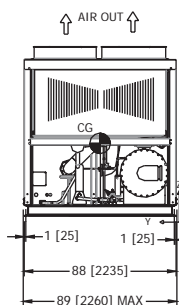
## AVX-A 400T-5HR

### NOTES:

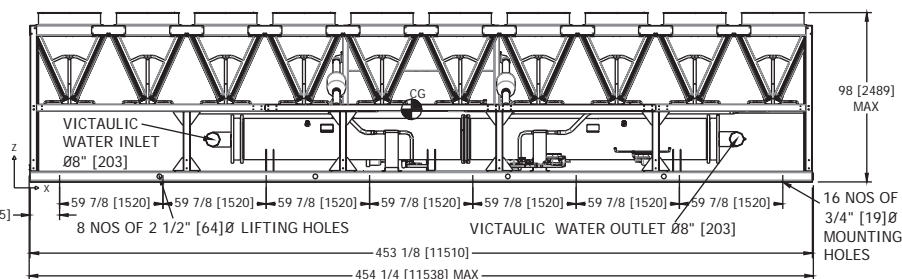
1. ALL DIMENSIONS ARE IN INCHES AND MILLIMETERS.
2. ALLOW 60" [1524mm] CLEARANCE AT CONTROL PANEL END OF UNIT FOR SERVICE.
3. USE MINIMUM 36" [914mm] FLEXIBLE CONDUIT TO CONTROL BOX TO ISOLATE UNIT.
4. WATER PIPING TO BE SUPPORTED TO MINIMIZE LOAD ON UNIT.



TOP VIEW



LEFT VIEW

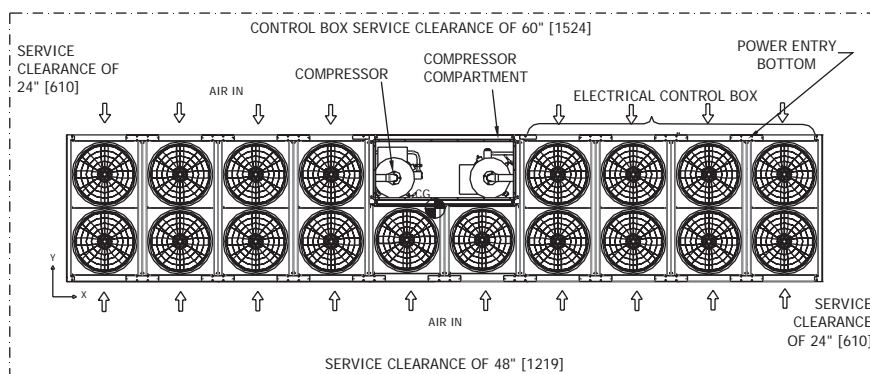


FRONT VIEW

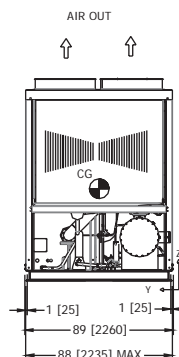
## AVX-A 450T-5HR, 520T-5HR

### NOTES:

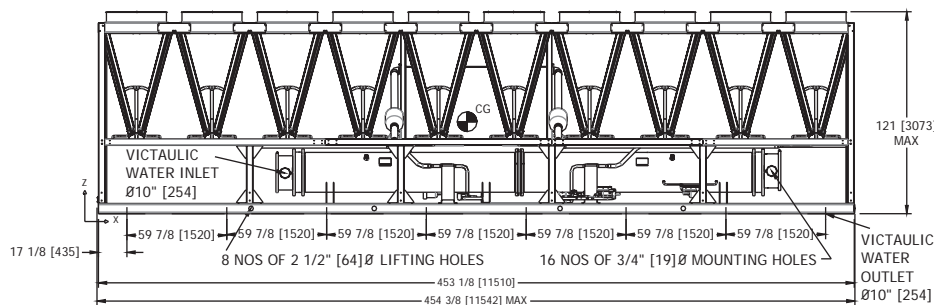
1. ALL DIMENSIONS ARE IN INCHES AND MILLIMETERS.
2. ALLOW 60" [1524mm] CLEARANCE AT CONTROL PANEL END OF UNIT FOR SERVICE.
3. USE MINIMUM 36" [914mm] FLEXIBLE CONDUIT TO CONTROL BOX TO ISOLATE UNIT.
4. WATER PIPING TO BE SUPPORTED TO MINIMIZE LOAD ON UNIT.



TOP VIEW



LEFT VIEW



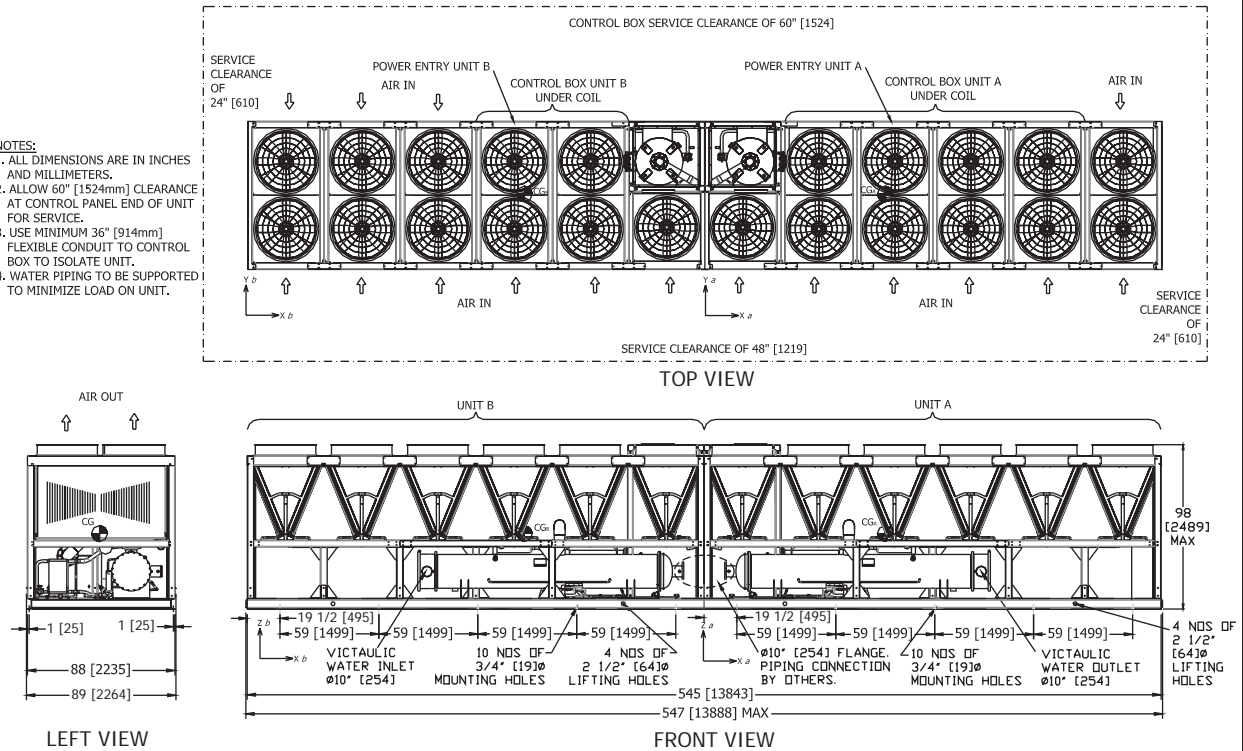
FRONT VIEW

# DIMENSIONAL DATA

## AVX-A 450M-5HR

### NOTES:

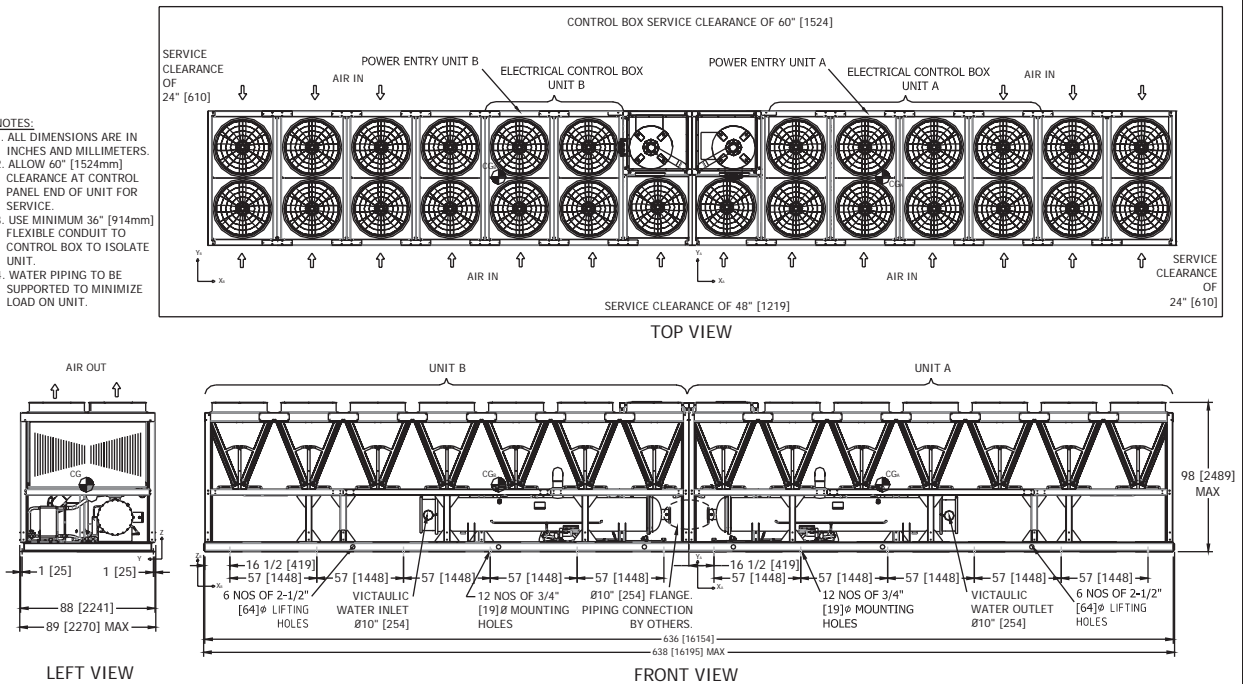
1. ALL DIMENSIONS ARE IN INCHES AND MILLIMETERS.
2. ALLOW 60" [1524mm] CLEARANCE AT CONTROL PANEL END OF UNIT FOR SERVICE.
3. USE MINIMUM 36" [914mm] FLEXIBLE CONDUIT TO CONTROL BOX TO ISOLATE UNIT.
4. WATER PIPING TO BE SUPPORTED TO MINIMIZE LOAD ON UNIT.



## AVX-A 520M-5HR

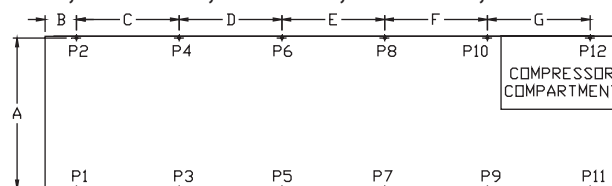
### NOTES:

1. ALL DIMENSIONS ARE IN INCHES AND MILLIMETERS.
2. ALLOW 60" [1524mm] CLEARANCE AT CONTROL PANEL END OF UNIT FOR SERVICE.
3. USE MINIMUM 36" [914mm] FLEXIBLE CONDUIT TO CONTROL BOX TO ISOLATE UNIT.
4. WATER PIPING TO BE SUPPORTED TO MINIMIZE LOAD ON UNIT.

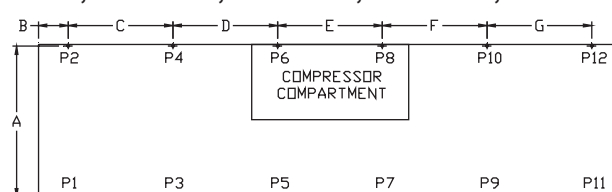


# FLOOR LOADING DIAGRAM

## AVX-A 95S-5HR, 115S-5HR, 140S-5HR, 170S-5HR, 200S-5HR, 220S-5HR, 250S-5HR



## AVX-A 135T-5HR, 170T-5HR, 185T-5HR, 235T-5HR, 260T-5HR, 285T-5HR, 320T-5HR



### a.) Point Load Location – inches [mm]

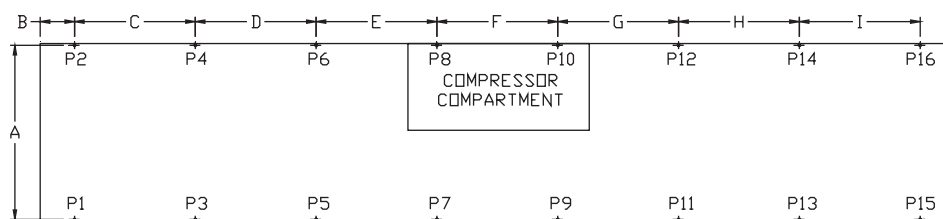
Model AVX-A	Dimensions - Inches [mm]						
	A Dim.	B Dim.	C Dim.	D Dim.	E Dim.	F Dim.	G Dim.
95S-5HR	86 [2184]	14 [350]	56 [1430]	56 [1430]	-	-	-
115S-5HR	86 [2184]	10 [255]	55 [1400]	55 [1400]	55 [1400]	-	-
135T-5HR	86 [2184]	21 [533]	63 [1600]	63 [1600]	63 [1600]	-	-
140S-5HR	86 [2184]	21 [545]	63 [1590]	63 [1590]	63 [1590]	-	-
170S-5HR	86 [2184]	21 [545]	63 [1590]	63 [1590]	63 [1590]	-	-
170T-5HR	86 [2184]	15 [381]	61 [1549]	61 [1549]	61 [1549]	61 [1549]	-
185T-5HR	86 [2184]	15 [381]	61 [1549]	61 [1549]	61 [1549]	61 [1549]	-
200S-5HR	86 [2184]	20 [508]	61 [1549]	61 [1549]	61 [1549]	61 [1549]	-
220S-5HR	86 [2184]	20 [508]	61 [1549]	61 [1549]	61 [1549]	61 [1549]	-
235T-5HR	86 [2184]	12 [305]	59 [1499]	59 [1499]	59 [1499]	59 [1499]	59 [1499]
250S-5HR	86 [2184]	18 [455]	59 [1499]	59 [1499]	59 [1499]	59 [1499]	59 [1499]
260T-5HR	86 [2184]	12 [305]	59 [1499]	59 [1499]	59 [1499]	59 [1499]	59 [1499]
285T-5HR	86 [2184]	19 [472]	65 [1651]	65 [1651]	65 [1651]	65 [1651]	65 [1651]
320T-5HR	86 [2184]	19 [472]	65 [1651]	65 [1651]	65 [1651]	65 [1651]	65 [1651]

### b.) Point Load Data – lbs [kg]

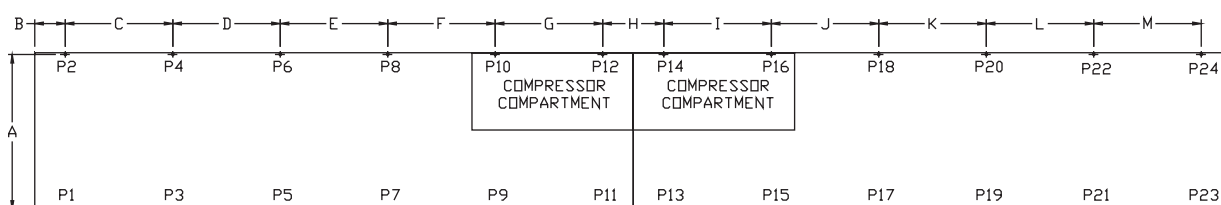
Model AVX-A	Point Load												Operating Weight
	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10	P11	P12	
95S-5HR	1244 [564]	1056 [479]	1362 [618]	1407 [638]	1479 [671]	1759 [798]	-	-	-	-	-	-	8307 [3768]
115S-5HR	1135 [515]	910 [413]	1173 [532]	1088 [494]	1210 [549]	1266 [574]	1248 [566]	1445 [655]	-	-	-	-	9475 [4298]
135T-5HR	1531 [695]	1321 [599]	1543 [700]	1407 [638]	1555 [705]	1492 [677]	1567 [711]	1578 [716]					11995 [5441]
140S-5HR	1196 [542]	1002 [455]	1228 [557]	1178 [534]	1261 [572]	1354 [614]	1293 [586]	1530 [694]	-	-	-	-	10042 [4555]
170S-5HR	1303 [591]	1071 [486]	1415 [642]	1329 [603]	1528 [693]	1586 [719]	1641 [744]	1844 [836]	-	-	-	-	11717 [5315]
170T-5HR	1358 [616]	1242 [563]	1360 [617]	1257 [570]	1361 [617]	1272 [577]	1363 [618]	1287 [584]	1364 [619]	1302 [591]			13166 [5972]
185T-5HR	1465 [664]	1447 [656]	1466 [665]	1461 [663]	1467 [666]	1475 [669]	1469 [666]	1489 [675]	1470 [667]	1503 [682]			14711 [6673]
200S-5HR	1123 [510]	962 [436]	1218 [553]	1150 [522]	1314 [596]	1338 [607]	1409 [639]	1525 [692]	1504 [682]	1713 [777]	-	-	13256 [6013]
220S-5HR	1219 [553]	1021 [463]	1327 [602]	1237 [561]	1434 [651]	1452 [659]	1542 [699]	1667 [756]	1649 [748]	1883 [854]	-	-	14431 [6546]
235T-5HR	1340 [608]	1342 [609]	1330 [603]	1321 [599]	1319 [598]	1300 [590]	1308 [594]	1279 [580]	1298 [589]	1259 [571]	1287 [584]	1238 [561]	15622 [7086]
250S-5HR	1102 [500]	969 [439]	1180 [535]	1109 [503]	1259 [571]	1249 [566]	1337 [607]	1389 [630]	1416 [642]	1528 [693]	1494 [678]	1668 [757]	15699 [7121]
260T-5HR	1393 [632]	1380 [626]	1382 [627]	1359 [616]	1371 [622]	1338 [607]	1360 [617]	1317 [597]	1349 [612]	1296 [588]	1339 [607]	1275 [578]	16160 [7330]
285T-5HR	1851 [840]	1559 [707]	1798 [815]	1570 [712]	1744 [791]	1580 [717]	1690 [767]	1591 [722]	1636 [742]	1601 [726]	1583 [718]	1612 [731]	19815 [8988]
320T-5HR	1886 [855]	1589 [721]	1831 [831]	1601 [726]	1776 [806]	1612 [731]	1722 [781]	1624 [737]	1667 [756]	1636 [742]	1612 [731]	1647 [747]	20203 [9164]

# FLOOR LOADING DIAGRAM

## AVX-A 340T-5HR, 365T-5HR, 400T-5HR, 450T-5HR, 520T-5HR



## AVX-A 450M-5HR, 520M-5HR



### a.) Point Load Location – inches [mm]

Model AVX-A	Dimensions - Inches [mm]												
	A Dim.	B Dim.	C Dim.	D Dim.	E Dim.	F Dim.	G Dim.	H Dim.	I Dim.	J Dim.	K Dim.	L Dim.	M Dim.
340T-5HR	86 [2184]	20 [508]	61 [1560]	61 [1560]	61 [1560]	61 [1560]	61 [1560]	61 [1560]	-	-	-	-	-
365T-5HR	86 [2184]	20 [508]	61 [1560]	61 [1560]	61 [1560]	61 [1560]	61 [1560]	61 [1560]	-	-	-	-	-
400T-5HR	86 [2184]	17 [435]	60 [1520]	60 [1520]	60 [1520]	60 [1520]	60 [1520]	60 [1520]	60 [1520]	-	-	-	-
450M-5HR	86 [2184]	19 [483]	59 [1490]	59 [1490]	59 [1490]	59 [1485]	38 [966]	59 [1490]	59 [1490]	59 [1490]	59 [1490]	-	-
450T-5HR	86 [2184]	17 [435]	60 [1520]	60 [1520]	60 [1520]	60 [1520]	60 [1520]	60 [1520]	60 [1520]	-	-	-	-
520M-5HR	86 [2184]	16 [419]	57 [1448]	57 [1448]	57 [1448]	57 [1448]	57 [1448]	33 [835]	57 [1448]	57 [1448]	57 [1448]	57 [1448]	57 [1448]
520T-5HR	86 [2184]	17 [435]	60 [1520]	60 [1520]	60 [1520]	60 [1520]	60 [1520]	60 [1520]	60 [1520]	-	-	-	-

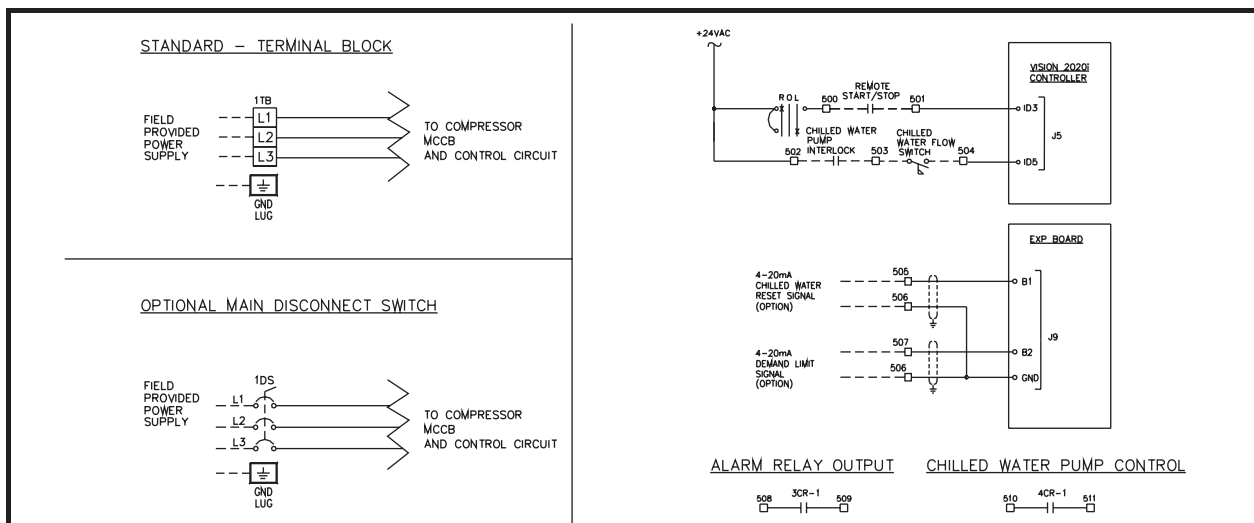
### b.) Point Load Data – lbs [kg]

Model AVX-A	Point Load																								Operating Weight
	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10	P11	P12	P13	P14	P15	P16	P17	P18	P19	P20	P21	P22	P23	P24	
340T-5HR	1690 [767]	1482 [672]	1677 [761]	1506 [683]	1664 [755]	1530 [694]	1651 [749]	1555 [705]	1638 [743]	1579 [716]	1626 [737]	1603 [727]	1613 [732]	1628 [738]	-									-	22443 [10180]
365T-5HR	1700 [771]	1510 [685]	1687 [765]	1534 [696]	1674 [759]	1558 [707]	1661 [753]	1582 [718]	1648 [747]	1606 [728]	1635 [741]	1630 [739]	1622 [736]	1654 [750]	-									-	22698 [10296]
400T-5HR	1690 [767]	1527 [693]	1661 [753]	1524 [691]	1632 [740]	1520 [690]	1603 [727]	1517 [688]	1575 [714]	1514 [687]	1546 [701]	1511 [685]	1517 [688]	1507 [684]	1488 [675]	1504 [682]									24837 [11266]
450M-5HR	1160 [526]	994 [451]	1292 [586]	1217 [552]	1423 [646]	1441 [654]	1555 [705]	1664 [755]	1686 [765]	1888 [856]	1647 [747]	1883 [854]	1538 [697]	1675 [760]	1428 [648]	1467 [666]	1318 [598]	1260 [571]	1208 [548]	1052 [477]					28796 [13062]
450T-5HR	1898 [861]	1739 [789]	1866 [846]	1734 [787]	1834 [832]	1730 [785]	1802 [817]	1726 [783]	1770 [803]	1722 [781]	1738 [788]	1717 [779]	1706 [774]	1713 [777]	1674 [759]	1709 [775]									28075 [12735]
520M-5HR	1053 [478]	946 [429]	1148 [521]	1098 [498]	1243 [564]	1250 [567]	1338 [607]	1402 [636]	1433 [650]	1555 [705]	1528 [693]	1707 [774]	1494 [677]	1738 [788]	1414 [641]	1587 [720]	1334 [605]	1436 [654]	1254 [569]	1253 [568]	1175 [533]	1135 [515]	1095 [497]	984 [446]	31599 [14335]
520T-5HR	2010 [912]	1850 [839]	1976 [897]	1845 [837]	1943 [881]	1840 [835]	1910 [866]	1836 [833]	1877 [851]	1831 [830]	1843 [836]	1826 [828]	1810 [821]	1821 [826]	1777 [806]	1817 [824]									29813 [13523]

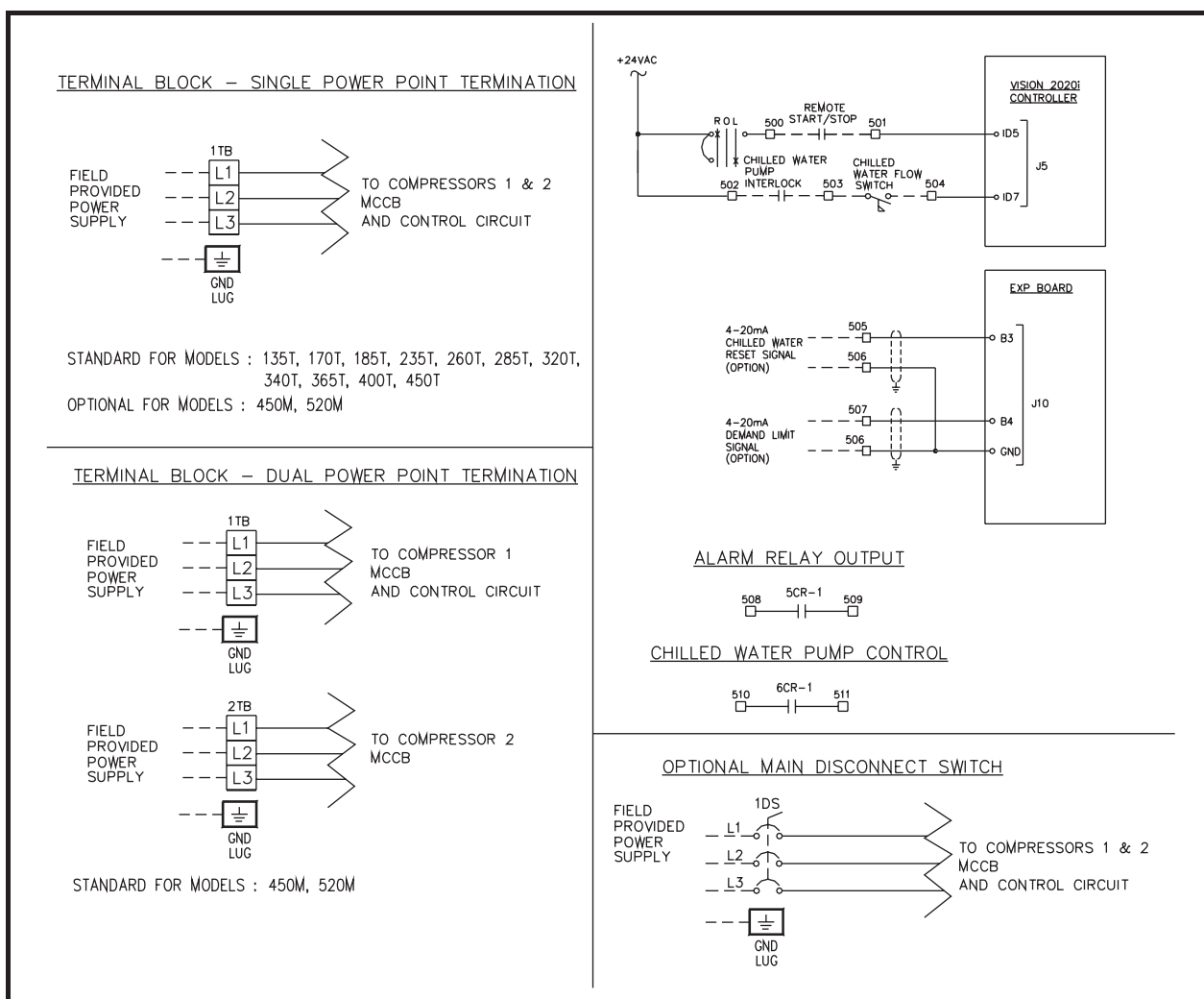
# FIELD POWER & CONTROL WIRING SCHEMATIC

## TYPICAL FIELD WIRING DIAGRAM

### 1 COMPRESSOR



### 2 COMPRESSORS



# APPLICATION DATA

## UNIT DESIGNED OPERATING RANGE

### Unit Operating Range – 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.

### Operating Limits – Ambient Temperature

Operating Ambient Temperature	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]

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

### Unit Operating Range – Evaporator Temperature

The unit is designed to deliver chilled fluid temperature within 40~60°F [4.5~18°C]. The unit can start and pull down with up to 80°F [27°C] entering-fluid temperature. For sustained operation, it is recommended that the entering fluid temperature not exceed 70°F [21°C].

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

### Operating Limits – Leaving Fluid Temperature

Leaving Fluid Temperature	Minimum	Maximum
Standard	40 °F [4.5 °C]	60 °F [18 °C]
Dual Mode / Low Temp. Operation	18 °F [-7.8 °C]	60 °F [18 °C]

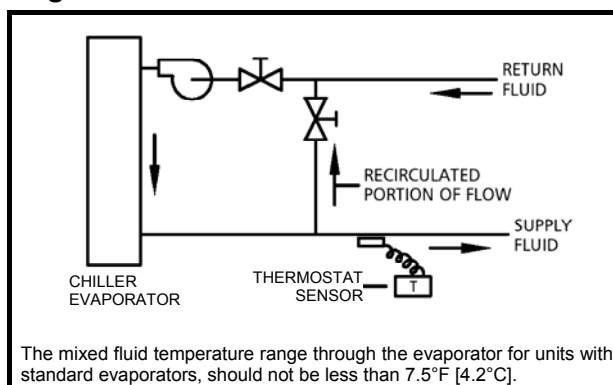
## EVAPORATOR FLUID CIRCUIT

### Wide Range $\Delta T$ - Low Flow Applications

Multiple smaller chillers may be applied in series, each providing a portion of the design temperature range typical 10°F [5.5°C] each.

Chilled fluid may be recirculated through the evaporator as shown below to allow the chiller to operate with acceptable flow rates and temperature ranges (Figure 1A).

Figure 1A

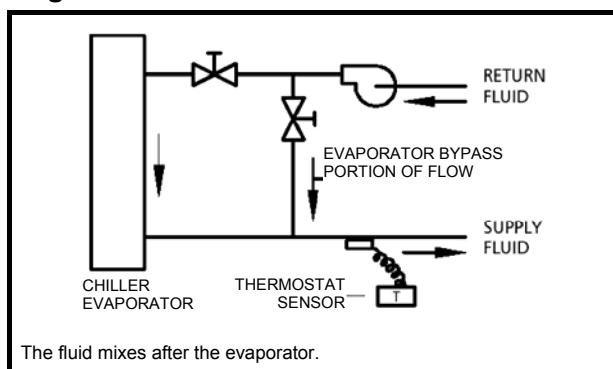


### Narrow Range $\Delta T$ - High Flow Applications

For Narrow Range  $\Delta T$  applications, a partial evaporator bypass piping and valve configuration can be used as shown below.

This permits a higher  $\Delta T$  and lower  $\Delta P$  (pressure drop) through the evaporator (Figure 1B).

Figure 1B



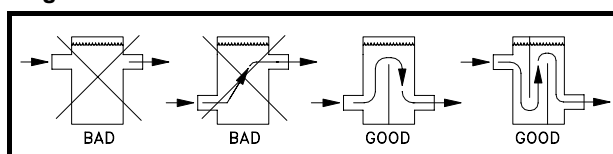
### Minimum Chilled Fluid Loop Volume

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

### Tanks for System Volume Enhancement

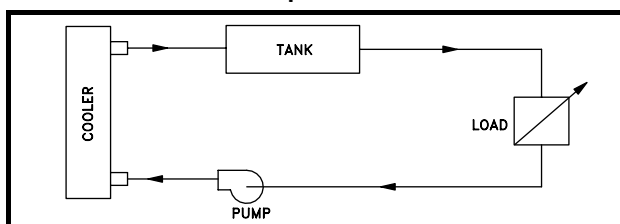
It may be necessary to install a tank in the system to provide sufficient system fluid volume, as shown below. The tank should be baffled and piped for proper fluid mixing to prevent stratification.

Figure 2A

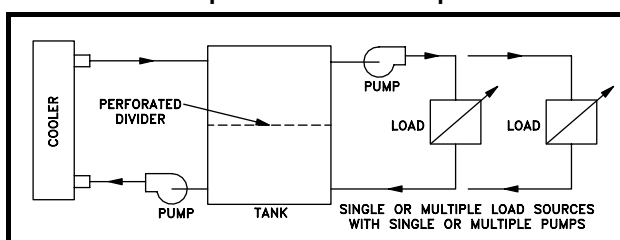


# APPLICATION DATA

**Figure 2B Single Loop System with Storage Tank to Increase Loop Volume**



**Figure 2C Primary and Secondary Loop Systems are normally used where the secondary system has variable flow and/or multiple loads. See example below.**



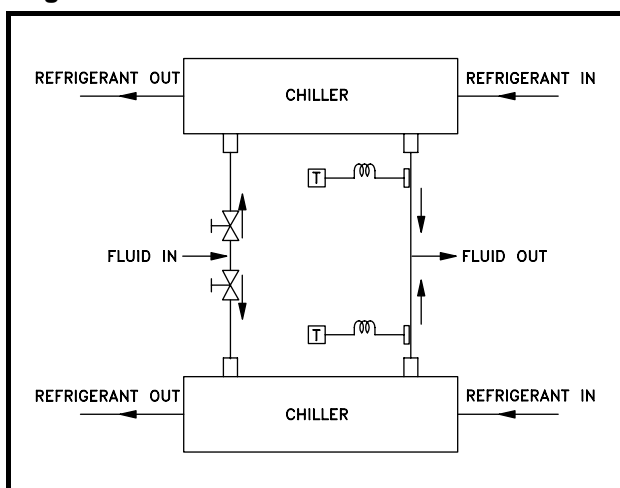
## Multiple Chillers In A Chilled Water System

Where the load is greater than available from one Achelous AVX-A, where standby capacity is required or the load profile dictates, multiple chillers may be piped in parallel. Units of equal size help to ensure fluid flow balance, but balancing valves ensure balanced flows even with dissimilar sized chillers.

Temperature controller sensors may or may not need to be moved to the common fluid piping depending on the specific application.

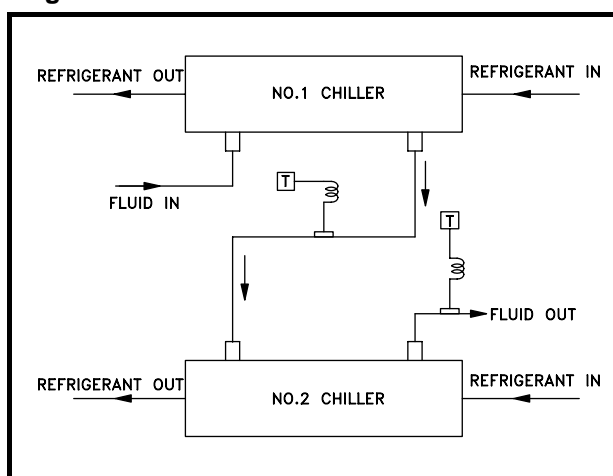
**Parallel Chiller Applications** – Both units operate simultaneously modulating with load variations. Each unit operates independently sensing its own leaving fluid temperature. The set point of each thermostat is set to maintain the desired loading scheme. (Figure 3A)

**Figure 3A**



**Series Chiller Applications** – Where a large temperature range is required (over 25 °F [13.9 °C]), the chiller may be piped in series. In this case the units are controlled independently. The load is progressive by temperature so the chiller selections are critical. (Figure 3B)

**Figure 3B**



## 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.

## Sound and Vibration

The compressors in AVX-A units are resiliently, mounted to reduce the transmission of any noise and vibration to the frame.

The compressors are not mounted on springs because extra movement may cause line breakage and refrigerant leaks. Unit isolation helps prevent any remaining sound or vibration from entering the building structure, piping or electrical service.

## 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.



# APPLICATION DATA

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.

**Table 1 : Ethylene Glycol**

% E. G. By Weight	Freeze Point		C1 Capacity Factor	K1 kW Rate	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 Rate	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

**Table 3 : Correction Factor - Elevation**

Elevation above Sea Level		Capacity Correction Factor	kW Correction Factor
Feet [m]	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

**Table 4 : Correction Factor - FF**

Fouling Factor		Capacity Correction Factor	kW Correction Factor
Hr.ft².°F/BTU	m².°C/kW		
0.0001	0.018	1.000	1.000
0.00025	0.044	0.993	0.997
0.00050	0.088	0.978	0.990
0.00100	0.176	0.951	0.978

Note: P.D. – Pressure drop across evaporator

## 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

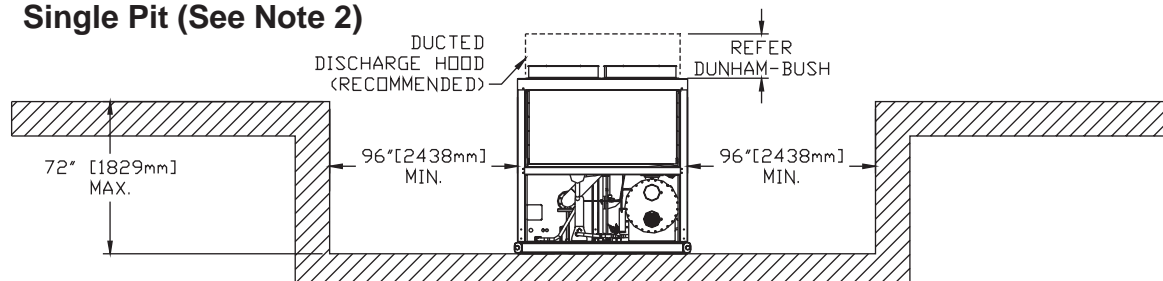
**Rebates:** ITES usually qualifies for rebates offered by electric utilities or governments for equipment that shift peak loads to off-peak hours

**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.

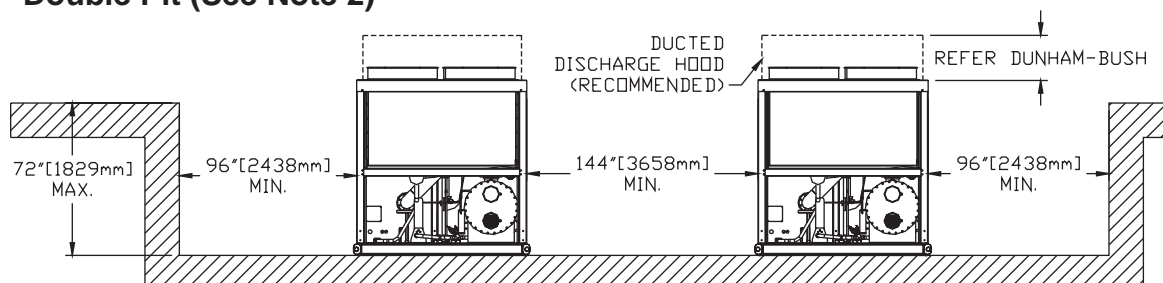
**Standby Cooling Capacity:** Energy stored in ITES can be utilized to cater peak or unexpected loads which exceeded total cooling capacity available from the installed chillers. This is savior to the regions which having difficulties on power generation plants expansion, where with ITES, will significantly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

# MINIMUM CLEARANCE REQUIREMENTS

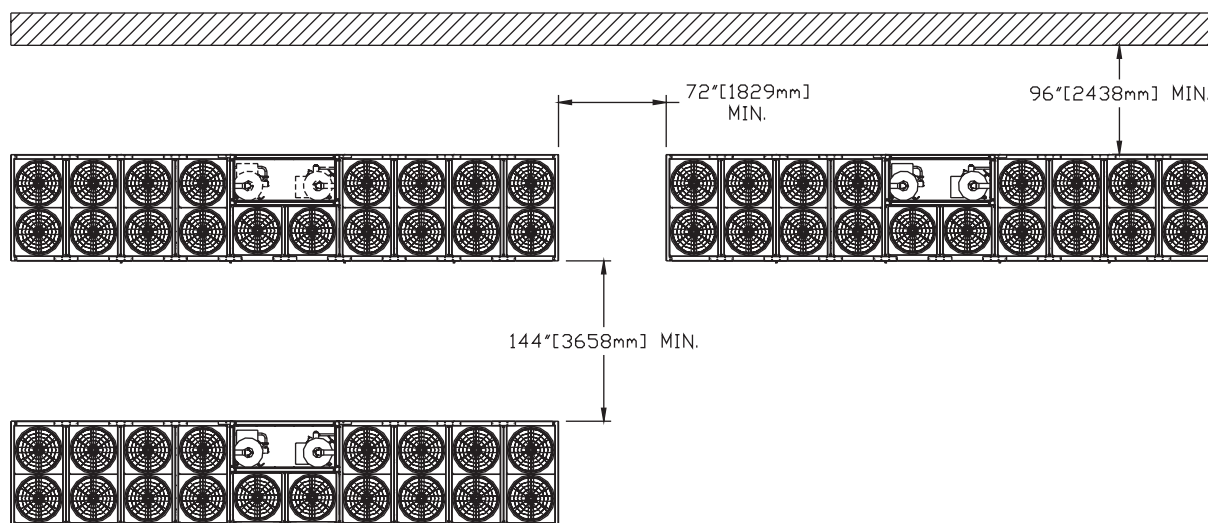
## Single Pit (See Note 2)



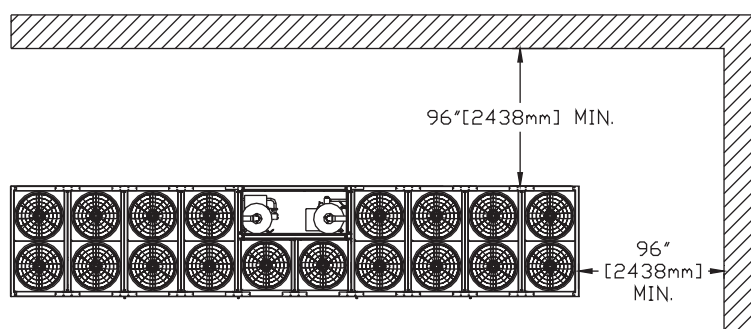
## Double Pit (See Note 2)



## Multi Pit



## Corner Wall



### Notes:

- 1.) All dimensions are minimal, unless otherwise noted.
- 2.) Pit installations are not recommended. 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

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## 1.0 GENERAL

### 1.1 SUMMARY

Supply and commissioning of complete factory assembled air cooled screw chiller suitable for outdoor installation. The air cooled chiller shall contain rotary vertical 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 to connect and interlock controller, starter, 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.

Contractor shall furnish and install chiller as shown and scheduled on the drawings. Unit shall be installed in accordance with this specification.

### 1.2 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 accordance with ASME Boiler and Pressure vessel code, Section VIII, Division 1 "Unfired Pressure Vessels"
- ✱ 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.
- ✱ [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
- ✱ 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.

### 1.3 DESIGN BASE

The construction drawings indicate a system based on a selected manufacturer of equipment and the design data available to the Engineer during construction document preparation. Electrical services, size, configuration and space allocations are consistent with that manufacturer's recommendations and requirements.

Other listed or approved manufacturers are encouraged to provide equipment on this project; however, it will be the Contractor and/or Supplier's responsibility to assure the equipment is consistent with the design base. No

compensation will be approved for revisions required by the design base or other manufacturers for any different services, space, clearances, etc.

### 1.4 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.

### 1.5 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.

### 1.6 MAINTENANCE

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

## 2.0 PRODUCTS

### 2.1 OPERATING REQUIREMENTS

The units will be furnished as shown on capacity schedules and drawings. Unit performance will be in accordance with AHRI Standard 550/590.

The unit shall be capable of starting up with entering fluid temperature to the cooler at 95°F [35°C].

The unit shall be capable to produce chilled fluid temperature between 40°F to 60°F [4.5°C to 18°C] at standard operating mode.

#### [OPTIONAL]:

- A. Dual Mode operation – The unit shall capable for ice thermal storage applications with supply brine temperature down to 18°F [-7.8°C].
- B. Low Temp. Operation – The unit shall capable for process cooling application with supply fluid temperature down to 18°F [-7.8°C].

The unit shall be design to operate at ambient temperature 45°F to 125°F [7°C to 52°C].

#### [OPTIONAL]:

- A. Low Ambient Operation (LA1) – The unit shall capable to operate with ambient temperature down to 14°F [-10°C].

# GUIDE SPECIFICATIONS

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- B. Extra Low Ambient Operation (LA2) – The unit shall be capable to operate with ambient temperature down to -20°F [-29°C].

Unit shall be able to operate with 3-phase 50Hz power supply with voltage within +/- 10% of unit rated voltage. Control Voltage shall be 115V/1ph/50Hz

## 2.2 CONSTRUCTION

The unit panels, control boxes shall be constructed by heavy gauge, galvanized steel with powder coating baked finishing to pass 1000-hours salt spray test in accordance with ATSM B117 standard.

## 2.3 COMPRESSOR

The packaged chiller shall be furnished with direct drive, hermetic sealed, positive displacement rotary screw compressor(s), driven by a 2950 RPM-50Hz (3500 RPM-60Hz) 2 pole motor.

Each compressor shall include integral oil separation system, oil sump and oil filter. The oil differential pressure shall be controlled during operation to maintain proper oil lubrication throughout the lubrication system. An electric oil heater shall be supplied with each compressor to maintain required oil temperature during shutdown period. The heater shall be energized when the chiller is switched off.

Each compressor shall have an oil level sight glass, suction check valve, suction filter and discharge service valve. Unit shall be provided with isolation valves to allow condenser to be used as a pump down receiver.

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, anti-reverse tapered roller type, shall be able to carry both radial and thrust loads.

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

### [OPTIONAL]:

- A. Compressor Suction Service Valve – To further isolate compressor from evaporator
- B. Compressor Sound Enclosure – For unit operation with lower sound level
- C. Flanged Semi-Hermetic Compressor – Semi-hermetic compressor shall be provided on request

## 2.4 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 type for tube cleaning. Water connections shall be with Victaulic grooves in compliance to ANSI / AWWAC-606. 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.

Evaporator refrigerant side shall be designed and constructed in accordance with the ASME Code for Unfired Pressure Vessels. Evaporator shell side shall be designed for working pressure up to 200PSIG [13.8BAR] and undergo pneumatic pressure test at 220PSIG [15.2BAR]. Tube side shall be designed for 150PSIG [10.3BAR] working pressure and undergo hydrostatic pressure test at 195PSIG [13.4BAR].

The flooded evaporator shall have an efficient and reliable oil recovery system. The oil recovery system shall 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 shall not be acceptable.

All low temperature surfaces shall be factory insulated with 1 inch [25mm] thick Polyethylene resin having K factor of 0.26 btu-in / hr.ft².°F.

### [OPTIONAL]:

- A. Evaporator Flanged Water Connection – Flanged water connection shall be provided in lieu of Victaulic connection.
- B. Double Thick Insulation – Evaporator shall be provided with 2 inch [50mm] thick closed cell insulation for extra resistance to condensation.
- C. 250PSIG Working Pressure Vessel – Evaporator with 250PSIG working pressure on shell side shall be provided.
- D. JKKP Compliance – Evaporator with JKKP approval shall be provided for installation in Malaysia.
- E. PED Compliance – Evaporator with PED approval shall be provided for installation in European countries.

## 2.5 CONDENSER AND FANS

Condenser shall be Air cooled type with tube/fin coil design. The coil shall be constructed of seamless inner-grooved copper tube and die formed 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

# GUIDE SPECIFICATIONS

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maintain optimum head pressure. Coil plate shall be made 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 alloy 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, TEFC or TENV, 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 450PSIG [31BAR].

The condenser shall be sized for full pump down capacity.

## [OPTIONAL]:

- A. Pre-coated Aluminum fin/Copper tube coil – Copper/Pre-coated Aluminum fin construction shall be made of seamless inner grooved copper tubes mechanically expanded into pre-coated (hydrophilic coated) aluminum fins. The tube sheet shall be of galvanized steel and the divider baffles shall be of galvanized steel with powder coating
- B. Copper tube/ Copper fin coil – Copper/Copper coil 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.
- C. Post-coated Aluminum fin coil – Copper tube/post-coated 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.
- D. Protective Grille For Condenser Coil – Protective grille shall be provided to condenser coil section to prevent unauthorized access.
- E. Low Noise Operation – Low noise operation shall be provided to lower down unit operating sound level.

## 2.6 REFRIGERANT CIRCUIT

The refrigerant circuit shall include discharge service valves, liquid line shut off valve, oil filter, replaceable filter drier, and sight glass at liquid line. Liquid line angle valve shall be provided for refrigerant charging. Pressure relief valves shall be provided at evaporator and compressor body.

The packaged chiller shall be furnished with electronic expansion valve for precise modulation of refrigerant flow control and improve efficiency by optimizing the suction and discharge superheat. In addition, the refrigerant control system shall optimized refrigerant

liquid level in the flooded evaporator to protect the compressor from slugging liquid refrigerant. Fixed orifice control systems shall not be acceptable.

## [OPTIONAL]:

- A. Heat Recovery – Factory supplied shell-and-tube heat exchanger to reclaim waste heat from the system to produce hot water up to 131°F [55°C].
- B. Hotgas Bypass – Shall be factory for operation down to approximately 10% of full load

## 2.7 OIL MANAGEMENT

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

## 2.8 ELECTRICAL AND CONTROL PANEL

The electrical switch gears, controller, sensor transmitters and relays shall be housed in IP54 panel. The panel casing shall be of galvanized steel with powder coating baked finishing 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.

The chiller manufacturer shall provide suitable reduced inrush starter (part winding or star-delta) 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.

The electrical panel compartment shall include:

- A. Main incoming power terminal block suitable to receive single entry of three phase 3-wire power supply with specified voltage.
- B. Circuit breaker for each compressor
- C. Solid state / thermal compressor motor with over current protection module for each phase
- D. Solid state compressor motor overheat protection module
- E. Under/over voltage phase reversal and imbalance relay.

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.

## [OPTIONAL]:

- A. Single Power Connection Point – Single point connection point shall be provided for unit with modular design.

# GUIDE SPECIFICATIONS

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- B. Unit Mounted Main Disconnect Switch – Non-fused disconnect switch with external lockable handle shall be provided to isolate unit main incoming power supply for servicing.
- C. Ground Fault Interrupt (GFI) – GFI shall be provided for ground fault protection of the unit.
- D. Softstarter for compressors motor – Solid state starter comes with bypass contactor shall be offered in lieu of standard starter for better compressor starting characteristic.
- E. Ammeter / Voltmeter – Analog ammeter and voltmeter with 3-phase selector switch shall be provided for quick system voltage and current indication
- F. IP55 control panel – Option shall be offered to upgrade the standard IP54 control panel to IP55 rated.

## 2.9 CONTROLS

### 2.9.1 GENERAL

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 that does not require a battery back-up. Controller requires back-up battery is not acceptable.

115V power supply to the control circuit shall be provided by a factory mounted control transformer installed in the panel. External power source to the control circuit 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 provide 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 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, control relays. The controller should be able to be configured and connected multiple units 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 self-diagnostic 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. Readings and settings displayed shall be selectable between 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 capable to accept low level remote control signal. Remote Start/Stop shall be provided as standard for unit start/stop by external on/off signal.

#### [OPTIONAL]:

Chilled Water Temperature Reset – The controller shall be capable to accept a 0 to 5VDC chilled water temperature reset signal to reset the chilled water supply temperature setpoint, based on external demand.

Demand Limit / Current Limit – The controller shall be capable to accept a 0 to 5VDC demand limit signal to limit the compressors operating current during the unit operation.

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:

### 2.9.2 AUTOMATIC CONTROLS

- ✱ Compressor motor increment contactors
- ✱ Start delay timer
- ✱ Anti-recycle timer
- ✱ Oil sump heater interlock relays
- ✱ Chilled water pump on/off control
- ✱ Programmable with Seven day operation cycle

### 2.9.3 MANUAL CONTROLS

- ✱ Auto/Local/Remote switch
- ✱ Control circuit stop and start switches
- ✱ Compressor enable switch

#### [OPTIONAL]:

Dual mode changeover switch – Digital input to changeover unit operation from chiller mode to freezing mode.

### 2.9.4 INDICATOR LIGHTS

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

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

# GUIDE SPECIFICATIONS

## 2.9.5 REFRIGERANT CONTROLS

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

## 2.9.6 SYSTEM INFORMATION

The chiller display shall provide following operating information.

- ✱ Leaving chilled water temperature
- ✱ Entering Chilled water temperature
- ✱ Compressor discharge temperature
- ✱ Leaving chilled water temperature derivative
- ✱ Evaporator pressure
- ✱ Condenser pressure
- ✱ Ambient Temperature
- ✱ Compressor amps draw for each compressor
- ✱ Compressor elapsed run time of each compressor
- ✱ Compressor start status
- ✱ Oil level sensor status
- ✱ Water flow switch status
- ✱ External start/stop command status
- ✱ Percentage of compressor capacity
- ✱ Electronic expansion valve percentage of opening.

### [OPTIONAL]:

- ✱ Operating supply Voltage
- ✱ Chilled water temperature reset value
- ✱ Demand limiting value

## 2.9.7 SAFETY PROTECTION

- ✱ Short circuit protection.
- ✱ Compressor motor over load protection (3 phase)
- ✱ Under or over voltage and phase failure relay
- ✱ Reverse rotation
- ✱ Compressor motor overheat protection
- ✱ High discharge temperature protection
- ✱ Low oil level protection via optical sensor
- ✱ High condenser pressure
- ✱ Low evaporator pressure
- ✱ Low differential pressure
- ✱ Freeze protection (low chilled liquid leaving temperature )
- ✱ Chilled water flow loss
- ✱ Compressor run error
- ✱ Power loss
- ✱ Sensor error
- ✱ Refrigerant loss
- ✱ Low Ambient Lockoff

Controller shall be able to retain up to 99 alarm histories 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.

## 2.9.8 REMOTE MONITORING (BMS INTERFACING)

The controller shall be designed to make easy on BMS interfacing by just an optional add-on communication card.

Various communication protocols as below shall be offered for user's selection.

- ✱ Modbus RTU RS485 / TCPIP
- ✱ BACnet TCPIP / MsTP / PTP
- ✱ LONworks

## 2.9.9 OPTIONAL ACCESSORIES

Factory shall supply below accessories for customer's field installation.

- ✱ Evaporator Water Flow Switch – Weather tight flow switch with three options for customer's selection; Flow switch with CE mark; NEMA 3R and NEMA 4 rated flow switch.
- ✱ Rubber-In-Shear Isolators
- ✱ Spring Isolators

# 3.0 EXECUTION

## 3.1 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.

## 3.2 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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