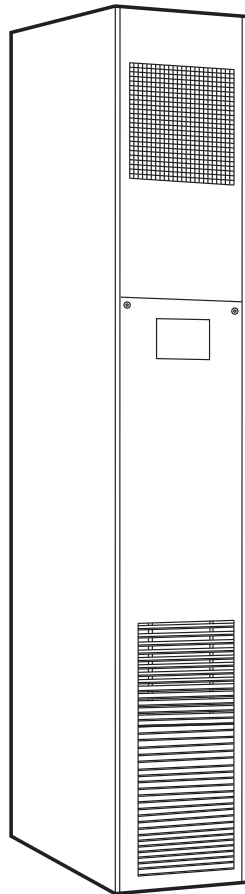




Product Data

AQUAZONE™ 50VS Vertical Stack Water Source Heat Pump with PURON® (R-410A) Refrigerant

³/₄ to 3 Nominal Tons



Single-package vertically stacked water source heat pumps with electronic controls offer:

- Puron non-ozone depleting R-410A refrigerant
- Compressor isolation
- Stainless steel drain pan
- 4-way compressor isolation for ultra-quiet operation
- Removable chassis and blower motor assembly
- Performance certified to ARI/ISO 13256-1:1998; sound tested to ARI 350-86
- Flexible and reliable controls include LON protocol and BACnet™ controls
- Cleanable pre-filter
- Multiple supply air discharge and riser piping location options

Features/Benefits

Carrier's Aquazone vertical stack water source heat pump with Puron (R-410A) refrigerant is a high quality, ultra-efficient solution for boiler/tower and geothermal design applications.

Operating efficiency

Carrier's vertical stack water source heat pumps are designed for quality and high performance over a lifetime of operation. All stack models with Puron (R-410A) refrigerant offer cooling EERs (Energy Efficiency Ratios) to 21.0 and heating COPs (Coefficient of Performance) to 4.7.

**ASHRAE
90.1
COMPLIANT**

Well exceeds
ASHRAE 90.1 and
Energy Star Standards.


Puron
the environmentally sound refrigerant

Features/Benefits (cont)



All efficiencies stated are in accordance with standard conditions under ISO (International Organization for Standardization) Standard 13256-1:1998 and provide among the highest ratings in the industry, exceeding ASHRAE (American Society of Heating, Refrigerant and Air Conditioning Engineers) 90.1 Energy Standards. Units are sound tested to ARI (Air Conditioning & Refrigeration Institute) Standard 350-86 and are ETL certified in the U.S.A. and Canada.

High quality construction and testing

All units are manufactured to meet extensive quality control protocol from start to finish through an automated control system, which provides continuous monitoring of each unit and performs quality control checks as equipment progresses through the production process. Standard construction features of the Aquazone™ units include:

Cabinet — Standard unit fabrication consists of heavy gage galvanized sheet metal cabinet construction designed for part standardization (i.e., minimal number of parts) and modular design. Compressor section interior surfaces are lined with 1/2-in. thick, dual density, 1 3/4-lb per cubic ft acoustic type fiberglass insulation. Air-handling section interior surfaces are lined with

1/2-in. thick, single density, 1 3/4-lb per cubic ft foil-backed fiber insulation for ease of cleaning. Insulation placement is designed to eliminate any exposed edges to prevent the introduction of glass fibers into the airstream. Vertical water source heat pumps are fabricated from heavy gage G90 galvanized steel. The compact cabinet dimensions are designed to fit tight space limitations in vertical configurations.

Compressor — The Puron® (R-410A) refrigerant compressor offers a 4-level vibration isolation system. Vibration pads are used under the compressor mounting frame and at each connection point. The compressor is wrapped in a blanket of insulation and is located in the acoustically insulated compressor housing away from the airstream to minimize sound transmission. The compressor also has thermal overload protection.

Blower and motor assembly — The blower has inlet rings to allow removal of the wheel and motor from one side without removing the housing. The 3-speed permanent split capacitor (PSC) motor provides extended and reliable motor life, low operating cost, and quiet operation. The fan motor is isolated from the housing by rubber grommets, is permanently lubricated and has thermal overload protection. A special dehumidification mode

is provided to allow lower airflows in cooling for efficient dehumidification.

Refrigeration/water circuit — All units contain sealed Puron (R-410A) refrigerant circuits including a high-efficiency rotary compressor designed for heat pump operation, a thermostatic expansion valve for refrigerant metering, an enhanced corrugated aluminum-lanced fin and rifled copper tube refrigerant to air heat exchanger, reversing valve, coaxial (tube-in-tube) refrigerant-to-water heat exchanger, and safety controls including a high-pressure switch, low-pressure switch, water coil low temperature sensor, and air coil low temperature sensor.

ARI/ISO — Aquazone units have ARI/ISO, NRTL (Nationally Recognized Testing Lab), or ETL labels and are factory tested under normal operating conditions at nominal water flow rates.

Quiet operation

Fan motor insulation, double isolated compressor, and no metal to metal contact are provided for sound isolation, cabinets are fully insulated to reduce noise transmission, low speed blowers are utilized for quiet operation through reduced outlet air velocities, and air-to-refrigerant coils are designed for lower airflow coil face velocities.

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Puron® (R-410A) refrigerant

Puron (R-410A) refrigerant is a non-chlorine based refrigerant. Compared to R-22, Puron (R-410A) refrigerant has the following characteristics:

- Binary and near azeotropic mixture of 50% R-32 and 50% R-125.
- Higher efficiencies (50 to 60% higher operating pressures).
- Non-ozone depleting potential and lower global warming potential.
- Virtually no glide. Unlike other alternative refrigerants, the two components in Puron (R-410A) refrigerant have virtually the same leak rates. Therefore, refrigerant can be added if necessary without recovering the charge.

Aluminum air coils

Carrier's 50VS units come standard with aluminum air coils. Modern building materials, such as countertops, floor coverings, paints and other materials, can "outgas" chemicals into the indoor air. Some of these chemicals are suspected of contributing to corrosion in the air coils found in both traditional and geothermal heating and cooling equipment. Corrosion often results in refrigerant leaks and eventual failure of the air coil. Studies have also shown that these air coil coatings improve moisture shedding and therefore improve a unit's moisture removal capability resulting in a more comfortable indoor environment. The 50VS units assure both maximum air coil life and comfort.

Design flexibility

Airflow configurations for stack units are highly flexible and are available in many arrangements including single, double, triple, or no supply with either front, right, or left return configurations. Standard entering water temperature is between 20 F and 120 F and offers maximum design flexibility for all applications including boiler/tower and geothermal applications. Water flow rates as low as 1.5 gpm per ton assist with selection from a various range of circulating pumps. Factory-installed options are offered to meet specific design requirements.

Safe, reliable operation

Standard safety features for the refrigerant circuit include high-pressure switch, low-pressure sensor to detect loss of refrigerant, and low air temperature sensor to safeguard against freezing. Equipment safety features include water loop temperature monitoring,

voltage protection, water coil freeze protection, and standard electronic condensate overflow shutdown. All safety features are tested and run at the factory to assure proper operation of all components and safety switches.

All components are carefully designed and selected for endurance, durability, and carefree day-to-day operation.

The Aquazone™ unit is shipped to provide internal and external equipment protection.

Ease of installation

The Aquazone unit is packaged for simple low cost handling, with minimal time required for installation. All units are pre-wired and factory charged with refrigerant. Units are provided with fully assembled and insulated risers as well as an internally insulated, trapped condensate drain to reduce labor associated with installing an external trap for each unit. Water connections (FPT) and condensate drains are anchored securely to the unit cabinet.

The pre-piped risers and valve packages reduce the pipe connections that need to be made by the mechanical contractor. The design of the vertical stack system with its factory-installed risers allows the units to be set in place, floor by floor, one on top of the other in a vertical column. Each riser is swaged at the top to allow the quick and easy insertion of the riser from the unit on the above floor. The swaged riser design drastically reduces the time and expense associated with brazing as compared with slip-coupling connectors.

Factory-supplied risers with swaged connections are available in a number of different diameters, tube thicknesses, and lengths.

Simple maintenance and serviceability

The Aquazone water source heat pump (WSHP) units are constructed to provide ease of maintenance. Units allow access to the compressor section and have large removable panels for easy access. Additional panels are provided to access the blower and control box sections.

The blower housing assembly can be serviced through the removable blower/motor assembly. Blower units are provided with permanently lubricated bearings for worry-free performance.

Electrical disconnection of the blower motor and control box is easily accomplished from quick disconnects on each component.

The chassis is also removable which allows for ease of maintenance and helps protect integral components from partial damage during the construction phase. Drop down legs and wheels allow maintenance on the chassis without removing the chassis entirely from the cabinet.

Maximum control flexibility

Aquazone water source heat pumps provide reliable control operation using a standard microprocessor board with flexible alternatives for many direct digital controls (DDC) applications including the Carrier Comfort Network® (CCN) and open protocol systems.

Carrier's Aquazone standard unit solid-state control system provides control of the unit compressor, reversing valve, fan, safety features, and troubleshooting fault indication features. Many features are field selectable to provide field installation flexibility. The overall features of this standard control system include:

75 va transformer — The transformer assists in accommodating accessory loads with manual resettable fuse.

Anti-short cycle timer — Timer provides a minimum off time to prevent the unit from short cycling. The 5-minute timer energizes when the compressor is deenergized, resulting in a 5-minute delay before the unit can be restarted.

Random start relay — Random start relay provides a random delay in energizing each different WSHP unit. This option minimizes peak electrical demand during start-up from different operating modes or after building power outages.

High and low pressure refrigerant protection — This protection safeguards against unreliable unit operation and helps prevent refrigerant from leaking.

Condensate overflow sensor — The electronic sensor is mounted to the drain pan. When condensate pan liquid reaches an unacceptable level, unit is automatically deactivated and placed in a lockout condition. Thirty continuous seconds of overflow is recognized as a fault by the sensor.

High and low voltage protection — Safety protection for excessive or low voltage conditions is included.

Features/Benefits (cont)



Automatic intelligent reset — Unit will automatically restart 5 minutes after shutdown if the fault has cleared. Should a fault occur 3 times sequentially, lockout will occur.

Accessory output — Twenty-four volt output is provided to cycle a motorized water valve or damper actuator with compressor in applications such as variable speed pumping arrangements.

Performance Monitor (PM) — Unique feature monitors water temperatures to warn when the heat pump is operating inefficiently or beyond typical operating range. Field selectable switch initiates a warning code on the unit display.

Water coil freeze protection (selectable for water or antifreeze) — Field selectable switch for water and water/glycol solution systems initiates a fault when temperatures exceed the selected limit for 30 continuous seconds.

Air coil freeze protection (check filter operation) — Field selectable switch for assessing excessive filter pressure drop initiates a fault when temperatures exceed the selected limit for 30 continuous seconds.

Alarm relay setting — Selectable 24 v or pilot duty dry contact provides activation of a remote alarm.

Electric heat option — The output provided on the controller operates two stages of emergency electric heat.

Service test mode with diagnostic LED (light-emitting diode) — The Test mode allows service personnel to check the operation of the WSHP and

control system efficiently. Upon entering Test mode, time delays are sped up, and the Status LED will flash a code to indicate the last fault experienced for easy diagnosis. Based on the fault code flashed by the status LED, system diagnostics are assisted through the use of Carrier provided troubleshooting tables for easy reference to typical problems.

LED visual output — An LED panel indicates high pressure, low pressure, low voltage, high voltage, air/water freeze protection, condensate overflow, and control status.

PremierLink™ controller adds reliability, efficiency, and simplification

The PremierLink direct digital controller can be ordered as a factory-installed option. Designed and manufactured exclusively by Carrier, the controller can be used to actively monitor and control all modes of operation as well as monitor the following diagnostics and features: unit number, zone temperature, zone set point, zone humidity set point, discharge air temperatures, fan status, stages of heating, stages of cooling, outdoor-air temperature, leaving-air temperature, leaving water temperature, alarm status, and alarm lockout condition.

This controller has a 38.4 kilobaud communications capability and is compatible with *ComfortLink™* controls, CCN and *ComfortVIEW™* software. The scrolling marquee and Navigator™ display are optional tools that can be used for programming and

monitoring the unit for optimal performance. The addition of the Carrier CO₂ sensor in the conditioned space provides ASHRAE 62-99 compliance and demand controlled ventilation (DCV). A DCV control strategy is especially beneficial for a water source heat pump system to minimize the energy utilized to condition ventilation air. The DCV approach enhances the energy efficient performance of the Aquazone™ units.

The PremierLink peer-to-peer, Internet ready communicating control is designed specifically for constant volume (CV) and variable volume and temperature (VVT®) applications. This comprehensive controls system allows water source heat pumps to be linked together to create a fully functional HVAC (heating, ventilation, and air conditioning) automation system.

Open protocol for diverse control

— The LON controller option is ideal when building automation requires interoperability across diverse control platforms. This LONMark® compliant offering can operate as standalone or as a part of Local Operating Network (LON) via the LonWorks® FTT-10 Free Topology communication network. The option provides factory-installed software applications specific to Aquazone water source heat pumps. Digital wall sensors that communicate over Sensor Link (S-Link) communication protocol complete a system of networked control.

Model number nomenclature



50VS A A 1 A A A A A SA 1 A 1

50VS – Aquazone™ Vertical Stack Water Source Heat Pump

Capacity and Voltage
A – 9,000 Btuh; 208-1-60
B – 9,000 Btuh; 230-1-60
C – 12,000 Btuh; 208-1-60
D – 12,000 Btuh; 230-1-60
E – 15,000 Btuh; 208-1-60
F – 15,000 Btuh; 230-1-60
G – 18,000 Btuh; 208-1-60
H – 18,000 Btuh; 230-1-60
I – 24,000 Btuh; 208-1-60
J – 24,000 Btuh; 230-1-60
K – 30,000 Btuh; 208-1-60
L – 30,000 Btuh; 230-1-60
M – 36,000 Btuh; 208-1-60
N – 36,000 Btuh; 230-1-60

Unit Configuration
A – Chassis, Cabinet, and Risers
B – Chassis, Cabinet, and Risers (Master)
C – Chassis and Cabinet Only (Slave)
D – Chassis Only
E – Cabinet Only

Controls and Power Termination
1 – Microprocessor
2 – Microprocessor with Disconnect
3 – Microprocessor with LON
4 – Microprocessor with LON with Disconnect
5 – Microprocessor with BACNet
6 – Microprocessor with BACNet and Disconnect
7 – Customer Supplied DDC Controls (ETO Required)
8 – Customer Supplied DDC Controls and Disconnect (ETO Required)

Heat Exchanger
A – Copper Coax with Coated Air Coil

Riser Length
A – No Riser **H** – 110 in.
B – 104 in. **I** – 111 in.
C – 105 in. **J** – 112 in.
D – 106 in. **K** – 113 in.
E – 107 in. **L** – 114 in.
F – 108 in. **M** – 115 in.
G – 109 in.

Supply/Return Riser
A – No Riser
B – 3/4 in. Type L Copper with 1/2 in. Insulation
C – 3/4 in. Type L Copper with 3/4 in. Insulation
D – 1 in. Type L Copper with 1/2 in. Insulation
E – 1 in. Type L Copper with 3/4 in. Insulation
F – 1-1/4 in. Type L Copper with 1/2 in. Insulation
G – 1-1/4 in. Type L Copper with 3/4 in. Insulation
H – 1-1/2 in. Type L Copper with 1/2 in. Insulation
I – 1-1/2 in. Type L Copper with 3/4 in. Insulation
J – 2 in. Type L Copper with 1/2 in. Insulation
K – 2 in. Type L Copper with 3/4 in. Insulation
L – 2-1/2 in. Type L Copper with 1/2 in. Insulation
M – 2-1/2 in. Type L Copper with 3/4 in. Insulation
N – 3/4 in. Type M Copper with 1/2 in. Insulation
O – 3/4 in. Type M Copper with 3/4 in. Insulation
P – 1 in. Type M Copper with 1/2 in. Insulation
Q – 1 in. Type M Copper with 3/4 in. Insulation
R – 1-1/4 in. Type M Copper with 1/2 in. Insulation
S – 1-1/4 in. Type M Copper with 3/4 in. Insulation
T – 1-1/2 in. Type M Copper with 1/2 in. Insulation
U – 1-1/2 in. Type M Copper with 3/4 in. Insulation
V – 2 in. Type M Copper with 1/2 in. Insulation
W – 2 in. Type M Copper with 3/4 in. Insulation
X – 2-1/2 in. Type M Copper with 1/2 in. Insulation
Y – 2-1/2 in. Type M Copper with 3/4 in. Insulation

Revision
1 – Current

Options
A – None
B – Sight and Sound Baffle(s)

Supply Air Size
1 – Single Discharge, 14 in. x 12 in.
2 – Single Discharge, 16 in. x 14 in.
3 – Double Discharge, 10 in. x 8 in.
4 – Double Discharge, 12 in. x 10 in.
5 – Triple Discharge, 10 in. x 8 in.
6 – Triple Discharge, 12 in. x 10 in.
7 – No Openings

Supply Air Configuration (See Chart)

Riser Transitions
A – None
B – Top Capped Riser
C – Bottom Capped Riser
D – Bottom Riser with Pipe Diameter One Size Larger than Top (Selected) Riser Size (Digits 10 and 11)
E – Bottom Riser with Pipe Diameter One Size Smaller than Top (Selected) Riser Size (Digits 10 and 11)

Condensate Riser
A – No Riser
B – 3/4 in. Type L Copper with 1/2 in. Insulation
C – 3/4 in. Type L Copper with 3/4 in. Insulation
D – 1 in. Type L Copper with 1/2 in. Insulation
E – 1 in. Type L Copper with 3/4 in. Insulation
F – 1-1/4 in. Type L Copper with 1/2 in. Insulation
G – 1-1/4 in. Type L Copper with 3/4 in. Insulation
H – 1-1/2 in. Type L Copper with 1/2 in. Insulation
I – 1-1/2 in. Type L Copper with 3/4 in. Insulation
J – 2 in. Type L Copper with 1/2 in. Insulation
K – 2 in. Type L Copper with 3/4 in. Insulation
L – 2-1/2 in. Type L Copper with 1/2 in. Insulation
M – 2-1/2 in. Type L Copper with 3/4 in. Insulation
N – 3/4 in. Type M Copper with 1/2 in. Insulation
O – 3/4 in. Type M Copper with 3/4 in. Insulation
P – 1 in. Type M Copper with 1/2 in. Insulation
Q – 1 in. Type M Copper with 3/4 in. Insulation
R – 1-1/4 in. Type M Copper with 1/2 in. Insulation
S – 1-1/4 in. Type M Copper with 3/4 in. Insulation
T – 1-1/2 in. Type M Copper with 1/2 in. Insulation
U – 1-1/2 in. Type M Copper with 3/4 in. Insulation
V – 2 in. Type M Copper with 1/2 in. Insulation
W – 2 in. Type M Copper with 3/4 in. Insulation
X – 2-1/2 in. Type M Copper with 1/2 in. Insulation
Y – 2-1/2 in. Type M Copper with 3/4 in. Insulation

LEGEND
DDC – Direct Digital Controls
ETO – Engineer To Order
LON – Local Operating Network



SUPPLY AIR CONFIGURATION (DIGITS 13 AND 14)

SUPPLY	RETURN CONFIGURATION	DIGITS 13 AND 14	SUPPLY POSITION			
			Front	Right	Left	
Single	Front	SA	X	-	-	
		SB	-	X	-	
		SC	-	-	X	
	Right	SE	X	-	-	
		SF	-	X	-	
		SG	-	-	X	
	Left	SJ	X	-	-	
		SK	-	X	-	
		SL	-	-	X	
Double	Front	DA	X	X	-	
		DB	X	-	X	
		DC	-	X	X	
	Right	DE	X	X	-	
		DF	X	-	X	
		DG	-	X	X	
	Left	DJ	X	X	-	
		DK	X	-	X	
		DL	-	X	X	
Triple	Front	TA	X	X	X	
		TE	X	X	X	
		TJ	X	X	X	
	None	Front	NA	-	-	-
		Right	NB	-	-	-
		Left	NC	-	-	-

ARI/ISO capacity ratings



50VS WATER LOOP AND GROUND WATER APPLICATIONS

UNIT	WATER LOOP HEAT PUMP				GROUND WATER HEAT PUMP				GROUND LOOP HEAT PUMP			
	Total Cooling at 86° F		Total Heating at 68° F		Total Cooling at 59° F		Total Heating at 50° F		Total Cooling at 77° F		Total Heating at 32° F	
	Capacity (Btuh)	EER (Btuh/W)	Capacity (Btuh)	COP	Capacity (Btuh)	EER (Btuh/W)	Capacity (Btuh)	COP	Capacity (Btuh)	EER (Btuh/W)	Capacity (Btuh)	COP
50VSA,B	9,200	13.5	12,500	4.7	11,200	21.0	10,500	4.1	9,700	15.6	8,100	3.4
50VSC,D	12,000	13.0	16,000	4.6	14,800	21.0	13,500	4.0	13,200	15.5	10,000	3.3
50VSE,F	16,500	13.0	21,500	4.5	19,500	20.0	18,500	3.9	18,000	15.0	15,000	3.2
50VSG,H	18,500	13.0	23,500	4.5	20,500	19.5	19,500	3.9	19,000	14.8	16,800	3.2
50VSI,J	22,500	13.0	29,500	4.7	26,800	20.0	24,500	4.2	24,000	15.0	19,000	3.3
50VSK,L	30,000	12.7	37,000	4.5	35,000	19.0	32,000	4.0	32,000	14.5	25,000	3.3
50VSM,N	34,000	13.0	41,000	4.5	38,000	19.0	35,000	4.0	36,000	15.0	27,000	3.2

LEGEND

COP — Coefficient Performance
 db — Dry Bulb
 EER — Energy Efficiency Ratio
 wb — Wet Bulb

NOTES:

- Cooling capacity based upon 80.6 F db, 66.2 F wb entering air temperature.
- Heating capacity based upon 68 F db, 59 F wb entering air temperature.
- All ratings based upon airflow at high speed and operation at lower voltage (208-vac) of dual voltage ratings.
- Certified in accordance with the ARI/ISO Standard 13256-1:1998 Certification Program.



Physical data

PHYSICAL DATA — 50VS UNIT

UNIT	50VSA,B	50VSC,D	50VSE,F	50VSG,H	50VSI,J	50VSK,L	50VSM,N
COOLING CAPACITY (Btuh)	9,200	11,700	16,500	18,000	22,500	28,500	32,700
HEATING CAPACITY (Btuh)	12,500	16,000	22,500	24,500	31,000	38,000	45,000
CABINET WEIGHT (lb)	120				170		
CHASSIS WEIGHT (lb)	99	105	119	122	187	198	205
COMPRESSOR (1 each)	Rotary						Scroll
High Side Pressure (psig)	550						
Low Side Pressure (psig)	170						
FACTORY REFRIGERANT CHARGE R-410A (oz)	27.5	27.5	36.7	41.6	49.4	63.5	61.8
FAN DATA	PSC/2 speed						
Fan Motor Type/Speeds	PSC/2 speed						
Blower Wheel Size (Depth x Width) (in.) Std/High Static	7.08 x 6.69			9.21 x 9.99			
Airflow (cfm)	370	450	540	640	820	1120	1300
Static Pressure (in. wg)	0						
WATER/CONDENSATE SIDE DATA							
Flow Rate (gpm)	2.6	3.2	4.5	5.2	6.5	8.5	9.5
Water Connection Size (FPT) (in.)	1/2				3/4		
Water Side Pressure Drop (psi)	5.8	5.8	11.5	11.8	4.8	7.2	10.2
Condensate Connection Size (in.)	3/4						
AIR COIL DATA							
Total Face Area (sq ft)	1.48	1.48	1.81	1.48	1.48	1.81	1.48
Tube Size (in.)	3/8						
Fin Spacing (FPI)	12		14		10		
Number of Rows	2		3		2	3	
CABINET DATA							
Depth (in.)	18			24			
Height (in.)	88			88			
Width (in.)	18			24			
Standard Filter -- 1 in. Washable	14-1/4 x 18-1/2		14-1/4 x 22-1/2		19 x 28-3/4		

LEGEND

FPI — Fins Per Inch
 PSC — Permanent Split Capacitor

Options and accessories



ITEM	FACTORY-INSTALLED OPTIONS	FIELD-INSTALLED ACCESSORIES
Ball Valves (Brass Body)		X
Disconnect Switch	X	
Fire-Rated Hoses		X
Hose Kit Assemblies		X
Loop Controller		X
Non-Programmable Thermostat		X
Programmable 5-Day Thermostat		X
Programmable 7-Day Flush-Mount Thermostat		X
Programmable 7-Day Light-Activated Thermostat		X
Programmable 7-Day Thermostat		X
Remote Sensors		X
Sound Baffles	X	
Two-Way Motorized Control Valve	X	X
Y Strainers (Brass Body)		X
LonWorks® and BacNet™ Controls	X	
Flow Regulators	X	X
Risers	X	
Return Panels		X
Supply Grilles		X
Paint Color	X	

Factory-installed options

Risers made of type L and type M copper with a swaged connection are available in the following diameter sizes: ¾, 1, 1¼, 1½, 2, 2½, and 3 inches. Risers can be ordered with ½ in. or ¾ in. closed cell insulation, a capped top or bottom, and shipped loose upon request.

Paint color chip matching is available for the exterior of the unit.

Disconnect switch is industrial grade with back and side wire connections. Available with ratings of 20 and 30 amps with 120/277 vac.

Flow regulators constructed of forged brass with EPDM O-rings are available in ½ in. and ¾ in. sizes. Flow rates for ½ in. sizes are 0.5, 1.0, 1.5, 2.0, 2.5, and 3.0 gpm. Flow rates for ¾ in. sizes are 0.5, 1.0, 1.5, 2.0, 2.5, 3.0, 3.5, 4.0, 5.0, 6.0, 7.0, 8.0, 9.0, and 10.5 gpm. The flow regulators are designed to operate at 600 psig, 325 F.

LonWorks and BACnet controls can be factory installed for direct digital controls (DDC) capability.

Two-way motorized control valve can be provided for applications involving open type systems or variable speed pumping. This valve will slowly open and close in conjunction with the compressor operation to shut off or turn on water to the unit.

Sound baffles are available for applications that require especially low noise levels. The standard unit noise reduction features (i.e., as mentioned previously) as well as factory-installed sound baffles provide sound levels and noise reduction to the highest degree.

Field-installed accessories

Return panel options include hinged panels with quarter turn or keylock fasteners or removable, stamped louvered perimeter bypass return panels with quarter-turn fasteners. A return panel frame can be installed after all unit construction has been completed.

Supply grilles are available as single, double, or double deflection grilles with opposed dampers in sizes 16 in. x 14 in., 14 in. x 12 in., 12 in. x 10 in., and 10 in. x 8 inches. Supply grilles can be painted to match return air panels.

Hose kits are available in ½ in. and ¾ in. connection sizes. Each kit includes a 3 ft long fabric reinforced EPDM stainless steel hose, full port ball valve with PT (pressure and temperature) test plug, balance valve with PT test plug, and memory stop. An adapter to allow braze connection to risers and a union connection to allow easy removal of chassis are also included.

Flow regulators constructed of forged brass with EPDM O-rings are available in ½ in. and ¾ in. sizes. Flow rates for ½ in. sizes are 0.5, 1.0, 1.5, 2.0, 2.5, and 3.0 gpm. Flow rates for ¾ in. sizes are 0.5, 1.0, 1.5, 2.0, 2.5, 3.0, 3.5, 4.0, 5.0, 6.0, 7.0, 8.0, 9.0, and 10.5 gpm. The flow regulators are designed to operate at 600 psig, 325 F.

Carrier's line of Aquazone™ thermostats are both attractive and multi-functional, accommodating stand-alone water source heat pump installations.

Programmable 7-day thermostat — Thermostat offers 2-stage heat, 2-stage cool, auto changeover, 7-day programmable with copy command, 4 settings per day, fully electronic, 24-vac, backlit LCD, keypad lockout, no batteries required, 5-minute compressor protection, NEVERLOST™ memory, 3 security levels, temperature display in degrees F or C.

Programmable 7-day light-activated thermostat — Thermostat offers same features as the 7-day programmable thermostat and includes occupied comfort settings with lights on, unoccupied energy savings with lights off.

Programmable 7-day flush-mount thermostat — Thermostat offers same features as the 7-day programmable thermostat and includes locking coverplate with tamper proof screws, flush to wall mount, holiday/vacation

Options and accessories (cont)



programming, set point limiting, dual point with adjustable deadband, O or B terminal, and optional wall or duct-mounted remote sensor.

Programmable 5-day thermostat — Thermostat offers 2-stage heat, 2-stage cool, auto changeover, 5-minute built-in compressor protection, locking cover included, temperature display in degrees F or C, keypad lockout, backlit display, 5-1-1 programming, O or B terminal, dual set point with adjustable deadband, configurable display, self-prompting program, and 4 settings per day.

Non-programmable thermostat — Thermostat offers 2 heat stages, 2 cool stages, auto changeover, 5-minute built in compressor protection, locking cover included, temperature display in degrees F or C, keypad lockout, large display, backlit display, O or B terminal, dual set point with adjustable deadband, and backplate with terminals.

Loop controller with six stages (2 stages for heating and 4 stages for cooling) includes:

- Loop temperature alarms
- Two pump single loop flow monitoring with the ability to manually select the lead pump
- One common alarm signal and indicating light and one audible alarm
- Loop water temperature sensor test circuit
- Functional test simulation from operator keypad

- Real timeclock, industrial noise ratings
- Loop water temperature control switch

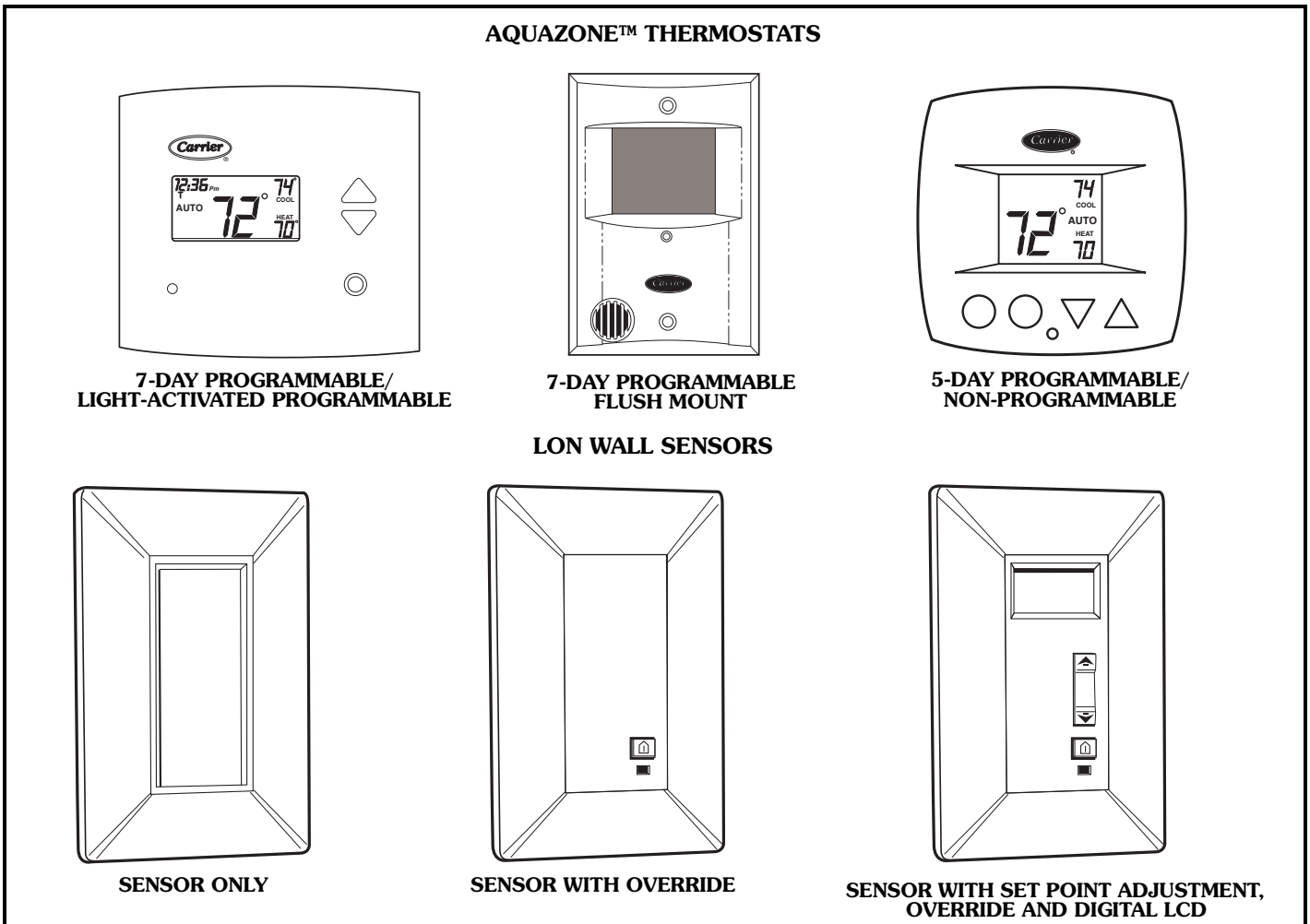
Remote sensors are available for Aquazone flush mount thermostats. Available sensors are for wall (wired and wireless) or duct mounted applications.

Two-way motorized control valve can be provided for applications involving open type systems or variable speed pumping. This valve will slowly open and close in conjunction with the compressor operation to shut off or turn on water to the unit.

Fire-rated hoses are 2 ft long and have a fixed MPT on one end and a swivel with an adapter on the other end. Hose kits are provided with both a supply and return hose and can be either stainless steel or galvanized. Hoses are available in 1/2 and 3/4 in. sizes.

Ball valves (brass body) are used for shutoff and balancing water flow and are available with memory, memory stop, and pressure temperature ports. Ball valves consist of UL-listed brass body, ball and stem type with Teflon seats and seals. Valves are available in 1/2 and 3/4 in. sizes.

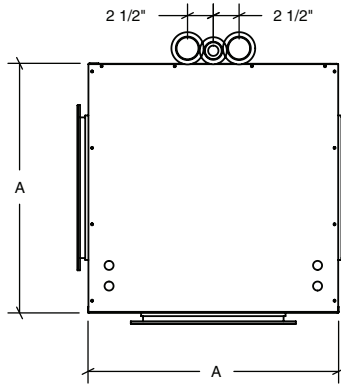
Y strainers (bronze body) are “Y” type strainers with a brass cap. With a maximum operating pressure rating of 450 psi, the strainer screen is made of stainless steel and is available with blow down valves. Strainers are available in 1/2 and 3/4 in. sizes.



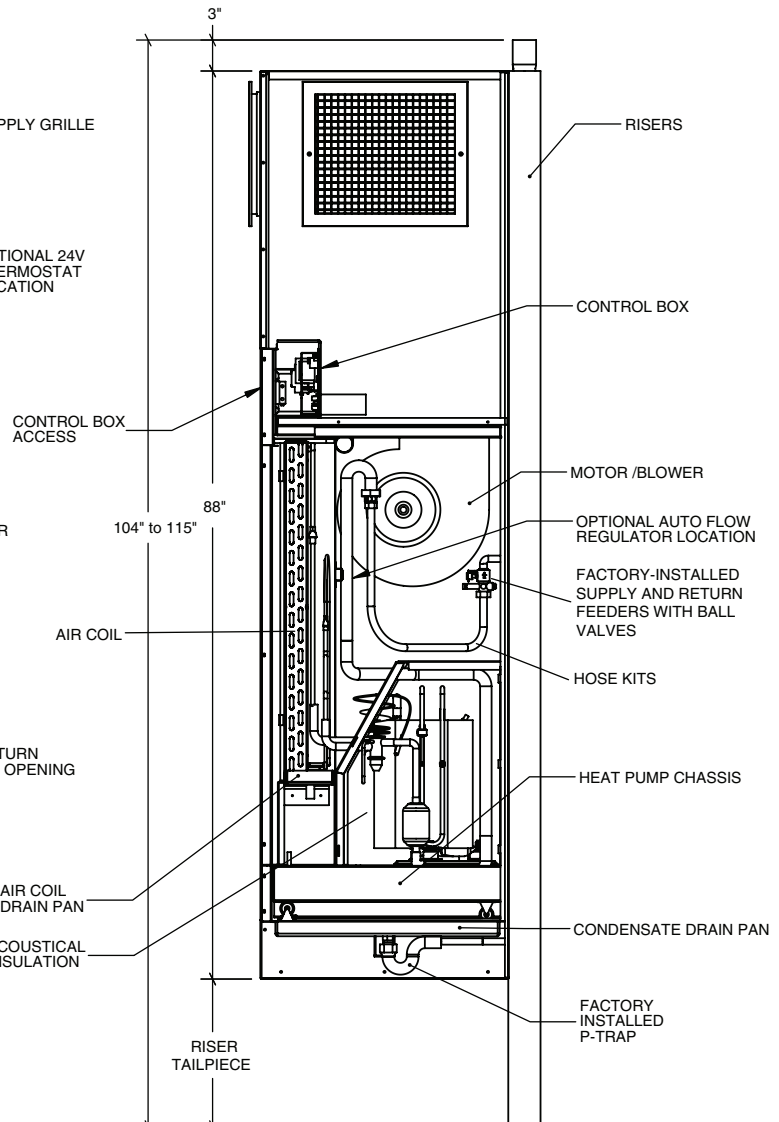
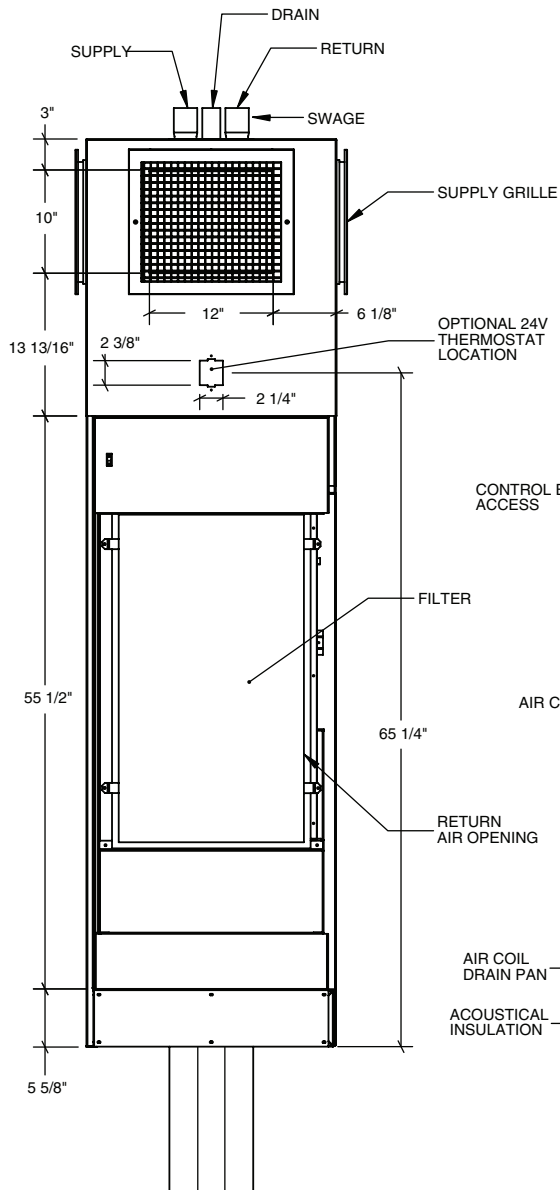
Dimensions



50VS UNIT DIMENSIONAL DATA



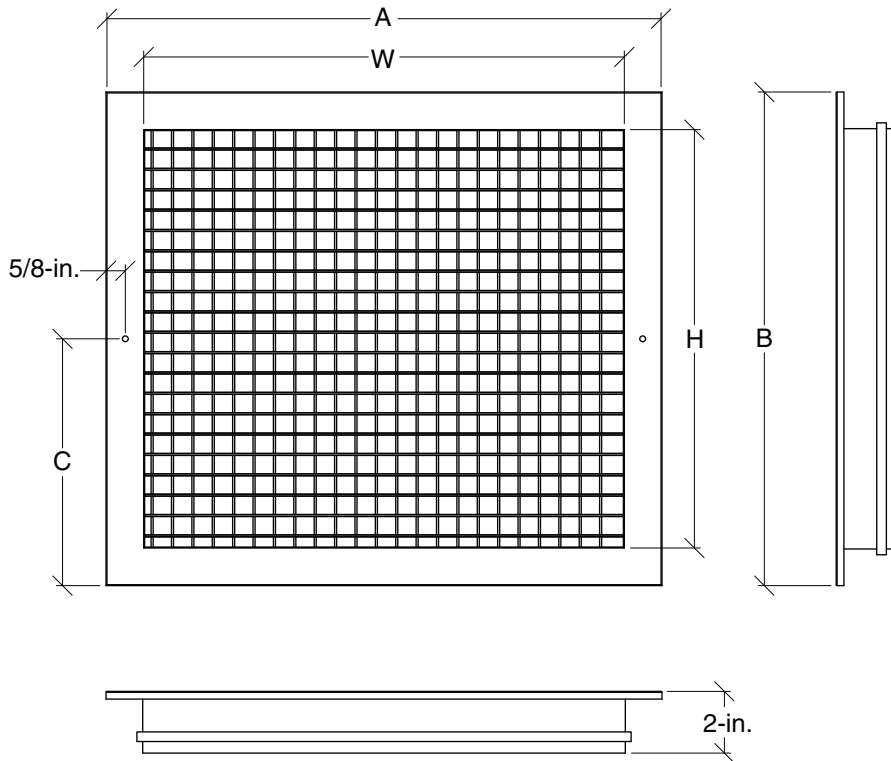
UNIT	NOMINAL CAPACITY (TONS)	DIMENSION A (in.)	WATER CONNECTION SIZE (FPT) (in.)	COIL CONNECTION SIZE (in.)
50VSA,B	3/4	18	1/2	1/2
50VSC,D	1	18	1/2	1/2
50VSE,F	1 1/4	18	3/4	3/4
50VSG,H	1 1/2	18	3/4	3/4
50VSI,J	2	24-1/4	3/4	3/4
50VSK,L	2 1/2	24-1/4	3/4	3/4
50VSM,N	3	24-1/4	3/4	3/4



Dimensions (cont)



SINGLE AND DOUBLE DEFLECTION ALUMINUM DISCHARGE GRILLE



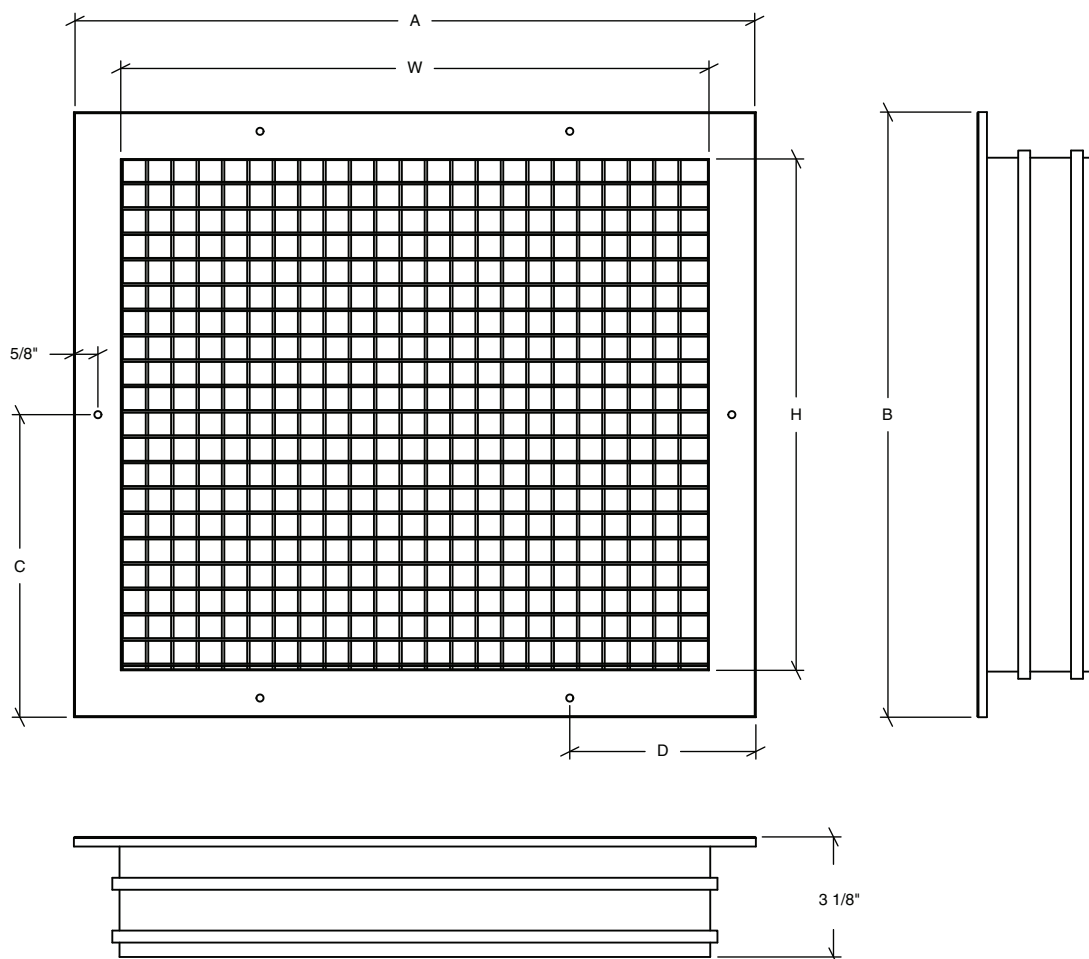
DIMENSIONAL DATA

Grille Size (in.)	Cabinet Height	W (in.)	H (in.)	A (in.)	B (in.)	C (in.)
16 x 14	STD	15- ⁷ / ₁₆	13- ⁷ / ₁₆	18	16	8
14 x 12	STD	13- ³ / ₈	11- ³ / ₈	16	14	7
12 x 10	STD	11- ⁷ / ₁₆	11- ⁷ / ₁₆	14	12	6
10 x 8	STD	9- ⁷ / ₁₆	9- ⁷ / ₁₆	12	10	5

NOTES:

1. Single deflection grilles include adjustable vertical blades for controlling horizontal path of discharge.
2. Double deflection grilles include adjustable vertical and horizontal blades for controlling horizontal and vertical path of discharge air (recommended).
3. Dimensions are in inches.
4. All dimensions are $\pm 1/4$ inch.
5. Discharge grilles are shipped loose for field installation.
6. Construction is roll formed aluminum frame and blades.
7. Standard finish is powder coated and will be the same color as the return grille.
8. Installation of grille on adjacent unit sides may require a duct extension to prevent air bypass around discharge grilles.
9. Mounting hardware included.

DOUBLE DEFLECTION WITH OPPOSED DAMPER ALUMINUM DISCHARGE GRILLE



DIMENSIONAL DATA

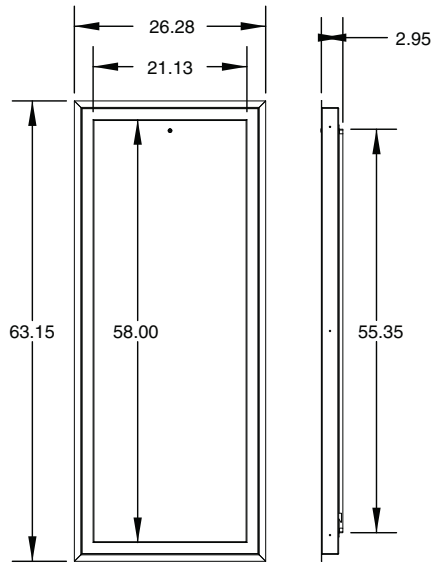
Grille Size (in.)	Cabinet Height	W (in.)	H (in.)	A (in.)	B (in.)	C (in.)	D (in.)
16 x 14	STD	15 ^{-3/16}	13 ^{-3/16}	17 ^{-3/4}	15 ^{-3/4}	N/A	4 ^{-7/8}
14 x 12	STD	13 ^{-3/16}	11 ^{-3/16}	15 ^{-3/4}	13 ^{-3/4}	6 ^{-7/8}	N/A
12 x 10	STD	11 ^{-3/16}	9 ^{-3/16}	13 ^{-3/4}	11 ^{-3/4}	5 ^{-7/8}	N/A
10 x 8	STD	9 ^{-3/16}	7 ^{-3/16}	11 ^{-3/4}	9 ^{-3/4}	4 ^{-7/8}	N/A

NOTES:

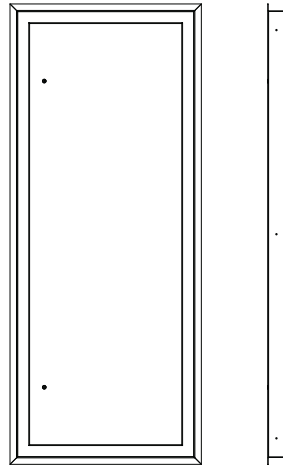
1. The opposed blade damper allows control of air volume (cfm) and path of discharge air. Recommended for applications requiring unequal airflow or side discharge grille(s) with additional top discharge air opening.
2. Dimensions are in inches.
3. All dimensions are $\pm 1/4$ inch.
4. Discharge grilles are shipped loose for field installation.
5. Construction is roll formed aluminum frame and blades.
6. Standard finish is powder coated and will be the same color as the return grille.
7. Installation of grille on adjacent unit sides may require a duct extension to prevent air bypass around discharge grilles.
8. Mounting hardware included.

RETURN PANEL AND FRAME DIMENSIONS — 50VSA-VSH UNITS

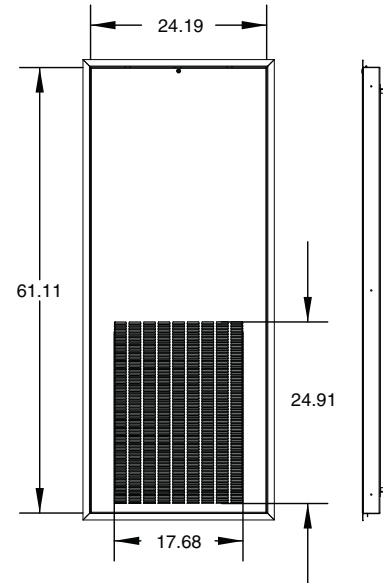
STANDARD PERIMETER BYPASS ALLEN LOCK, REMOVABLE



OPTIONAL PERIMETER BYPASS ALLEN LOCK OR KEY LOCK, HINGED

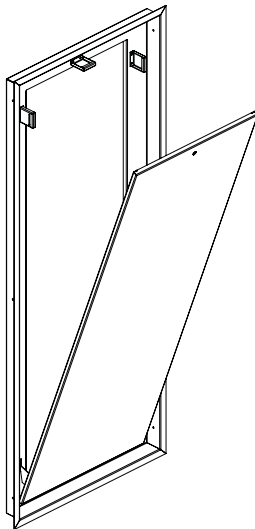


OPTIONAL LOUVERED ALLEN LOCK, REMOVABLE

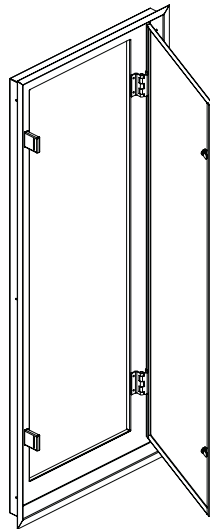


* ROUGH-IN OPENING PLUS 1/4-in.

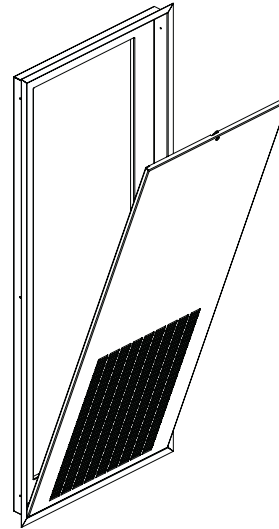
STANDARD PERIMETER BYPASS ALLEN LOCK, REMOVABLE



OPTIONAL PERIMETER BYPASS ALLEN LOCK OR KEY LOCK, HINGED

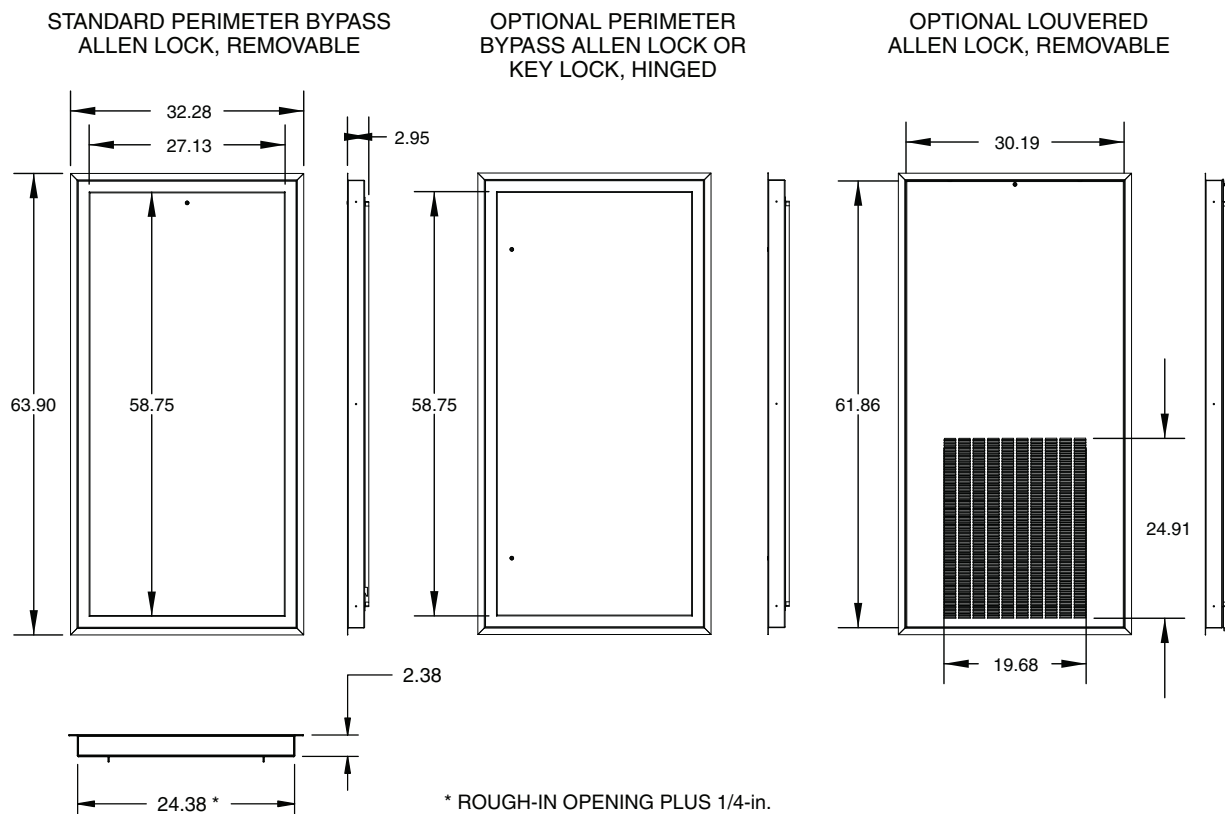


OPTIONAL LOUVERED ALLEN LOCK, REMOVABLE



NOTE: All dimensions are in inches.

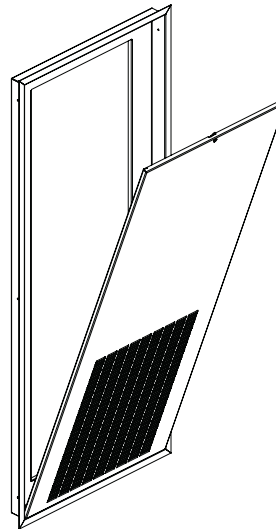
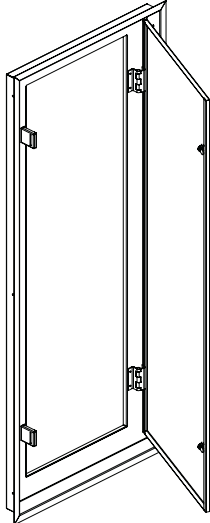
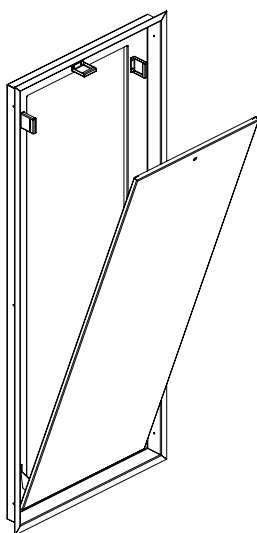
RETURN PANEL AND FRAME DIMENSIONS — 50VSI-VSN UNITS



STANDARD PERIMETER BYPASS ALLEN LOCK, REMOVABLE

OPTIONAL PERIMETER BYPASS ALLEN LOCK OR KEY LOCK, HINGED

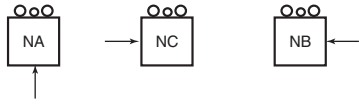
OPTIONAL LOUVERED ALLEN LOCK, REMOVABLE



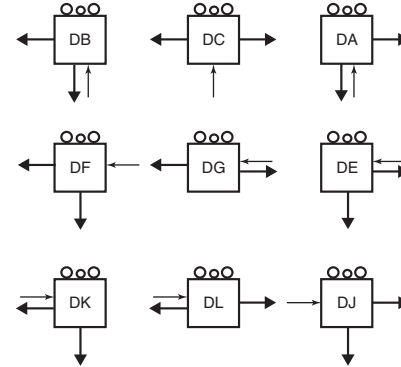
NOTE: All dimensions are in inches.

50VS UNIT AIRFLOW ARRANGEMENTS

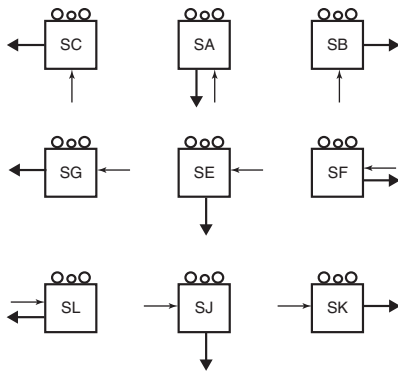
NO SUPPLY OPENINGS



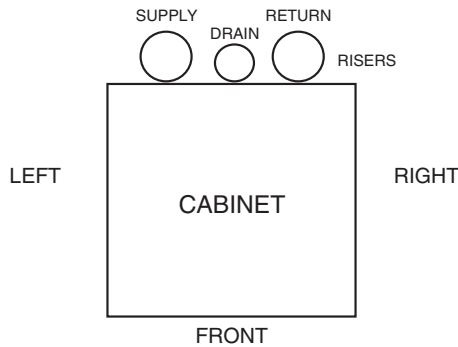
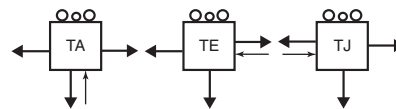
DOUBLE SUPPLY



SINGLE SUPPLY

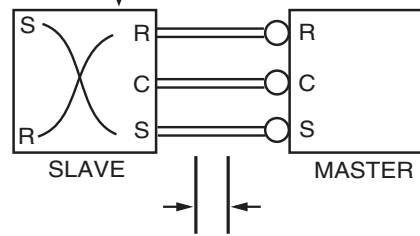


TRIPLE SUPPLY



↑ SUPPLY AIR TO ROOM
↑ RETURN AIR FROM ROOM

Field-supplied and installed piping
Cross hoses in slave cabinet
(36 in. hoses required in slave unit)



Dimension to suit local codes and installer

LEGEND

- C — Condensate Drain
- R — Return
- S — Supply

SUPPLY GRILLE SIZES AND ARRANGEMENTS

UNIT	NOMINAL CAPACITY (TONS)	SINGLE DISCHARGE (in.)	DOUBLE DISCHARGE (in.)	TRIPLE DISCHARGE (in.)
50VSA,B (Small Cabinet)	3/4	14x12	10x8	10x8
50VSC,D (Small Cabinet)	1	14x12	10x8	10x8
50VSE,F (Small Cabinet)	1 1/4	14x12	10x8	10x8
50VSG,H (Small Cabinet)	1 1/2	14x12	10x8	10x8
50VSI,J (Large Cabinet)	2	16x14	12x10	12x10
50VSK,L (Large Cabinet)	2 1/2	16x14	12x10	12x10
50VSM,N (Large Cabinet)	3	16x14	12x10	12x10

NOTES:

1. Refer to the table and the airflow arrangements above to determine grille size and location based on the type and size of the unit cabinet/chassis combination.
2. The riser compartment is defined as being the rear of each unit. Supply air grilles and return air/access panel can be any side except rear.
3. Return air location also denotes the control location and servicing access.
4. Single discharge openings are not recommended for 50VSI-VSN units. Triple discharge openings are not recommended for 50VSA-VSD units.

Selection procedure (50VSI unit example)



I Determine the actual cooling and heating loads at the desired dry bulb and wet bulb conditions.

Assume cooling load at desired dry bulb 80 F and wet bulb 67 F conditions as follows:

Given:

- Total Cooling (TC).....24,500 Btu/hr
- Sensible Cooling (SC)17,900 Btu/hr
- Entering-Air Temperature (db)80.6 F
- Entering-Air Temperature (wb).....66.2 F
- Airflow.....748 cfm

II Determine the following design parameters from the performance data tables: entering water temperature, water flow rate (gpm), airflow (cfm), water flow pressure drop, and design wet and dry bulb temperatures.

Airflow cfm should be between 300 and 450 cfm per ton. Unit water pressure drop should be kept as close as possible to similar vertical stack heat pumps to make water side balancing easier. Find the proper indicated water flow and water temperature from the 50VSI,J Unit Performance Data table on page 24.

Example:

- Entering water temperature.....70 F
- Water flow.....6.0 gpm
- Airflow (Rated).....820 cfm
- Voltage.....208-v

III Select a unit based on total cooling and total sensible cooling conditions. Unit selected should be closest to but not larger than the actual cooling load.

Find the design water flow and water temperature in the performance data tables. Read the total sensible cooling capacities.

NOTE: Interpolation is permissible, extrapolation is not.

Example:

Enter the 50VSI,J Unit Performance Data table at the design water flow and water flow temperature. Read the total cooling, sensible cooling, and heat of rejection capacities:

- Total cooling.....24,634 Btu/hr
- Sensible cooling20,152 Btu/hr
- Heat of rejection29,616 Btu/hr

Read the capacity.

NOTE: If the heat capacity exceeds the design criteria, it is acceptable. It is normal for water source heat pumps to be selected on cooling capacity only since the heating output is usually greater than the cooling capacity.

IV Determine the correction factors associated with the variable factors of dry bulb and wet bulb using the correction factor tables found in this catalog.

Use the following formulas to determine the dry bulb and wet bulb correction factors:

$$\text{Corrected Total Cooling} = \frac{\text{Tabulated Total Cooling}}{\text{Wet Bulb Correction}} \times \text{Airflow Correction}$$

$$\text{Corrected Sensible Cooling} = \frac{\text{Tabulated Sensible Cooling}}{\text{Wet/Dry Bulb Correction}} \times \text{Airflow Correction}$$

V Determine the entering air and airflow correction using the correction factors tables found on pages 28 and 29.

The nominal airflow for a 50VS with a capacity rating of 24,000 Btu/h is 820 cfm.

The design parameter is 748 cfm

$$748/820 = 90.0\% \text{ of nominal airflow:}$$

Use the 90.0% row in the 50VS Unit Airflow Correction Factors table.

The entering air temperature is 66.2 F wb. Use the 66.2 F row in the 50VS Unit Heating/Cooling Correction Factors table.

Use the following formulas to determine the entering air and airflow correction factors:

	Table	Ent. Air	Airflow	Corrected
Corrected Total Cooling	= 24,634 x	1.0	x 0.974	= 23,994
Corrected Sensible Cooling	= 20,152 x	1.0	x 0.938	= 18,903
Corrected Heat of Rejection	= 29,616 x	1.0	x 0.990	= 29,320

Compare the corrected capacities to the load requirements established in step one. If the capacities are within 10% of the load requirements, the equipment is acceptable. It is better to undersize rather than oversize because undersizing improves humidity control, reduces sound levels, and extends the service life of the equipment.

VI Calculate the water temperature rise and assess the selection using the following calculation:

$$\text{Actual Temperature Rise} = \frac{\text{Correction of Heat Rejection}}{\text{GPM} \times 500}$$

Example:

Using the corrected heat of rejection data from the previous step:

$$\text{Actual Temperature Rise} = \frac{29,320}{6.0 \times 500} = 9.7 \text{ F}$$

If the units selected are not within 10% of the load calculations, review what effect changing the gpm, water temperature, and/or airflow will have on the corrected capacities. If the desired capacity cannot be achieved, select the next larger or smaller unit and repeat the selection procedure from the beginning.

Selection procedure (cont)



Riser design

The dimensions of the unit risers must be considered when determining unit specifications.

Riser specifications

Tail piece (TP) — The tail piece is the section of the riser that extends below the cabinet bottom. The Riser Definitions figure shows a riser tail piece sized for 2 in. insertion into a 3 in. expanded section at top of cabinet. (While the 2-in. insertion is typical, actual application may require 1-in. to 3-in. insertion.) The tail piece should extend at least 5 in. beyond the bottom of the slab to allow clearance for brazing.

Expanded section — The riser is expanded at the top of the cabinet to accept a pipe diameter from the unit above. The top of the riser expanded section is always 3 in. above the top of the cabinet.

Floor-to-floor height (FFH) — The floor-to-floor height is the dimension from the top of the unit slab to the top of the slab above.

Slab thickness (ST) — This dimension includes the basic slab thickness plus any material added to the slab before cabinet placement.

Clear height (CH) — The clear height extends from the top of the unit slab to the bottom of the slab above.

This dimension is used to determine whether the cabinet-riser assembly will pivot through the slab core without hitting the bottom of the slab above the unit. If the selected cabinet-riser will not pivot into position, a special riser extension or shorter cabinet will have to be considered.

$$\text{Clear Height} = \text{Floor-to-Floor Height (FFH)} - \text{Slab Thickness (ST) (Above Unit)}$$

Room riser height (RRH)

$$\text{Cabinet Height} + 3 \text{ in.} - \text{Standard Cabinet Height (88 in.)} + 3 \text{ in.} = 91 \text{ in.}$$

Shorter than standard cabinet heights will have shorter room riser heights.

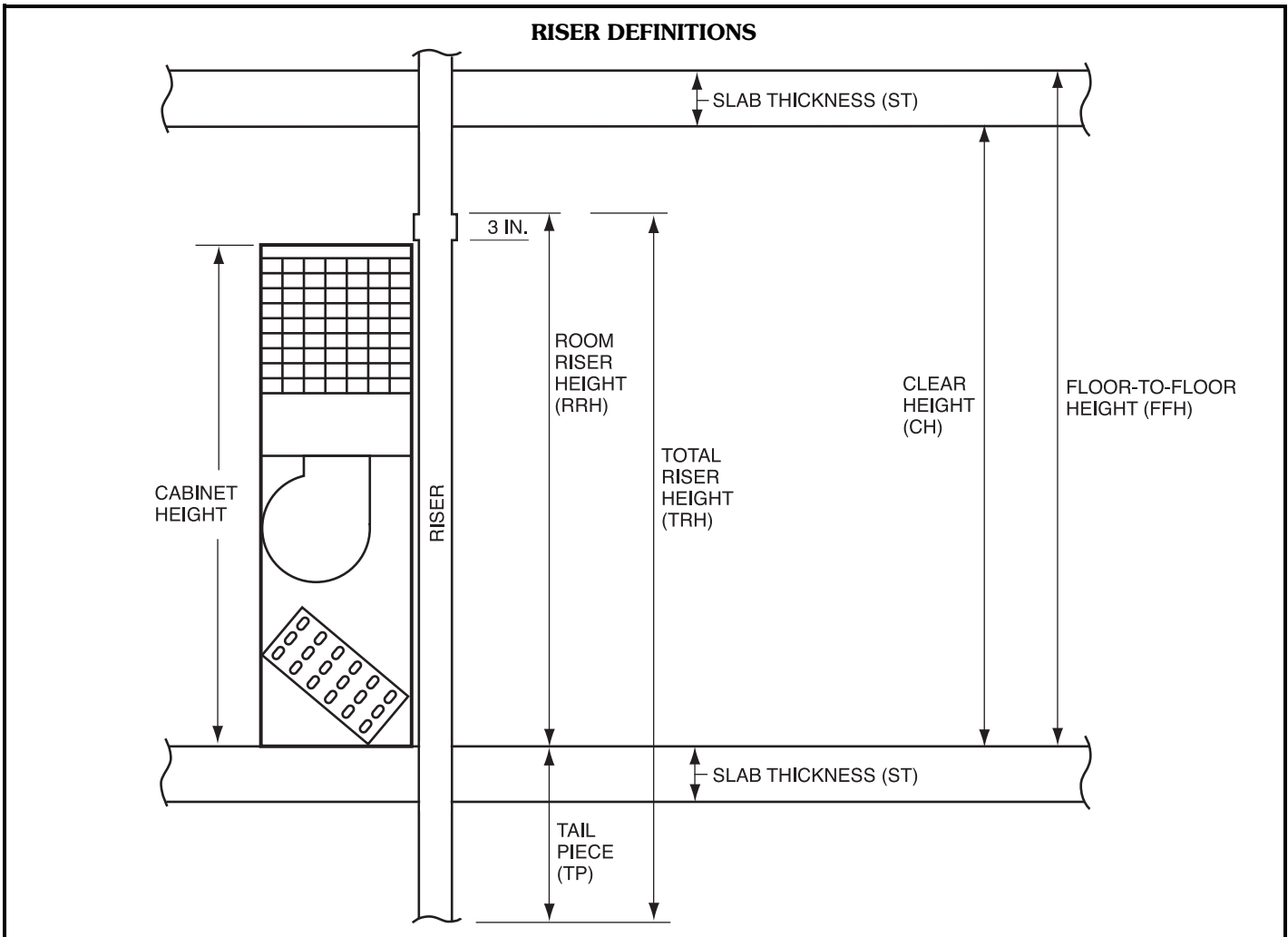
Maximum riser height — Maximum length is 115 in.

Total riser height (TRH)

$$\text{Room Riser Height (RRH)} + \text{Riser Tail Piece (TP) Length} = \text{Total Riser Height (115 in. Maximum)}$$

or

$$\text{Floor-to-Floor Height (FFH)} + 2 \text{ in.} = \text{Total Riser Height}$$



Riser tail piece length

Use the following formulas to determine the riser tail piece length of a unit.

Unit without riser extensions:

$$\text{Riser Tail Piece} = \text{FFH} - \text{RRH} + 2 \text{ in.}$$

FFH: Floor-to-floor height is the dimension from the top of the slab above to the top of the slab below.

RRH: Room riser height is cabinet height + 3 inches.

NOTE: Standard cabinet height is 88 in.

$$\text{RRH} = 88 \text{ in.} + 3 \text{ in.} = 91 \text{ in.}$$

Unit requiring riser extensions to a unit below:

$$\text{Minimum Riser Tail Piece Length} = \text{Slab Thickness} + 5 \text{ in.}$$

To determine riser extensions lengths see the Riser Extension Length section.

NOTE: If the riser length exceeds 115 in., riser extensions must be used. See Riser Extension Length section. The riser tail piece must extend through the slab a minimum of 5 in. to facilitate brazing. Special care must be taken in sizing riser lengths and tail piece lengths when:

- Riser extensions are used.
- Floor-to-floor heights vary.
- Slab thickness varies from floor to floor.

See Riser Arrangements section on page 19 for selection of top floor riser applications.

Riser extension length

Use the following formulas to determine the needed length for unit riser extensions.

NOTE: Riser extensions are ordered for unit on floor above. For example, riser extensions would be for the third floor unit in the Riser Extension Length figure.

The riser tail piece is the length of the riser extending down from the cabinet. The riser tail piece must extend a minimum of 5 in. below the slab.

To find the riser extension length, start with the floor-to-floor dimension (FFH). Subtract the room riser height (RRH) and tail piece length. Then add 4 in. to the 2 joint overlaps.

$$\text{Riser Extension Length} = \text{FFH} - (\text{Tail Piece} + \text{RRH}) + 4 \text{ in.}$$

For example:

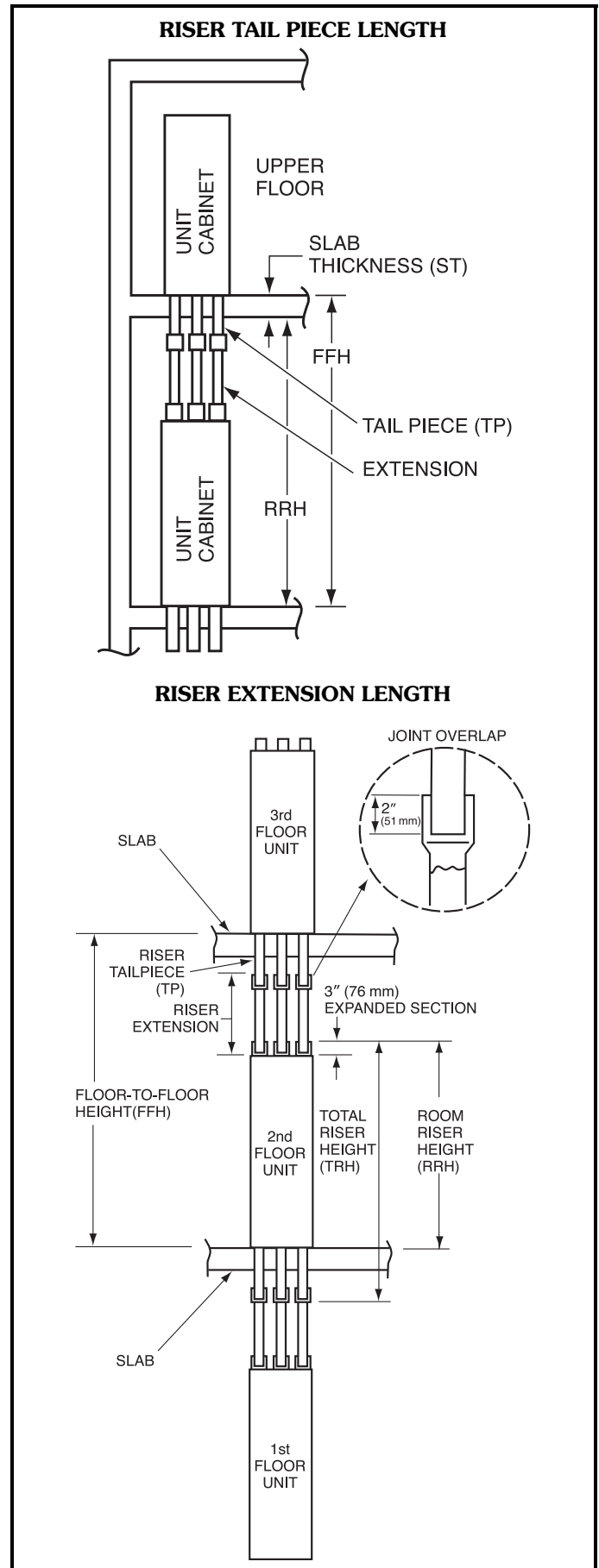
$$\text{FFH} = 120 \text{ in.}$$

$$\text{RRH} = 91 \text{ in.}$$

$$\text{Tail Piece} = 13 \text{ in.}$$

$$\text{Riser Extension Length} = 120 - (13 + 91) + 4 \text{ in.}$$

$$\text{Riser Extension Length} = 20 \text{ in.}$$



Selection procedure (cont)



Riser gpm sizing

Riser gpm requirements and individual unit gpm requirements are necessary to select the proper riser piping diameters. After determining the riser and unit gpm requirements, refer to the Riser Diameter Sizing section to determine riser piping diameters.

The following example is for a bottom supply/bottom return system feed loop. gpm's are dependent upon unit load and system loop water temperatures. Refer to the Performance Data section for individual unit gpm requirements.

Unit gpm (UGPM): Required gallon per minute from the Performance Data section.

Total riser gpm (TRGPM): The sum of all unit gpm's on each riser.

Using the Riser gpm Sizing figure example:

$$\text{TRGPM} = 3.0 + 4.0 + 3.0 + 2.0 + 2.0 = 14 \text{ gpm.}$$

Total gpm per floor (TGF): Total gpm minus the sum of unit gpm from all floors below.

$$\text{TGF} = \text{TRGPM} - (\text{sum UGPM from units below})$$

Using the Riser gpm Sizing figure example:

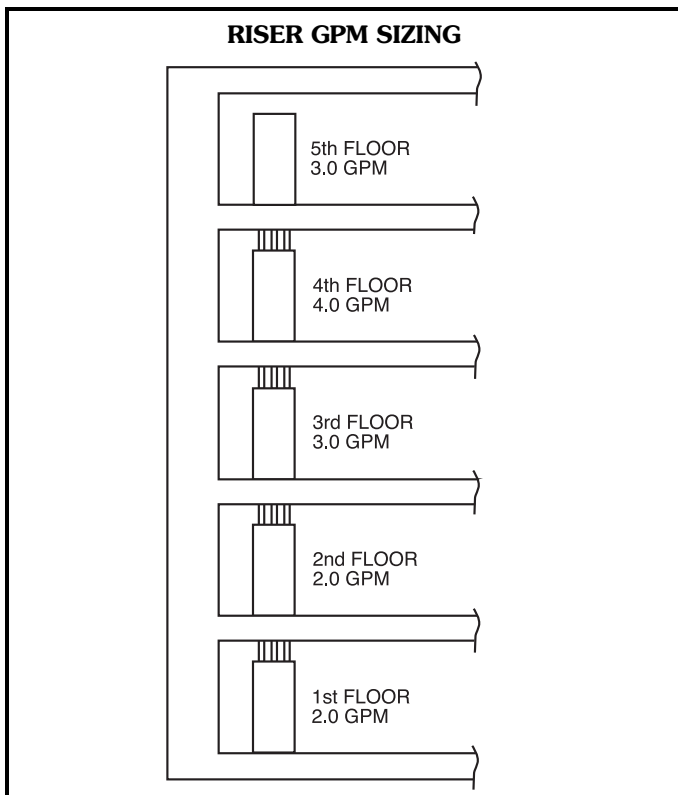
$$\text{5th Floor: TGF} = 14 - (2.0 + 2.0 + 3.0 + 4.0) = 3 \text{ gpm needed at fifth floor.}$$

$$\text{4th Floor: TGF} = 14 - (2.0 + 2.0 + 3.0) = 7 \text{ gpm needed at fourth floor.}$$

$$\text{3rd Floor: TGF} = 14 - (2.0 + 2.0) = 10 \text{ gpm needed at third floor.}$$

$$\text{2nd Floor: TGF} = 14 - (2.0) = 12 \text{ gpm needed at second floor.}$$

$$\text{1st Floor: TGF} = 14 - (\text{no floors below}) = 14 \text{ gpm needed at first floor.}$$



Riser diameter sizing

Each vertical stack unit has 3 riser pipes. The following example will be for one riser pipe (from the top floor to the bottom floor), and will be representative of the remaining 2 riser pipes.

From the Riser Diameter table determine the proper riser diameter needed to satisfy the required gpm's at each unit. Refer to the Riser Diameter per Floor table for a summary.

The following nomenclature is used to designate the diameters at the top and bottom of each unit.

Top cap: Top half of riser is eliminated and sealed.

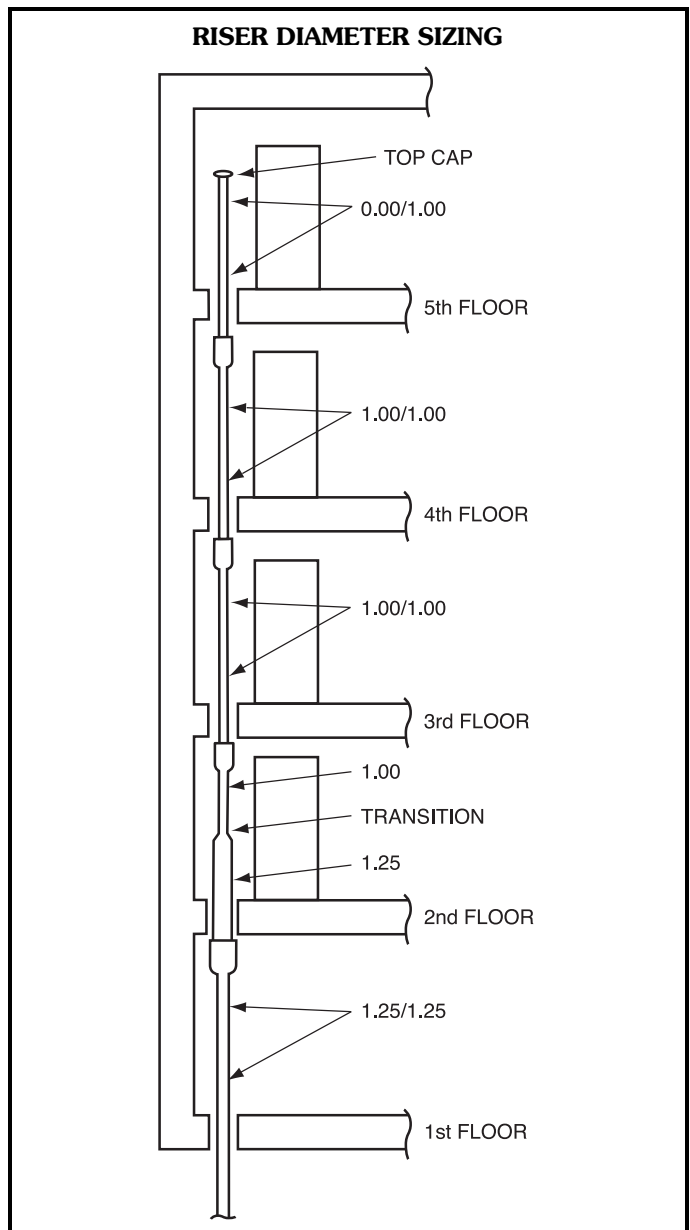
Bottom cap: Bottom half of riser is eliminated and sealed.

0.00/1.00: Indicates top cap/1 in. bottom.

1.00/1.25: Indicates 1 in. top/1.25 in. bottom.

1.25/0.00: Indicates 1.25 in. top/bottom cap.

NOTE: Transitions limited to 1 nominal diameter size larger or smaller within each floor.



RISER DIAMETER

MAXIMUM GPM	10.5	12	20	34	70	125	300
Nominal Riser Diameter (in.)	3/4	1	1 1/4	1 1/2	2	2 1/2	3

RISER DIAMETER PER FLOOR

FLOOR	GPM	RISER DIAMETER (in.)
5	3	1
4	7	1
3	10	1
2	12	1
1	14	1 1/4

Riser arrangements

RISER ARRANGEMENTS TABLE

TOP FLOOR UNITS	ARRANGEMENT	BOTTOM FLOOR UNITS	ARRANGEMENT
Supply and return open, drain capped at cabinet run-out <ul style="list-style-type: none"> • Bottom supply and return piping with open top for venting or flushing crossover • Top supply and return piping 		All risers capped at cabinet run-out, drain through slab <ul style="list-style-type: none"> • Isolated unit top supply and return from adjacent riser with separate drain • Check riser venting 	
Supply or return open at top, others capped at cabinet run-out <ul style="list-style-type: none"> • Bottom supply and top return piping • Top supply and bottom return piping 		Supply or return capped at cabinet run-out, other risers extend through slab <ul style="list-style-type: none"> • Bottom supply, top return piping • Bottom return, top supply piping 	
Capped supply and return, drain open at top <ul style="list-style-type: none"> • Bottom supply and return piping with open drain riser for venting to roof or picking up drain from other equipment above 		Supply and return capped at cabinet run-out, drain through slab <p>NOTE: Standard for top supply and return unless otherwise specified.</p> <ul style="list-style-type: none"> • Top supply and return • Supply and return mains above these units on "between-floors" main piping 	
All risers capped at cabinet run-outs <p>NOTE: Standard for bottom supply and return unless otherwise specified.</p> <ul style="list-style-type: none"> • System piping is bottom supply and return 		All risers through slab at bottom <p>NOTE: Standard for bottom supply and return unless otherwise specified.</p> <ul style="list-style-type: none"> • Bottom supply and return • Top supply and return feeding other equipment below 	
All risers open at top <p>NOTE: Standard for top supply and return unless otherwise specified.</p> <ul style="list-style-type: none"> • Bottom supply and return piping for supplying water to other units • Bottom supply and return piping for drain vent to roof, flushing crossover • Top supply and return piping 			

NOTES:

1. Check system flushing and air venting specifications.
2. Riser arrangements are available as standard with top or bottom capped risers.

3. Riser transitions include the bottom riser with a pipe diameter one size larger or smaller than the selected riser size in order to facilitate installation with the next unit.

Performance data



50VSA,B UNIT PERFORMANCE DATA — 3/4 TON

EWT (F)	GPM	WPD		CFM	COOLING EAT 80/67 F					HEATING EAT 70 F				
		PSI	FT		TC	SC	kW	HR	EER	HC	kW	HE	LAT	COP
20	2.25	4.10	9.47	L	Operation Not Recommended					6,808	631	4,655	85.2	3.2
				H						6,847	632	4,691	83.4	3.2
30	1.10	1.21	2.80	L	11,628	8,520	441	13,133	26.4	7,308	646	5,104	86.6	3.3
				H	11,755	8,772	446	13,277	26.4	7,335	645	5,134	84.6	3.3
	1.70	2.37	5.47	L	11,647	8,563	389	12,974	29.9	7,716	658	5,471	87.6	3.4
				H	11,859	8,823	399	13,114	29.7	7,788	656	5,550	85.6	3.5
	2.25	4.05	9.36	L	11,747	8,603	368	13,003	31.9	7,924	665	5,655	88.2	3.5
				H	11,964	8,866	376	13,047	31.8	7,963	662	5,704	86.0	3.5
40	1.10	1.15	2.66	L	11,408	8,278	467	13,001	24.4	8,485	676	6,178	89.7	3.7
				H	11,553	8,737	476	13,177	24.3	8,522	671	6,233	87.3	3.7
	1.70	2.32	5.36	L	11,494	8,338	420	12,927	27.4	8,956	687	6,612	90.9	3.8
				H	11,644	8,813	476	13,268	24.5	9,024	682	6,697	88.4	3.9
	2.25	4.00	9.24	L	11,574	8,382	396	12,925	29.2	9,238	698	6,856	91.7	3.9
				H	11,806	8,889	404	13,184	29.2	9,289	691	6,931	89.1	3.9
50	1.10	1.08	2.49	L	11,045	8,059	509	12,782	21.7	9,795	709	7,376	93.1	4.0
				H	11,328	8,630	519	13,099	21.8	9,848	699	7,463	90.3	4.1
	1.70	2.28	5.27	L	11,188	8,132	464	12,771	24.1	10,331	720	7,874	94.5	4.2
				H	11,465	8,732	519	13,236	22.1	10,403	710	7,980	91.6	4.3
	2.25	3.97	9.17	L	11,298	8,200	439	12,796	25.7	10,661	729	8,174	95.4	4.3
				H	11,648	8,834	446	13,170	26.1	10,730	718	8,280	92.4	4.4
60	1.10	1.03	2.38	L	10,655	7,850	563	12,576	18.9	11,147	741	8,619	96.7	4.4
				H	10,968	8,460	574	12,926	19.1	11,224	727	8,743	93.5	4.5
	1.70	2.23	5.15	L	10,827	7,933	519	12,598	20.9	11,746	752	9,180	98.2	4.6
				H	11,133	8,567	574	13,091	19.4	11,831	737	9,316	94.9	4.7
	2.25	3.93	9.08	L	10,939	8,005	494	12,625	22.1	12,102	759	9,512	99.2	4.7
				H	11,307	8,674	501	13,016	22.6	12,196	744	9,657	95.8	4.8
70	1.10	0.96	2.22	L	10,222	7,641	628	12,365	16.3	12,451	771	9,820	100.2	4.7
				H	10,492	8,236	639	12,672	16.4	12,559	753	9,990	96.6	4.9
	1.70	2.18	5.04	L	10,405	7,730	585	12,401	17.8	13,102	782	10,434	101.8	4.9
				H	10,669	8,334	639	12,849	16.7	13,212	763	10,609	98.2	5.1
	2.25	3.89	8.99	L	10,500	7,792	560	12,411	18.8	13,469	787	10,784	102.8	5.0
				H	10,816	8,432	567	12,751	19.1	13,594	767	10,977	99.1	5.2
80	1.10	0.90	2.08	L	9,733	7,419	702	12,128	13.9	13,615	796	10,899	103.3	5.0
				H	9,918	7,967	713	12,351	13.9	13,765	773	11,128	99.5	5.2
	1.70	2.13	4.92	L	9,915	7,513	659	12,164	15.0	14,303	808	11,546	105.0	5.2
				H	10,098	8,049	713	12,531	14.2	14,453	783	11,781	101.1	5.4
	2.25	3.86	8.92	L	9,984	7,557	635	12,151	15.7	14,674	813	11,900	106.0	5.3
				H	10,210	8,132	642	12,401	15.9	14,831	787	12,146	102.1	5.5
90	1.10	0.83	1.92	L	9,174	7,173	783	11,846	11.7	14,549	813	11,775	105.8	5.2
				H	9,263	7,663	793	11,969	11.7	14,751	787	12,066	101.9	5.5
	1.70	2.07	4.78	L	9,348	7,269	740	11,873	12.6	15,250	827	12,428	107.6	5.4
				H	9,440	7,729	793	12,146	11.9	15,460	797	12,741	103.6	5.7
	2.25	3.81	8.80	L	9,394	7,295	716	11,837	13.1	15,626	836	12,774	108.7	5.5
				H	9,521	7,796	724	11,991	13.2	15,815	804	13,072	104.6	5.8
100	1.10	0.77	1.78	L	8,531	6,891	869	11,496	9.8	Operation Not Recommended				
				H	8,544	7,333	879	11,543	9.7					
	1.70	2.03	4.69	L	8,698	6,986	826	11,516	10.5					
				H	8,719	7,390	879	11,718	9.9					
	2.25	3.79	8.75	L	8,733	7,001	803	11,473	10.9					
				H	8,784	7,448	811	11,551	10.8					
110	1.10	0.71	1.64	L	7,791	6,561	957	11,056	8.1					
				H	7,781	6,986	968	11,084	8.0					
	1.70	1.99	4.60	L	7,957	6,655	916	11,082	8.7					
				H	7,958	7,048	968	11,261	8.2					
	2.25	3.74	8.64	L	8,003	6,670	893	11,050	9.0					
				H	8,032	7,111	902	11,110	8.9					
120	1.10	0.64	1.48	L	6,938	6,171	1,046	10,507	6.6					
				H	6,989	6,631	1,060	10,606	6.6					
	1.70	1.93	4.46	L	7,119	6,262	1,007	10,555	7.1					
				H	7,178	6,719	1,060	10,795	6.8					
	2.25	3.70	8.55	L	7,208	6,299	985	10,569	7.3					
				H	7,298	6,808	994	10,690	7.3					

LEGEND

COP — Coefficient of Performance	H — High (360 cfm)	LAT — Leaving Air Temperature (F)
EAT — Entering Air Temperature	HC — Heating Capacity	SC — Sensible Capacity
EER — Energy Efficiency Ratio	HE — Heat of Extraction (Btuh)	TC — Total Capacity
EWT — Entering Water Temperature	HR — Heat of Rejection (Btuh)	WPD — Water Pressure Drop
GPM — Gallons Per Minute	L — Low (260 cfm)	



50VSC,D UNIT PERFORMANCE DATA — 1 TON

EWT (F)	GPM	WPD		CFM	COOLING EAT 80/67 F					HEATING EAT 70 F				
		PSI	FT		TC	SC	kW	HR	EER	HC	kW	HE	LAT	COP
20	3.00	5.65	13.05	L	Operation Not Recommended					8,380	769	5,756	87.5	3.2
				H						8,437	778	5,782	85.8	3.2
30	1.50	1.44	3.33	L	14,577	10,251	567	16,512	25.7	9,036	794	6,327	89.1	3.3
				H	14,866	10,609	583	16,855	25.5	9,053	796	6,337	87.2	3.3
	2.25	3.23	7.46	L	14,964	10,405	485	16,619	30.9	9,519	807	6,766	90.4	3.5
				H	15,242	10,789	505	16,965	30.2	9,614	812	6,843	88.5	3.5
	3.00	5.54	12.80	L	15,207	10,522	446	16,729	34.1	9,814	818	7,023	91.1	3.5
				H	15,358	10,821	462	16,934	33.2	9,888	820	7,090	89.2	3.5
40	1.50	1.41	3.26	L	14,470	10,196	609	16,548	23.8	10,403	837	7,547	92.3	3.6
				H	14,711	10,512	625	16,844	23.5	10,453	835	7,604	90.1	3.7
	2.25	3.16	7.30	L	14,781	10,339	540	16,623	27.4	10,935	853	8,025	93.7	3.8
				H	15,021	10,609	625	17,154	24.0	11,055	852	8,148	91.5	3.8
	3.00	5.42	12.52	L	14,925	10,412	509	16,662	29.3	11,343	867	8,385	94.8	3.8
				H	15,112	10,795	524	16,900	28.8	11,469	864	8,521	92.6	3.9
50	1.50	1.38	3.19	L	14,182	10,051	667	16,458	21.3	11,920	885	8,900	95.9	3.9
				H	14,382	10,494	683	16,712	21.1	12,008	879	9,009	93.4	4.0
	2.25	3.09	7.14	L	14,447	10,185	607	16,518	23.8	12,502	903	9,421	97.4	4.1
				H	14,648	10,556	683	16,978	21.5	12,653	897	9,592	94.9	4.1
	3.00	5.31	12.27	L	14,533	10,231	580	16,512	25.1	12,910	918	9,778	98.4	4.1
				H	14,738	10,669	595	16,768	24.8	13,105	909	10,003	96.1	4.2
60	1.50	1.35	3.12	L	13,734	9,826	738	16,252	18.6	13,479	934	10,292	99.6	4.2
				H	13,901	10,282	756	16,480	18.4	13,610	925	10,454	96.9	4.3
	2.25	3.03	7.00	L	13,975	9,953	684	16,309	20.4	14,106	955	10,848	101.2	4.3
				H	14,139	10,368	756	16,718	18.7	14,296	943	11,078	98.4	4.4
	3.00	5.19	11.99	L	14,038	9,989	658	16,283	21.3	14,455	967	11,156	102.0	4.4
				H	14,243	10,454	674	16,543	21.1	14,718	953	11,466	99.4	4.5
70	1.50	1.32	3.05	L	13,147	9,534	822	15,952	16.0	14,973	982	11,622	103.2	4.5
				H	13,286	9,989	841	16,155	15.8	15,150	968	11,847	100.3	4.6
	2.25	2.96	6.84	L	13,381	9,657	770	16,008	17.4	15,636	1,005	12,207	104.9	4.6
				H	13,511	10,077	841	16,380	16.1	15,870	988	12,499	101.9	4.7
	3.00	5.08	11.73	L	13,443	9,691	744	15,982	18.1	15,920	1,014	12,460	105.5	4.6
				H	13,637	10,163	761	16,234	17.9	16,234	995	12,839	102.7	4.8
80	1.50	1.29	2.98	L	12,442	9,187	917	15,571	13.6	16,295	1,026	12,794	106.6	4.7
				H	12,558	9,632	937	15,755	13.4	16,519	1,007	13,083	103.5	4.8
	2.25	2.89	6.68	L	12,678	9,306	865	15,629	14.7	16,976	1,049	13,397	108.3	4.7
				H	12,778	9,720	937	15,975	13.6	17,262	1,027	13,758	105.2	4.9
	3.00	4.96	11.46	L	12,754	9,345	838	15,613	15.2	17,247	1,058	13,637	108.9	4.8
				H	12,926	9,809	856	15,847	15.1	17,576	1,034	14,048	105.8	5.0
90	1.50	1.26	2.91	L	11,640	8,798	1,021	15,124	11.4	17,336	1,061	13,716	109.4	4.8
				H	11,738	9,228	1,042	15,293	11.3	17,607	1,038	14,065	106.2	5.0
	2.25	2.81	6.49	L	11,882	8,914	967	15,181	12.3	18,014	1,085	14,312	111.1	4.9
				H	11,959	9,312	1,042	15,514	11.5	18,358	1,060	14,741	108.0	5.1
	3.00	4.84	11.18	L	11,974	8,959	940	15,181	12.7	18,378	1,096	14,638	112.0	4.9
				H	12,119	9,403	959	15,391	12.6	18,669	1,068	15,025	108.7	5.1
100	1.50	1.23	2.84	L	10,763	8,377	1,132	14,625	9.5					
				H	10,845	8,795	1,155	14,786	9.4					
	2.25	2.76	6.38	L	11,005	8,490	1,077	14,680	10.2					
				H	11,068	8,877	1,155	15,009	9.6					
	3.00	4.74	10.95	L	11,110	8,539	1,048	14,686	10.6					
				H	11,223	8,958	1,069	14,870	10.5					
110	1.50	1.20	2.77	L	9,832	7,937	1,250	14,097	7.9					
				H	9,899	8,348	1,273	14,242	7.8					
	2.25	2.68	6.19	L	10,063	8,046	1,192	14,130	8.4					
				H	10,121	8,417	1,273	14,464	8.0					
	3.00	4.62	10.67	L	10,166	8,093	1,163	14,134	8.7					
				H	10,246	8,487	1,186	14,293	8.6					
120	1.50	1.17	2.70	L	8,867	7,491	1,372	13,548	6.5					
				H	8,922	7,905	1,395	13,682	6.4					
	2.25	2.61	6.03	L	9,070	7,595	1,313	13,550	6.9					
				H	9,135	7,955	1,395	13,895	6.6					
	3.00	4.51	10.42	L	9,146	7,628	1,285	13,530	7.1					
				H	9,197	8,002	1,311	13,670	7.0					

LEGEND

- | | | |
|---|--|--|
| COP — Coefficient of Performance | H — High (420 cfm) | LAT — Leaving Air Temperature (F) |
| EAT — Entering Air Temperature | HC — Heating Capacity | SC — Sensible Capacity |
| EER — Energy Efficiency Ratio | HE — Heat of Extraction (Btu/h) | TC — Total Capacity |
| EWT — Entering Water Temperature | HR — Heat of Rejection (Btu/h) | WPD — Water Pressure Drop |
| GPM — Gallons Per Minute | L — Low (300 cfm) | |

Operation Not Recommended

Performance data (cont)



50VSE,F UNIT PERFORMANCE DATA — 1 1/4 TONS

EWT (F)	GPM	WPD		CFM	COOLING EAT 80/67 F					HEATING EAT 70 F				
		PSI	FT		TC	SC	kW	HR	EER	HC	kW	HE	LAT	COP
20	4.2	5.65	13.05	L	Operation Not Recommended					11,757	1,122	7,929	89.9	3.1
				H						11,861	1,124	8,026	86.8	3.1
30	2.1	1.21	2.08	L	19,827	13,906	893	22,874	22.2	12,707	1,157	8,759	91.7	3.2
				H	20,378	15,126	924	23,531	22.1	12,829	1,155	8,888	88.4	3.3
	3.1	2.58	5.96	L	20,968	14,486	824	23,779	25.5	13,312	1,176	9,299	92.8	3.3
				H	22,178	15,943	854	25,092	26.0	13,475	1,171	9,480	89.4	3.4
	4.2	4.42	10.21	L	21,660	14,787	786	24,342	27.6	13,648	1,187	9,598	93.5	3.4
				H	23,900	16,597	803	24,807	29.8	13,813	1,181	9,783	90.0	3.4
40	2.1	1.18	2.73	L	19,349	13,595	918	22,481	21.1	14,730	1,219	10,571	95.7	3.5
				H	19,847	14,736	944	23,068	21.0	14,873	1,205	10,762	91.9	3.6
	3.1	2.51	5.80	L	20,103	13,976	851	23,007	23.6	15,386	1,240	11,155	97.0	3.6
				H	20,917	15,060	944	24,138	22.2	15,585	1,222	11,416	93.0	3.7
	4.2	4.31	9.96	L	20,664	14,236	816	23,448	25.3	15,834	1,256	11,549	97.8	3.7
				H	21,174	15,385	838	24,033	25.3	16,040	1,238	11,816	93.8	3.8
50	2.1	1.14	2.63	L	18,774	13,250	974	22,097	19.3	16,944	1,287	12,553	100.2	3.9
				H	19,224	14,337	999	22,633	19.2	17,125	1,259	12,829	95.7	4.0
	3.1	2.45	5.66	L	19,276	13,503	907	22,371	21.3	17,656	1,310	13,166	101.6	4.0
				H	19,831	14,602	999	23,240	19.9	17,910	1,279	13,546	97.0	4.1
	4.2	4.21	9.73	L	19,717	13,716	874	22,699	22.6	18,157	1,327	13,629	102.5	4.0
				H	20,266	14,868	899	23,333	22.5	18,397	1,295	13,978	97.8	4.2
60	2.1	1.35	3.12	L	18,104	12,872	1,058	21,714	17.1	19,175	1,354	14,555	104.6	4.2
				H	18,509	13,924	1,083	22,204	17.1	19,416	1,314	14,933	99.6	4.3
	3.1	3.03	7.00	L	18,463	13,054	990	21,841	18.7	19,943	1,379	15,238	106.1	4.2
				H	18,867	14,142	1,083	22,562	17.4	20,278	1,334	15,726	101.1	4.5
	4.2	5.19	11.99	L	18,796	13,219	956	22,058	19.7	20,456	1,394	15,700	107.1	4.3
				H	19,336	14,361	982	22,687	19.7	20,740	1,347	16,144	101.9	4.5
70	2.1	1.08	2.49	L	17,342	12,462	1,166	21,320	14.9	21,251	1,417	16,416	108.7	4.4
				H	17,706	13,494	1,194	21,780	14.8	21,579	1,364	16,925	103.3	4.6
	3.1	2.32	5.36	L	17,641	12,616	1,095	21,377	16.1	22,072	1,442	17,152	110.4	4.5
				H	17,974	13,676	1,194	22,048	15.1	22,515	1,385	17,789	104.9	4.8
	4.2	3.98	9.19	L	17,882	12,735	1,060	21,499	16.9	22,573	1,455	17,609	111.4	4.6
				H	18,379	13,859	1,087	22,088	16.9	22,926	1,393	18,173	105.7	4.8
80	2.1	1.04	2.40	L	16,492	12,020	1,295	20,911	12.7	22,999	1,469	17,987	112.2	4.6
				H	16,816	13,042	1,325	21,337	12.7	23,445	1,405	18,651	106.5	4.9
	3.1	2.25	5.20	L	16,786	12,174	1,221	20,952	13.8	23,865	1,494	18,767	114.0	4.7
				H	17,098	13,198	1,325	21,619	12.9	24,447	1,427	19,578	108.3	5.0
	4.2	3.87	8.94	L	16,955	12,255	1,184	20,995	14.3	24,348	1,505	19,213	114.9	4.7
				H	17,387	13,355	1,210	21,516	14.4	24,809	1,430	19,930	108.9	5.1
90	2.1	1.02	2.36	L	15,555	11,549	1,440	20,468	10.8	24,245	1,505	19,110	114.7	4.7
				H	15,842	12,565	1,473	20,868	10.8	24,847	1,432	19,961	108.9	5.1
	3.1	2.19	5.06	L	15,847	11,716	1,363	20,525	11.7	25,143	1,529	19,926	116.5	4.8
				H	16,187	12,704	1,473	21,213	11.0	25,903	1,454	20,942	110.8	5.2
	4.2	3.76	8.69	L	15,993	11,768	1,325	20,514	12.1	25,622	1,540	20,368	117.4	4.9
				H	16,353	12,844	1,351	20,963	12.1	26,246	1,457	21,275	111.4	5.3
100	2.1	0.99	2.29	L	14,536	11,047	1,598	19,988	9.1					
				H	14,786	12,060	1,633	20,358	9.1					
	3.1	2.11	4.87	L	14,881	11,229	1,520	20,067	9.8					
				H	15,190	12,190	1,633	20,762	9.3					
	4.2	3.65	8.43	L	14,975	11,267	1,480	20,025	10.1					
				H	15,271	12,321	1,506	20,409	10.1					
110	2.1	0.94	2.17	L	13,346	10,517	1,765	19,458	7.6					
				H	13,650	11,521	1,801	19,795	7.6					
	3.1	2.06	4.76	L	13,783	10,698	1,687	19,539	8.2					
				H	14,055	11,650	1,801	20,200	7.8					
	4.2	3.53	8.15	L	13,882	10,740	1,648	19,505	8.4					
				H	14,135	11,780	1,674	19,847	8.4					
120	2.1	0.91	2.10	L	12,258	9,959	1,937	18,867	6.3					
				H	12,436	10,945	1,971	19,161	6.3					
	3.1	1.99	4.60	L	12,556	10,110	1,862	18,909	6.7					
				H	12,728	11,080	1,971	19,453	6.5					
	4.2	3.43	7.92	L	12,693	10,179	1,824	18,916	7.0					
				H	12,938	11,215	1,853	19,260	7.0					

LEGEND

- COP — Coefficient of Performance
- EAT — Entering Air Temperature
- EER — Energy Efficiency Ratio
- EWT — Entering Water Temperature
- GPM — Gallons Per Minute
- H — High (540 cfm)
- HC — Heating Capacity
- HE — Heat of Extraction (Btuh)
- HR — Heat of Rejection (Btuh)
- L — Low (390 cfm)
- LAT — Leaving Air Temperature (F)
- SC — Sensible Capacity
- TC — Total Capacity
- WPD — Water Pressure Drop

Operation Not Recommended



50VSG,H UNIT PERFORMANCE DATA — 1 1/2 TONS

EWT (F)	GPM	WPD		CFM	COOLING EAT 80/67 F					HEATING EAT 70 F				
		PSI	FT		TC	SC	kW	HR	EER	HC	kW	HE	LAT	COP
20	4.20	5.65	13.05	L	Operation Not Recommended					12,883	1,194	8,809	88.3	3.2
				H						13,052	1,216	8,903	86.1	3.2
30	2.25	1.21	2.80	L	22,097	15,618	983	25,451	22.5	13,480	1,221	9,314	89.3	3.2
				H	22,133	16,422	1,013	25,489	21.8	13,635	1,243	9,394	86.9	3.2
	3.38	2.58	5.96	L	23,152	16,145	929	26,322	24.9	14,605	1,255	10,323	91.1	3.4
				H	23,386	17,028	969	26,692	24.1	14,761	1,274	10,414	88.5	3.4
	4.50	4.42	10.21	L	23,306	16,246	885	26,326	26.3	14,958	1,252	10,686	91.7	3.5
				H	23,535	17,048	920	26,674	25.6	15,153	1,283	10,775	89.1	3.5
40	2.25	1.18	2.73	L	21,287	15,276	992	24,672	21.5	15,599	1,278	11,238	92.8	3.6
				H	21,378	16,112	1,027	24,882	20.8	15,766	1,291	11,361	90.1	3.6
	3.38	2.51	5.80	L	21,945	15,601	934	25,132	23.5	16,642	1,308	12,179	94.5	3.7
				H	22,185	16,112	1,027	25,689	21.6	16,799	1,318	12,302	91.6	3.7
	4.50	4.31	9.96	L	22,061	15,668	897	25,122	24.6	17,178	1,315	12,691	95.4	3.8
				H	22,296	16,522	933	25,479	23.9	17,379	1,339	12,810	92.4	3.8
50	2.25	1.14	2.63	L	20,459	14,888	1,042	24,014	19.6	17,924	1,341	13,349	96.7	3.9
				H	20,641	15,738	1,081	24,329	19.1	18,114	1,345	13,525	93.6	3.9
	3.38	2.45	5.66	L	20,883	15,097	980	24,227	21.3	18,893	1,367	14,229	98.3	4.1
				H	21,115	15,738	1,081	24,803	19.5	19,068	1,367	14,404	95.0	4.1
	4.50	4.21	9.73	L	20,989	15,152	946	24,217	22.2	19,452	1,379	14,747	99.2	4.1
				H	21,218	16,019	984	24,575	21.6	19,660	1,387	14,928	95.9	4.2
60	2.25	1.35	3.12	L	19,603	14,459	1,129	23,455	17.4	20,278	1,404	15,488	101.0	4.2
				H	19,823	15,307	1,171	23,818	16.9	20,502	1,398	15,732	97.2	4.3
	3.38	3.03	7.00	L	19,918	14,618	1,061	23,538	18.8	21,196	1,428	16,324	102.0	4.4
				H	20,132	15,307	1,171	24,127	17.2	21,411	1,418	16,573	98.5	4.4
	4.50	5.19	11.99	L	20,034	14,678	1,028	23,542	19.5	21,691	1,441	16,774	103.0	4.4
				H	20,246	15,528	1,067	23,887	19.0	21,926	1,429	17,050	99.3	4.5
70	2.25	1.08	2.49	L	18,707	13,991	1,246	22,958	15.0	22,483	1,464	17,488	104.0	4.5
				H	18,924	14,826	1,290	23,325	14.7	22,757	1,448	17,816	101.0	4.6
	3.38	2.32	5.36	L	19,005	14,147	1,173	23,007	16.2	23,387	1,487	18,313	106.0	4.6
				H	19,191	14,826	1,290	23,592	14.9	23,671	1,466	18,669	102.0	4.7
	4.50	3.98	9.19	L	19,142	14,222	1,139	23,028	16.8	23,804	1,499	18,689	107.0	4.7
				H	19,327	15,037	1,179	23,350	16.4	24,107	1,470	19,091	103.0	4.8
80	2.25	1.04	2.40	L	17,762	13,489	1,387	22,494	12.8	24,360	1,515	19,191	108.0	4.7
				H	17,944	14,303	1,433	22,833	12.5	22,833	1,491	19,614	104.0	4.9
	3.38	2.25	5.20	L	18,096	13,668	1,309	22,562	13.8	25,301	1,539	20,050	109.0	4.8
				H	18,247	14,303	1,433	23,136	12.7	25,691	1,510	20,539	105.0	5.0
	4.50	3.87	8.94	L	18,257	13,761	1,273	22,600	14.3	25,699	1,551	20,407	110.0	4.9
				H	18,409	14,535	1,314	22,892	14.0	26,133	1,511	20,977	106.0	5.1
90	2.25	1.02	2.36	L	16,755	12,955	1,547	22,033	10.8	25,732	1,552	20,437	110.0	4.9
				H	16,885	13,744	1,595	22,327	10.6	26,160	1,521	20,970	106.0	5.0
	3.38	2.19	5.06	L	17,143	13,166	1,465	22,142	11.7	26,775	1,580	21,384	112.0	5.0
				H	17,254	13,744	1,595	22,696	10.8	27,314	1,544	22,046	108.0	5.2
	4.50	3.76	8.69	L	17,325	13,274	1,426	22,191	12.2	27,288	1,593	21,853	113.0	5.0
				H	17,437	14,009	1,469	22,449	11.9	27,933	1,557	22,621	109.0	5.3
100	2.25	0.99	2.29	L	15,677	12,393	1,720	21,546	9.1					
				H	15,746	13,157	1,769	21,782	8.9					
	3.38	2.11	4.87	L	16,101	12,624	1,636	21,683	9.8					
				H	16,168	13,157	1,769	22,204	9.1					
	4.50	3.65	8.43	L	16,292	12,737	1,594	21,731	10.2					
				H	16,361	13,449	1,640	21,957	10.0					
110	2.25	0.94	2.17	L	14,516	11,806	1,901	21,002	7.6					
				H	14,529	12,549	1,949	21,179	7.5					
	3.38	2.06	4.76	L	14,923	12,026	1,815	21,116	8.2					
				H	14,944	12,549	1,949	21,549	7.7					
	4.50	3.53	8.15	L	15,101	12,128	1,773	21,150	8.5					
				H	15,125	12,843	1,820	21,335	8.3					
120	2.25	0.91	2.10	L	13,263	11,198	2,082	20,367	6.4					
				H	13,372	11,927	2,131	20,503	6.2					
	3.38	1.99	4.60	L	13,560	11,356	1,998	20,377	6.8					
				H	13,617	11,927	2,131	20,808	6.4					
	4.50	3.43	7.92	L	13,700	11,424	1,957	20,377	7.0					
				H	13,777	12,178	2,007	20,525	6.9					

LEGEND

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|---|--|--|
| COP — Coefficient of Performance | H — High (630 cfm) | LAT — Leaving Air Temperature (F) |
| EAT — Entering Air Temperature | HC — Heating Capacity | SC — Sensible Capacity |
| EER — Energy Efficiency Ratio | HE — Heat of Extraction (Btu/h) | TC — Total Capacity |
| EWT — Entering Water Temperature | HR — Heat of Rejection (Btu/h) | WPD — Water Pressure Drop |
| GPM — Gallons Per Minute | L — Low (455 cfm) | |

Operation Not Recommended

Performance data (cont)



50VSI,J UNIT PERFORMANCE DATA — 2 TONS

EWT (F)	GPM	WPD		CFM	COOLING EAT 80/67 F					HEATING EAT 70 F				
		PSI	FT		TC	SC	KW	HR	EER	HC	KW	HE	LAT	COP
20	6.0	4.38	10.12	L	Operation Not Recommended					16,444	1,473	11,418	87.2	3.3
				H						16,660	1,485	11,593	85.0	3.3
30	3.0	1.10	2.54	L	28,019	20,475	1,153	31,953	24.3	17,564	1,504	12,432	88.4	3.4
				H	28,621	21,922	1,189	32,678	24.1	17,702	1,513	12,540	86.0	3.4
	4.5	2.48	5.73	L	29,442	21,123	1,058	33,052	27.8	18,601	1,533	13,370	89.6	3.6
				H	30,551	22,801	1,089	34,267	28.1	18,686	1,537	13,442	87.0	3.6
6.0	4.26	9.48	L	29,754	21,168	995	33,149	29.9	19,071	1,546	13,796	90.2	3.6	
			H	30,841	22,695	1,017	33,811	30.3	19,178	1,548	13,896	87.5	3.6	
40	3.0	1.07	2.47	L	26,809	19,942	1,208	30,931	22.2	20,094	1,568	14,744	91.4	3.8
				H	27,314	21,375	1,242	31,552	22.0	20,395	1,570	15,038	88.7	3.8
	4.5	2.41	5.57	L	27,899	20,431	1,116	31,707	25.0	21,152	1,596	15,706	92.6	3.9
				H	28,627	21,375	1,242	32,865	23.1	21,436	1,592	16,004	89.8	4.0
6.0	4.15	9.59	L	28,295	20,603	1,066	31,932	26.5	21,857	1,616	16,343	93.5	4.0	
			H	28,882	22,099	1,093	32,611	26.4	22,072	1,610	16,579	90.4	4.0	
50	3.0	1.04	2.40	L	25,632	19,418	1,296	30,054	19.8	22,902	1,638	17,313	94.8	4.1
				H	26,055	20,824	1,329	30,590	19.6	23,363	1,630	17,801	91.8	4.2
	4.5	2.32	5.36	L	26,487	19,791	1,205	30,598	22.0	23,992	1,664	18,314	96.0	4.2
				H	26,951	20,824	1,329	31,486	20.3	24,471	1,651	18,838	92.9	4.3
6.0	4.05	9.36	L	26,917	20,023	1,162	30,882	23.2	24,709	1,683	18,967	96.9	4.3	
			H	27,458	21,478	1,192	31,525	23.0	25,165	1,668	19,474	93.6	4.4	
60	3.0	1.02	2.36	L	24,457	18,888	1,413	29,278	17.3	25,790	1,707	19,966	98.2	4.4
				H	24,812	20,258	1,446	29,746	17.2	26,382	1,689	20,619	94.9	4.6
	4.5	2.23	5.15	L	25,160	19,180	1,322	29,671	19.0	26,923	1,731	21,017	99.5	4.6
				H	25,455	20,258	1,446	30,389	17.6	27,568	1,709	21,737	96.1	4.7
6.0	3.93	9.08	L	25,586	19,422	1,282	29,960	20.0	27,535	1,744	21,584	100.3	4.6	
			H	26,049	20,830	1,315	30,536	19.8	28,279	1,721	22,407	96.9	4.8	
70	3.0	0.99	2.29	L	23,255	18,338	1,557	28,567	14.9	28,558	1,769	22,522	101.6	4.7
				H	23,553	19,663	1,591	28,981	14.8	29,232	1,741	23,292	98.0	4.9
	4.5	2.15	4.97	L	23,870	18,580	1,465	28,869	16.3	29,747	1,791	23,636	102.9	4.9
				H	24,073	19,663	1,591	29,501	15.1	30,505	1,759	24,503	99.3	5.1
6.0	3.81	8.34	L	24,266	18,797	1,425	29,128	17.0	30,242	1,797	24,111	103.6	4.9	
			H	24,634	20,152	1,460	29,616	16.9	31,238	1,766	25,212	100.0	5.2	
80	3.0	0.96	2.22	L	21,998	17,753	1,726	27,887	12.8	31,009	1,817	24,809	104.5	5.0
				H	22,248	19,027	1,762	28,260	12.6	31,691	1,780	25,618	100.6	5.2
	4.5	2.07	4.78	L	22,572	17,969	1,633	28,144	13.8	32,269	1,839	25,994	106.0	5.1
				H	22,737	19,027	1,762	28,749	12.9	33,056	1,797	26,925	102.0	5.4
6.0	3.71	8.57	L	22,924	18,144	1,590	28,349	14.4	32,737	1,843	26,449	106.6	5.2	
			H	23,193	19,442	1,627	28,744	14.3	33,863	1,800	27,721	102.8	5.5	
90	3.0	0.93	2.15	L	20,655	17,117	1,918	27,199	10.8	32,943	1,846	26,644	106.9	5.2
				H	20,865	18,335	1,957	27,542	10.7	33,537	1,801	27,392	102.8	5.5
	4.5	1.99	4.60	L	21,219	17,328	1,823	27,439	11.6	34,292	1,867	27,922	108.5	5.4
				H	21,382	18,335	1,957	28,059	10.9	35,000	1,816	28,804	104.3	5.7
6.0	3.60	8.32	L	21,524	17,458	1,777	27,587	12.1	34,929	1,878	28,521	109.2	5.5	
			H	21,704	18,697	1,814	27,893	12.0	35,979	1,823	29,759	105.1	5.8	
100	3.0	0.90	2.08	L	19,199	16,417	2,131	26,470	9.0					
				H	19,373	17,576	2,173	26,787	8.9					
	4.5	1.90	4.39	L	19,765	16,635	2,034	26,705	9.7					
				H	19,939	17,576	2,173	27,353	9.2					
6.0	3.48	8.04	L	20,033	16,735	1,984	26,802	10.1						
			H	20,148	17,915	2,022	27,047	10.0						
110	3.0	0.87	2.01	L	17,600	15,638	2,363	25,663	7.5					
				H	17,740	16,736	2,407	25,953	7.4					
	4.5	1.83	4.23	L	18,162	15,871	2,263	25,883	8.0					
				H	18,342	16,736	2,407	26,555	7.6					
6.0	3.36	7.76	L	18,414	15,970	2,211	25,958	8.3						
			H	18,504	17,094	2,249	26,178	8.2						
120	3.0	0.84	1.94	L	15,828	14,764	2,611	24,737	6.1					
				H	15,936	15,802	2,658	25,005	6.0					
	4.5	1.74	4.02	L	16,365	15,014	2,509	24,926	6.5					
				H	16,524	15,802	2,658	25,593	6.2					
6.0	3.26	7.53	L	16,634	15,160	2,458	25,021	6.8						
			H	16,750	16,230	2,495	25,263	6.7						

LEGEND

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|---|--|--|
| COP — Coefficient of Performance | H — High (820 cfm) | LAT — Leaving Air Temperature (F) |
| EAT — Entering Air Temperature | HC — Heating Capacity | SC — Sensible Capacity |
| EER — Energy Efficiency Ratio | HE — Heat of Extraction (Btu/h) | TC — Total Capacity |
| EWT — Entering Water Temperature | HR — Heat of Rejection (Btu/h) | WPD — Water Pressure Drop |
| GPM — Gallons Per Minute | L — Low (600 cfm) | |

Operation Not Recommended



50VSK,L UNIT PERFORMANCE DATA — 2 1/2 TONS

EWT (F)	GPM	WPD		CFM	COOLING EAT 80/67 F					HEATING EAT 70 F				
		PSI	FT		TC	SC	kW	HR	EER	HC	kW	HE	LAT	COP
20	7.5	6.3	14.55	L	Operation Not Recommended					21,454	1,991	14,661	88.1	3.2
				H						21,744	2,007	14,896	85.9	3.2
30	3.7	1.7	3.93	L	36,807	27,588	1,594	42,246	23.1	22,884	2,029	15,961	89.4	3.3
				H	37,468	29,426	1,584	42,873	23.7	23,193	2,039	16,236	87.0	3.3
	5.6	3.65	8.43	L	37,637	27,956	1,508	42,783	25.0	24,034	2,056	17,019	90.5	3.4
				H	38,220	29,426	1,504	43,351	25.4	24,426	2,064	17,384	88.0	3.5
	7.5	6.12	14.14	L	37,828	27,957	1,450	42,775	26.1	24,615	2,070	17,552	91.0	3.5
				H	38,349	29,535	1,451	43,300	26.4	25,094	2,078	18,004	88.7	3.5
40	3.7	1.65	3.81	L	35,805	26,837	1,643	41,411	21.8	26,074	2,102	18,902	92.5	3.6
				H	36,447	28,624	1,677	42,169	21.7	26,430	2,103	19,255	89.8	3.7
	5.6	3.57	8.25	L	36,612	27,194	1,540	41,867	23.8	27,310	2,129	20,046	93.7	3.8
				H	37,179	28,624	1,677	42,901	22.2	27,759	2,127	20,502	91.0	3.8
	7.5	5.99	13.84	L	36,797	27,195	1,489	41,878	24.7	28,095	2,148	20,766	94.3	3.8
				H	37,304	28,731	1,539	42,556	24.2	28,658	2,147	21,332	91.8	3.9
50	3.7	1.61	3.72	L	34,830	26,106	1,755	40,818	19.8	29,513	2,178	22,082	95.8	4.0
				H	35,455	27,844	1,812	41,637	19.6	29,910	2,169	22,509	92.9	4.0
	5.6	3.50	8.09	L	35,615	26,454	1,638	41,204	21.7	30,811	2,205	23,288	97.1	4.1
				H	36,166	27,844	1,812	42,349	20.0	31,294	2,191	23,818	94.1	4.2
	7.5	5.84	13.49	L	35,795	26,455	1,589	41,217	22.5	31,632	2,222	24,051	97.8	4.2
				H	36,288	27,948	1,662	41,959	21.8	32,190	2,209	24,653	94.9	4.3
60	3.7	1.57	3.63	L	33,881	25,395	1,920	40,432	17.6	32,905	2,250	25,228	99.1	4.3
				H	34,489	27,086	1,984	41,258	17.4	33,326	2,230	25,717	95.9	4.4
	5.6	3.41	7.88	L	34,645	25,733	1,791	40,756	19.3	34,220	2,275	26,458	100.4	4.4
				H	35,181	27,086	1,984	41,950	17.7	34,696	2,250	27,019	97.1	4.5
	7.5	5.71	13.19	L	34,820	25,734	1,740	40,757	20.0	34,967	2,287	27,164	101.1	4.5
				H	35,300	27,187	1,817	41,500	19.4	35,445	2,260	27,734	97.8	4.6
70	3.7	1.54	3.56	L	32,372	24,714	2,126	39,626	15.2	35,953	2,310	28,071	102.0	4.6
				H	32,968	26,491	2,187	40,430	15.1	36,376	2,279	28,600	98.5	4.7
	5.6	3.32	7.67	L	33,146	25,097	1,990	39,936	16.7	37,219	2,333	29,259	103.3	4.7
				H	33,646	26,491	2,187	41,108	15.4	37,630	2,295	29,799	99.6	4.8
	7.5	5.57	12.87	L	33,474	25,257	1,933	40,069	17.3	37,838	2,338	29,861	103.9	4.7
				H	33,918	26,812	2,003	40,752	16.9	38,178	2,298	30,337	100.2	4.9
80	3.7	1.49	3.44	L	30,574	23,864	2,364	38,640	12.9	38,362	2,350	30,344	104.3	4.8
				H	31,025	25,556	2,416	39,268	12.8	38,753	2,310	30,871	100.5	4.9
	5.6	3.23	7.46	L	31,310	24,212	2,224	38,898	14.1	39,490	2,369	31,407	105.5	4.9
				H	31,726	25,556	2,416	39,969	13.1	39,761	2,320	31,845	101.4	5.0
	7.5	5.42	12.52	L	31,689	24,427	2,160	39,059	14.7	39,985	2,371	31,895	106.0	4.9
				H	32,047	25,994	2,215	39,605	14.5	40,143	2,319	32,231	101.7	5.1
90	3.7	1.45	3.35	L	28,570	22,911	2,623	37,520	10.9	39,836	2,363	31,773	105.8	4.9
				H	28,823	24,438	2,665	37,916	10.8	40,152	2,315	32,253	101.7	5.1
	5.6	3.15	7.28	L	29,253	23,189	2,481	37,718	11.8	40,717	2,375	32,614	106.6	5.0
				H	29,563	24,438	2,665	38,656	11.1	40,754	2,316	32,852	102.0	5.2
	7.5	5.29	12.22	L	29,615	23,390	2,412	37,845	12.3	41,146	2,380	33,025	107.0	5.1
				H	29,879	24,925	2,450	38,238	12.2	41,095	2,318	33,186	102.3	5.2
100	3.7	1.42	3.28	L	26,446	21,918	2,893	36,317	9.1					
				H	26,526	23,296	2,928	36,516	9.1					
	5.6	3.06	7.07	L	27,088	22,139	2,752	36,478	9.8					
				H	27,299	23,296	2,928	37,289	9.3					
	7.5	5.15	11.90	L	27,402	22,294	2,679	36,543	10.2					
				H	27,603	23,796	2,707	36,839	10.2					
110	3.7	1.38	3.19	L	24,286	20,950	3,164	35,084	7.7					
				H	24,298	22,289	3,200	35,216	7.6					
	5.6	2.97	6.86	L	24,929	21,174	3,026	35,254	8.2					
				H	25,076	22,289	3,200	35,994	7.8					
	7.5	5.02	11.60	L	25,199	21,285	2,953	35,275	8.5					
				H	25,412	22,798	2,981	35,583	8.5					
120	3.7	1.33	3.07	L	22,175	20,073	3,425	33,861	6.5					
				H	22,301	21,574	3,475	34,158	6.4					
	5.6	2.87	6.63	L	22,890	20,404	3,292	34,122	7.0					
				H	23,039	21,574	3,475	34,896	6.6					
	7.5	4.87	11.25	L	23,155	20,509	3,224	34,155	7.2					
				H	23,495	22,124	3,270	34,652	7.2					

Operation Not Recommended

LEGEND

- COP — Coefficient of Performance
- EAT — Entering Air Temperature
- EER — Energy Efficiency Ratio
- EWT — Entering Water Temperature
- GPM — Gallons Per Minute
- H — High (1080 cfm)
- HC — Heating Capacity
- HE — Heat of Extraction (Btuh)
- HR — Heat of Rejection (Btuh)
- L — Low (780 cfm)
- LAT — Leaving Air Temperature (F)
- SC — Sensible Capacity
- TC — Total Capacity
- WPD — Water Pressure Drop

Performance data (cont)



50VSM,N UNIT PERFORMANCE DATA — 3 TONS

EWT (F)	GPM	WPD		CFM	COOLING EAT 80/67 F					HEATING EAT 70 F				
		PSI	FT		TC	SC	KW	HR	EER	HC	KW	HE	LAT	COP
20	9.00	8.50	19.64	L	Operation Not Recommended					24,528	2216	16,967	88.1	3.2
				H						24,605	2219	17,034	86.4	3.3
30	4.50	2.29	5.29	L	42,957	30,973	1755	48,945	24.5	26,143	2246	18,480	89.4	3.4
				H	43,103	32,009	1790	49,010	24.1	26,292	2246	18,629	87.7	3.4
	6.75	4.89	11.30	L	44,140	31,507	1599	49,596	27.6	27,459	2271	19,710	90.5	3.5
				H	44,205	32,513	1643	49,811	26.9	27,651	2269	19,909	88.7	3.6
	9.00	8.32	19.22	L	45,178	30,801	1519	48,361	29.7	28,193	2285	20,397	91.1	3.6
				H	46,445	32,584	1552	49,740	29.9	28,316	2281	20,533	89.2	3.6
40	4.50	2.25	5.20	L	41,353	30,347	1784	47,440	23.2	29,840	2318	21,931	92.6	3.8
				H	41,499	31,486	1820	47,709	22.8	30,005	2309	22,127	90.6	3.8
	6.75	4.76	11.00	L	42,235	30,756	1651	47,868	25.6	31,248	2346	23,243	93.7	3.9
				H	42,531	31,486	1820	48,741	23.4	31,437	2334	23,473	91.7	4.0
	9.00	8.15	18.83	L	42,880	30,514	1588	47,398	27.0	32,230	2364	24,164	94.5	4.0
				H	43,822	32,075	1624	48,363	27.0	32,380	2351	24,358	92.4	4.0
50	4.50	2.20	5.08	L	39,749	29,611	1877	46,153	21.2	33,921	2399	25,736	96.0	4.1
				H	40,020	30,807	1914	46,551	20.9	34,119	2381	25,995	93.9	4.2
	6.75	4.63	10.70	L	40,426	29,936	1752	46,404	23.1	35,431	2430	27,140	97.3	4.3
				H	40,844	30,807	1914	47,375	21.3	35,637	2408	27,421	95.1	4.3
	9.00	7.98	18.43	L	40,599	29,974	1697	46,389	23.9	36,440	2450	28,081	98.2	4.4
				H	41,155	31,372	1736	47,078	23.7	36,617	2426	28,339	95.7	4.4
60	4.50	2.15	4.97	L	38,107	28,776	2034	45,047	18.7	38,086	2485	29,607	99.6	4.5
				H	38,443	29,992	2072	45,513	18.6	38,340	2458	29,953	97.2	4.6
	6.75	4.50	10.40	L	38,663	29,052	1907	45,170	20.3	39,702	2520	31,104	101.0	4.6
				H	39,118	29,992	2072	46,188	18.9	39,954	2488	31,465	98.5	4.7
	9.00	7.80	18.02	L	39,045	29,226	1851	45,361	21.1	40,623	2539	31,960	101.8	4.7
				H	39,429	30,513	1892	45,885	20.8	40,847	2505	32,300	99.1	4.8
70	4.50	2.10	4.85	L	36,390	27,851	2258	44,094	16.1	42,035	2570	33,266	103.0	4.8
				H	36,746	29,062	2297	44,583	16.0	42,375	2534	33,729	110.4	4.9
	6.75	4.36	10.07	L	36,894	28,108	2119	44,124	17.4	43,753	2610	34,848	104.5	4.9
				H	37,327	29,062	2297	45,164	16.3	44,091	2569	35,326	101.8	5.0
	9.00	7.61	17.58	L	37,324	28,315	2055	44,336	18.2	44,581	2629	35,611	105.3	5.0
				H	37,629	29,531	2097	44,784	17.9	44,890	2586	36,067	102.4	5.1
80	4.50	2.04	4.71	L	34,562	26,846	2551	43,266	13.6	45,469	2650	36,427	106.0	5.0
				H	34,906	28,036	2590	43,743	13.5	45,927	2607	37,032	103.2	5.2
	6.75	4.23	9.77	L	35,067	27,109	2391	43,225	14.7	47,276	2696	38,077	107.6	5.1
				H	35,446	28,036	2590	44,283	13.7	47,748	2648	38,713	104.8	5.3
	9.00	7.44	17.19	L	35,447	27,284	2315	43,346	15.3	48,115	2718	38,841	108.4	5.2
				H	35,738	28,465	2355	43,773	15.2	48,566	2666	39,470	105.4	5.3
90	4.50	2.00	4.62	L	32,584	25,772	2914	42,527	11.2	48,086	2720	38,805	108.3	5.2
				H	32,900	26,936	2952	42,972	11.1	48,702	2672	39,585	105.4	5.3
	6.75	4.12	9.52	L	33,132	26,058	2727	42,437	12.2	49,966	2772	40,508	110.0	5.3
				H	33,449	26,936	2952	43,521	11.3	50,629	2720	41,348	107.1	5.5
	9.00	7.26	16.77	L	33,420	26,178	2635	42,411	12.7	51,024	2802	41,464	110.9	5.3
				H	33,741	27,349	2672	42,858	12.6	51,694	2744	42,331	107.9	5.5
100	4.50	1.96	4.53	L	30,419	24,637	3350	41,849	9.1	Operation Not Recommended				
				H	30,705	25,780	3385	42,255	9.1					
	6.75	3.99	9.22	L	31,036	24,960	3132	41,722	9.9					
				H	31,310	25,780	3385	42,860	9.3					
	9.00	7.09	16.38	L	31,253	25,041	3022	41,564	10.3					
				H	31,622	26,220	3052	42,035	10.4					
110	4.50	1.90	4.39	L	28,031	23,452	3860	41,201	7.3					
				H	28,299	24,591	3891	41,575	7.3					
	6.75	3.86	8.92	L	28,729	23,820	3609	41,043	8.0					
				H	29,004	24,591	3891	42,280	7.5					
	9.00	6.92	15.99	L	28,955	23,916	3479	40,825	8.3					
				H	29,366	25,115	3499	41,305	8.4					

LEGEND

- COP — Coefficient of Performance
- EAT — Entering Air Temperature
- EER — Energy Efficiency Ratio
- EWT — Entering Water Temperature
- GPM — Gallons Per Minute
- H — High (1220 cfm)
- HC — Heating Capacity
- HE — Heat of Extraction (Btuh)
- HR — Heat of Rejection (Btuh)
- L — Low (850 cfm)
- LAT — Leaving Air Temperature (F)
- SC — Sensible Capacity
- TC — Total Capacity
- WPD — Water Pressure Drop



50VS UNIT OCTAVE BAND SOUND POWER LEVEL (dB re 1pW)

UNIT	NOMINAL CAPACITY (TONS)	UNIT TEST OPERATION MODE	WITH SINGLE SUPPLY DOUBLE DEFLECTION GRILLE AND STANDARD PERIMETER BYPASS PANEL, OCTAVE BAND FREQUENCY, Hz						
			125	250	500	1000	2000	4000	8000
50VSA,B	3/4	Fan Only: Low Speed	52.3	50.5	46.0	41.1	33.6	32.1	31.0
		Fan Only: High Speed	52.9	51.0	47.4	41.5	33.9	32.8	31.1
		Cooling: Low Speed	53.5	51.5	47.6	41.7	34.4	32.9	31.1
		Cooling: High Speed	56.5	54.3	50.1	44.3	37.9	36.3	31.8
		Heating: Low Speed	53.9	51.0	48.4	42.4	34.9	33.2	33.1
		Heating: High Speed	56.2	53.8	50.2	44.2	37.5	36.3	32.8
50VSC,D	1	Fan Only: Low Speed	54.8	52.3	40.1	43.3	37.5	36.5	32.7
		Fan Only: High Speed	54.4	52.1	37.6	43.4	36.9	38.6	32.2
		Cooling: Low Speed	56.0	53.3	49.6	43.9	38.3	36.6	32.8
		Cooling: High Speed	58.0	55.4	41.7	46.2	40.9	39.2	34.2
		Heating: Low Speed	60.9	54.2	49.9	44.2	37.6	36.4	33.8
		Heating: High Speed	60.7	56.2	51.7	45.8	39.6	38.6	34.4
50VSE,F	1 1/4	Fan Only: Low Speed	58.9	57.8	54.0	51.5	45.0	43.7	38.4
		Fan Only: High Speed	59.2	59.1	54.3	52.6	45.2	44.7	41.3
		Cooling: Low Speed	60.1	58.8	55.6	52.1	45.8	44.5	38.6
		Cooling: High Speed	62.8	62.4	58.2	55.4	49.1	48.1	41.8
		Heating: Low Speed	61.3	59.3	56.4	52.3	45.4	44.1	39.1
		Heating: High Speed	63.8	62.3	58.1	55.2	48.4	47.7	41.7
50VSG,H	1 1/2	Fan Only: Low Speed	62.0	60.9	55.9	54.9	48.3	47.4	42.1
		Fan Only: High Speed	61.6	60.9	55.4	53.6	47.8	47.0	44.2
		Cooling: Low Speed	63.3	61.9	57.4	55.5	49.1	48.2	42.3
		Cooling: High Speed	65.1	64.1	59.4	57.5	51.3	50.5	44.8
		Heating: Low Speed	63.8	61.9	57.9	55.1	48.3	47.1	42.0
		Heating: High Speed	65.1	63.9	59.4	57.5	50.3	49.2	43.7
50VSI,J	2	Fan Only: Low Speed	60.7	58.6	54.1	48.3	42.3	38.4	35.7
		Fan Only: High Speed	59.6	58.7	54.8	49.2	43.1	39.2	36.9
		Cooling: Low Speed	61.9	59.6	55.7	48.9	43.1	39.2	35.9
		Cooling: High Speed	63.1	62.0	58.9	52.0	47.1	43.0	37.5
		Heating: Low Speed	63.7	60.8	57.9	51.1	44.8	40.5	38.4
		Heating: High Speed	65.7	63.2	59.4	52.3	48.7	44.1	39.6
50VSK,L	2 1/2	Fan Only: Low Speed	67.4	63.7	58.8	54.3	49.9	45.7	41.3
		Fan Only: High Speed	65.2	64.2	58.7	55.8	50.4	46.9	44.0
		Cooling: Low Speed	68.6	64.8	60.2	54.8	50.7	46.6	41.5
		Cooling: High Speed	68.8	67.4	63.0	58.5	54.2	50.3	44.5
		Heating: Low Speed	69.7	65.7	61.2	56.1	51.9	47.8	41.9
		Heating: High Speed	68.7	67.7	63.2	58.6	54.4	50.3	44.8
50VSM,N	3	Fan Only: Low Speed	70.2	68.0	62.1	59.1	56.6	50.1	45.1
		Fan Only: High Speed	70.3	68.1	63.2	65.3	56.6	50.3	46.8
		Cooling: Low Speed	71.4	68.6	62.1	59.4	56.7	50.4	45.2
		Cooling: High Speed	71.5	69.8	64.0	65.4	56.2	52.1	47.0
		Heating: Low Speed	69.9	68.3	63.0	60.1	58.5	51.3	45.8
		Heating: High Speed	70.5	69.6	64.0	60.9	58.8	53.0	47.7

NOTES:

1. All performance is Sound Power Level in dB referenced to 1 picroWatt.
2. Data is based on sound measurements made in a reverberant room on representative units from each cabinet size in accordance with ARI Standard 350-86.

Performance data (cont)



50VS UNIT BLOWER PERFORMANCE

UNIT	NOMINAL CAPACITY (TONS)	FAN SPEED	RATED CFM	MIN CFM	EXTERNAL STATIC PRESSURE (in. wg)																										
					0	0.01	0.05	0.1	0.15	0.2	0.25	0.3	0.35	0.4	0.45	0.5															
50VSA,B	3/4	LOW	360	260	361	358	341	321	294	268	235	177																			
		HI			316	310	294	278	262	233	206																				
50VSC,D	1	LOW	420	300	424	421	398	376	350	315	280	240																			
		HI			361	358	341	321	305																						
50VSE,F	1 1/4	LOW	540	390	551	549	535	521	509	490	476	460									441	420	400								
		HI			470	465	455	439	428	412	397																				
50VSG,H	1 1/2	LOW	630	455	626	622	604	592	577	561	548	530									513	495	476								
		HI			551	549	535	521	509	490	476	460																			
50VSI,J	2	LOW	820	600	821	817	814	812	802	790	775	747									684	654	621								
		HI			768	765	762	759	751	742	722	683									653	625									
50VSK,L	2 1/2	LOW	1080	780	1081	1075	1070	1049	1024	931	880	843									801										
		HI			956	951	942	928	911	835	809																				
50VSM,N	3	LOW	1220	850	1222	1219	1194	1160	1129	1088	1057	1017	961																		
		HI			1102	1096	1091	1070	1044	949	897	860																			

NOTES:

1. Operation not recommended in shaded area.
2. Blower performance shown in cfm.

50VS UNIT HEATING/COOLING CORRECTION FACTORS

HEATING CORRECTIONS				COOLING CORRECTIONS										
EAT, DB (F)	HC	Power	HE	EAT, WB (F)	TC	Sensible Cooling Capacity Multiplier - Entering DB (F)							Power	HR
						70	75	80	80.6	85	90	95		
45	1.072	0.774	1.107	60	0.865	0.807	1.025	1.208	1.226	*	*	*	0.997	0.887
50	1.056	0.824	1.083	65	0.960	0.590	0.805	1.001	1.019	1.188	*	*	0.999	0.965
55	1.040	0.873	1.060	66.2	1.000	0.548	0.754	0.955	1.000	1.140	*	*	1.000	1.000
60	1.024	0.922	1.036	67	1.003	0.493	0.718	0.917	0.935	1.108	1.318	*	1.000	1.008
65	1.008	0.972	1.012	70	1.054		0.583	0.785	0.809	0.988	1.195	1.400	1.001	1.025
70	0.993	1.020	0.989	75	1.153			0.588	0.606	0.788	1.006	1.219	1.003	1.118
75	0.977	1.070	0.965											
80	0.961	1.120	0.942											

LEGEND

- | | |
|---------------------------------------|------------------------------------|
| DB — Dry Bulb | HR — Heat of Rejection |
| EAT — Entering Air Temperature | TC — Total Cooling Capacity |
| HC — Heating Capacity | WB — Wet Bulb |
| HE — Heat of Extraction | |

NOTE: Operation not recommended in shaded area.



50VS UNIT AIRFLOW CORRECTION FACTORS

UNIT	NOMINAL CAPACITY (TONS)	AIRFLOW	HEATING			COOLING			
		% of Nominal	HC	Power	HE	TC	SC	Power	HR
50VSA,B	3/4	70	0.931	1.098	0.974	0.910	0.813	0.994	0.96
		75	0.942	1.081	0.979	0.925	0.844	0.995	0.97
		80	0.954	1.065	0.983	0.940	0.875	0.996	0.97
		85	0.965	1.049	0.987	0.955	0.906	0.997	0.98
		90	0.977	1.033	0.991	0.970	0.938	0.998	0.99
		95	0.989	1.016	0.996	0.985	0.969	0.999	0.99
		100	1.000	1.000	1.000	1.000	1.000	1.000	1.000
50VSC,D	1	70	0.929	1.112	0.962	0.912	0.816	0.992	0.95
		75	0.941	1.093	0.968	0.927	0.847	0.993	0.96
		80	0.953	1.075	0.975	0.941	0.878	0.995	0.96
		85	0.965	1.056	0.981	0.956	0.908	0.996	0.97
		90	0.976	1.037	0.987	0.971	0.939	0.997	0.98
		95	0.988	1.019	0.994	0.985	0.969	0.999	0.99
		100	1.000	1.000	1.000	1.000	1.000	1.000	1.000
50VSE,F	1 1/4	70	0.932	1.103	0.961	0.915	0.821	0.985	0.95
		75	0.943	1.086	0.967	0.929	0.850	0.987	0.96
		80	0.955	1.069	0.974	0.943	0.880	0.990	0.97
		85	0.966	1.052	0.980	0.958	0.910	0.992	0.98
		90	0.977	1.034	0.987	0.972	0.940	0.995	0.98
		95	0.989	1.017	0.994	0.986	0.970	0.998	0.99
		100	1.000	1.000	1.000	1.000	1.000	1.000	1.000
50VSG,H	1 1/2	70	0.940	1.099	0.968	0.926	0.826	0.983	0.96
		75	0.950	1.082	0.973	0.938	0.855	0.986	0.96
		80	0.960	1.066	0.978	0.951	0.884	0.989	0.97
		85	0.970	1.050	0.984	0.963	0.913	0.992	0.98
		90	0.980	1.033	0.989	0.975	0.942	0.994	0.99
		95	0.990	1.017	0.995	0.988	0.971	0.997	0.99
		100	1.000	1.000	1.000	1.000	1.000	1.000	1.000
50VSI,J	2	70	0.922	1.067	0.952	0.920	0.813	0.973	0.96
		75	0.935	1.056	0.960	0.934	0.844	0.978	0.97
		80	0.948	1.045	0.968	0.947	0.875	0.982	0.98
		85	0.961	1.034	0.976	0.960	0.906	0.987	0.98
		90	0.974	1.022	0.984	0.974	0.938	0.991	0.99
		95	0.987	1.011	0.992	0.987	0.969	0.996	0.99
		100	1.000	1.000	1.000	1.000	1.000	1.000	1.000
50VSK,L	2 1/2	70	0.923	1.057	0.945	0.930	0.824	0.968	0.95
		75	0.936	1.048	0.954	0.942	0.853	0.973	0.96
		80	0.949	1.038	0.964	0.953	0.883	0.979	0.97
		85	0.962	1.029	0.973	0.965	0.912	0.984	0.98
		90	0.974	1.019	0.982	0.977	0.941	0.989	0.98
		95	0.987	1.010	0.991	0.988	0.971	0.995	0.99
		100	1.000	1.000	1.000	1.000	1.000	1.000	1.000
50VSM,N	3	70	0.935	1.092	0.953	0.941	0.837	0.968	0.95
		75	0.946	1.076	0.961	0.951	0.864	0.973	0.96
		80	0.957	1.061	0.969	0.961	0.891	0.978	0.97
		85	0.968	1.046	0.977	0.971	0.918	0.984	0.98
		90	0.978	1.031	0.984	0.981	0.946	0.989	0.98
		95	0.989	1.015	0.992	0.990	0.973	0.995	0.99
		100	1.000	1.000	1.000	1.000	1.000	1.000	1.000

LEGEND

HC — Heating Capacity **SC** — Sensible Cooling
HE — Heat of Extraction **TC** — Total Cooling Capacity
HR — Heat of Rejection

NOTE: Nominal airflow for R-410A units is not 400 cfm/ton. Therefore, correction factors for % of nominal (rated) is correct, but the corresponding cfm per ton changes by model.

Electrical data



CABINET ELECTRICAL DATA — 50VS UNIT

UNIT	NOMINAL CAPACITY (TONS)	SUPPLY VOLTAGE V-Hz-Ph	MOTOR VOLTAGE V-Hz-Ph	FAN MOTOR FLA (A)	MOTOR POWER (W)	MIN CIRCUIT AMP	MAX FUSE SIZE (A)
50VSA,B	3/4	208/230-1-60	208/230-1-60	0.30	130	6.2	15
50VSC,D	1	208/230-1-60	208/230-1-60	0.40	142	8.3	15
50VSE,F	1 1/4	208/230-1-60	208/230-1-60	0.88	180	13.3	25
50VSG,H	1 1/2	208/230-1-60	208/230-1-60	1.18	240	13.6	25
50VSI,J	2	208/230-1-60	208/230-1-60	1.60	304	15.1	25
50VSK,L	2 1/2	208/230-1-60	208/230-1-60	1.80	368	22.4	35
50VSM,N	3	208/230-1-60	208/230-1-60	2.06	442	25.3	40

LEGEND

FLA — Full Load Amps

CHASSIS ELECTRICAL DATA — 50VS UNIT

UNIT	NOMINAL CAPACITY (TONS)	SUPPLY VOLTAGE V-Hz-Ph	MIN CIRCUIT AMP	MAX FUSE SIZE (A)	COMPRESSOR (LRA)	COMPRESSOR (RLA)	COOLING CURRENT (A)	MAX COOLING CURRENT (A)	HEATING CURRENT (A)	MAX HEATING CURRENT (A)
50VSA,B	3/4	208/230-1-60	6.2	15	20	4.7	3.27	4.0	3.75	4.60
50VSC,D	1	208/230-1-60	8.3	15	27	6.3	4.40	4.0	5.25	6.25
50VSE,F	1 1/4	208/230-1-60	13.3	25	42	9.9	6.30	5.4	7.07	8.80
50VSG,H	1 1/2	208/230-1-60	13.6	25	42	9.9	6.70	7.6	7.50	9.00
50VSI,J	2	208/230-1-60	15.1	25	46	10.8	8.20	8.0	9.20	11.70
50VSK,L	2 1/2	208/230-1-60	22.4	35	70	16.5	11.00	10.4	12.20	14.10
50VSM,N	3	208/230-1-60	25.3	40	79	18.6	12.70	16.0	13.65	16.50

LEGEND

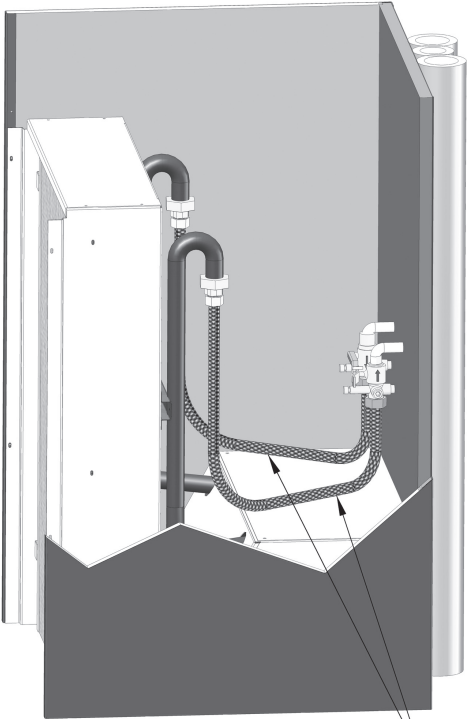
LRA — Locked Rotor Amps

RLA — Rated Load Amps

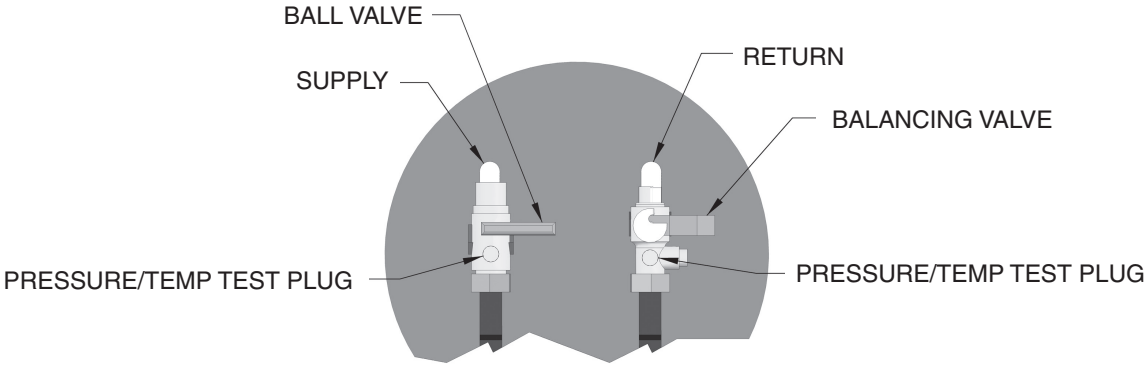
Typical piping and wiring



HOSE KIT INSTALLATION



1/2-in. FLEX HOSE (50VSA-VSH UNITS)
3/4-in. FLEX HOSE (50VSI-VSN UNITS)

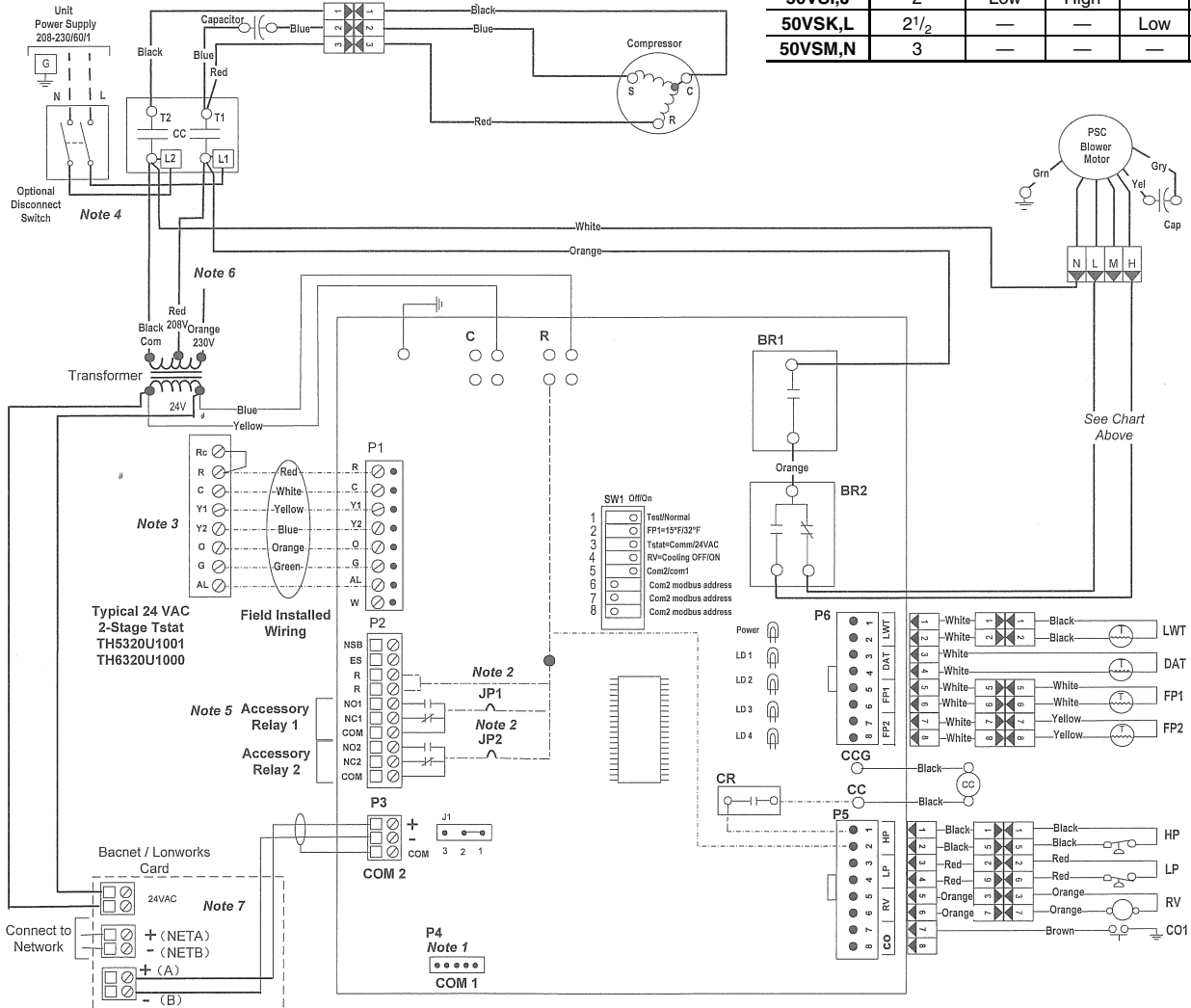


VALVE DETAIL VIEW

Typical control wiring schematics



BLOWER SPEED WIRING						
Unit	Nominal Capacity (Tons)	Orange	Brown	Black	Blue	Red
50VSA,B	3/4	Low	High	—	—	—
50VSC,D	1	—	Low	High	—	—
50VSE,F	1 1/4	—	—	Low	High	—
50VSG,H	1 1/2	—	—	—	Low	High
50VSI,J	2	Low	High	—	—	—
50VSK,L	2 1/2	—	—	Low	High	—
50VSM,N	3	—	—	—	Low	High



- LEGEND**
- BR1 — Fan Relay Speed 1
 - BR2 — Fan Relay Speed 2
 - CC — Compressor Contactor
 - CO — Condensate Overflow
 - CR — Compressor Relay
 - DAT — Discharge Air Temperature
 - FP1 — Freeze Protection Water Side
 - FP2 — Freeze Protection Air Side
 - HP — High Pressure Switch
 - LP — Low Pressure Switch
 - LWT — Leaving Water Temperature
 - RV — Reversing Valve
 - — — — — Factory Low Voltage Wiring
 - — — — — Factory High Voltage Wiring
 - - - - - Field Low Voltage Wiring
 - - - - - Field Line Voltage Wiring
 - - - - - Optional Block
 - - - - - Internal PCB Connection
 - — Quick Connect Terminal
 - — Screw Terminal
 - — Relay Coil
 - — Capacitor
 - — High Pressure Switch
 - — Low Pressure Switch
 - — Temperature Thermistor
 - — Condensate Switch
 - — Relay Contacts

- NOTES:**
- Used for optional communicating thermostat.
 - Cut JP1 or JP2 for dry contact output accessory relay 1 and 2.
 - If a single stage thermostat is used, place a jumper wire between Y1 and Y2 at P1 terminal.
 - If the disconnect option is not installed, connect the power to the L1 and L2 lugs on the compressor contactor.
 - Accessory relays 24-vac maximum, activated by compressor output.
 - For 230-v operation, remove the red wire and replace with the orange wire.
 - Before connecting BacNet™ or LonWorks® card, connect communicating thermostat, then short J1 (2-3). If adding terminating resistance, short J1 (1-2).

Application data



Operating Limits

Environment

Units are designed for indoor installation only. Never install units in areas subject to freezing or where humidity levels could cause cabinet condensation (such as unconditioned spaces subject to 100% outside air).

Power supply

A voltage variation of $\pm 10\%$ of nameplate utilization voltage is acceptable.

Starting conditions

Consult the Limits of Operation table for the 50VS starting conditions which are based upon the following:

- Conditions in the Limits of Operation table are not normal or continuous operating conditions. Minimum/maximum limits are start-up conditions to bring the building space up to occupancy temperatures. Units are not designed to operate under these conditions on a regular basis.
- Voltage utilization range complies with ARI Standard 110.
- Determination of operating limits is dependent primarily upon three factors:
 - Ambient temperature
 - Return air temperature
 - Water temperature
- When any one of these factors is at minimum or maximum levels, the other two factors should be at normal levels to ensure proper unit operation.

Extreme variations in temperature and humidity and/or corrosive water or air will adversely affect unit performance, reliability, and service life.

Heat exchanger

Refer to the Temperature Change through Heat Exchanger table for acceptable water flow temperature changes in closed and open loop systems.

LIMITS OF OPERATION

Air Limits	Cooling (F)	Heating (F)
Ambient Air Maximum	50	50
Ambient Air Minimum	100	85
Rated Ambient Air	80.6	68
Rated Entering Air (db/wb)	80.6/66.2	68
Entering Air Maximum (db/wb)	100/83	80
Entering Water Minimum	30	20
Entering Water (Normal)	50-110	30-70
Entering Water Maximum	120	90

LEGEND

db — Dry Bulb
wb — Wet Bulb

*Requires additional insulation when operating below the dew point.

TEMPERATURE CHANGE THROUGH HEAT EXCHANGER

Water Flow gpm	Rise in Cooling (°F)	Drop in Heating (°F)
For Closed Loop: Ground Source or Closed Loop Systems at 3 gpm per ton	9-12	4-8
For Open Loop: Ground Water Systems at 1.5 gpm per ton	20-26	10-17

Water loop system

Water loop (or boiler/tower) system applications typically include a number of units plumbed to a common piping system. For optimal performance, this system should be designed between 2.25 and 3 gpm per ton of cooling capacity. The system is comprised of highly efficient packaged reverse cycle heat pump units interconnected by a water loop. The water circuit serves as both a sink and source for heat absorption and rejection and is designed for entering water temperatures between 60 F and 90 F. Within this temperature range units can heat or cool as required from the same water source. Transferring heat from warm to cold spaces in the building, whenever they coexist, conserves energy rather than creating new heat.

Refer to the **Carrier Water Source Heat Pump System Design Guide** for assistance with the design of water loop systems. The guide includes a practical approach for the latest and most current design recommendations including:

- product application, including horizontal, vertical, console, rooftop and water-to-water applications
- ventilation methods and system design, including energy recovery
- acoustical considerations for different product types
- addressing indoor air quality (IAQ) issues such as condensate removal and humidity control
- air distribution design including diffuser selection/layout and ductwork design
- hydronic system design including pipe sizing/layout and boiler/tower sizing
- control configurations such as standalone, DDC, DCV, and VVT® controls
- Water Source Heat Pump Efficiency/Operational Cost Comparison chart
- system variations such as a system without a boiler, variable pumping, and variable air volume (VAV) for interior use

Ground water systems

To utilize Aquazone™ units in ground water applications, extended range should be specified. This will provide factory-installed insulation on the coaxial coil to prevent condensate from dripping when entering water temperatures are below 60 F. In addition, the copper coaxial coil installed on the Aquazone units may not be suitable for all water conditions. Refer to the Water Conditioning section for proper coaxial coil material selection.

Surface water system — This system is typically located near a lake or pond. In this application, the loop can be submerged in a series of coils beneath the water surface. The number of coils required depends on system load and design. This application requires minimum piping and excavation.

Open loop system — This system is used where ground water is plentiful. In this application, ground water is pumped through supply piping from the well to the building. The water is then pumped back into the ground through a discharge well as it leaves the building. An additional heat exchanger is usually installed between the building water

Application data (cont)



pipng system and the ground water piping system. This design limits the amount of piping and excavation required.

Aquazone units are provided with a standard thermostatic expansion valve (TXV) and are rated to extremely low temperatures to self-adjust the refrigeration circuit, therefore water regulating valves are not required on open loop systems. To conserve water on this type of system, a slow opening/closing solenoid valve is recommended.

Ground loop systems

There are many commonly specified designs for ground loop applications. Typical designs include vertical loops and horizontal loops. In some applications, water is piped from the ground or lake directly to the water source heat pump. Piping is limited to the amount of pipe required to get the water from the source to the unit.

NOTE: When utilizing Aquazone water source heat pumps in ground loop systems, refer to design considerations in the ground water system section.

Horizontal ground loop — This system is used when adequate space is available and trenching can be easily accomplished. A series of parallel pipes are laid out in trenches 3 to 6 ft below the ground surface, and then back-filled. Often, multiple pipes are used to maximize the heat transfer capability of each trench. The amount of pipe and the size of the ground loop field are based on ground conditions, heating, and cooling requirements of the application and system design.

Vertical ground loop — This system is used in vertical borehole applications. This design is well suited for retrofit applications when space is limited or where landscaping is already complete and minimum disruption of the site is desired. The vertical ground loop system contains a single loop of pipe inserted into a hole. The hole is back-filled and grouted after the pipe is inserted. The completed loop is concealed below ground. The number of loops required depends on ground conditions, heating and cooling requirements, and the depth of each hole.

Hybrid systems — In some applications, it may be beneficial to incorporate a cooling tower into the ground loop system to reduce the overall cost. A hybrid system discards excess heat into the air and increases the cooling performance of the ground loop.

Condensate drainage

Venting — Condensate lines should be properly vented to prevent fan pressure from causing water to hang up in the piping. Condensate lines should be pitched to assure full drainage of condensate under all load conditions. Chemical treatment should be provided to remove algae in the condensate pans and drains in geographical areas that are conducive to algae growth.

Trapping — Condensate trapping is an essential necessity on every water source heat pump unit. A trap is provided to prevent the backflow of moisture from the condensate pan and into the fan intake or downstream into the mechanical system. The water seal or the length of the trap depends on the positive or negative pressure on the drain pan. As a rule of thumb, the water seal should be sized for 1 in. for every 1 in. of negative pressure on the unit. The water seal is the distance from the bottom of the unit condensate piping connection to the bottom of the condensate drain line run-out piping. Therefore, the trap size should be double the water seal dimension.

Vertical units — Vertical units utilize a condensate hose inside the cabinet that acts as a trapping loop, therefore an external trap is not necessary. Each unit must be installed with its own vent and means to flush or blow out the condensate drain lines. Do not install a common trap or vent on vertical units.

Water conditioning

In some applications, maintaining proper water quality may require the use of higher corrosion protection for the water-to-refrigerant heat exchanger. Water quality varies from location to location and is unique for each job. Water characteristics such as pH value, alkalinity, hardness, and specific conductance are of importance when considering any WSHP application. Water typically includes impurities and hardness that must be removed. The required treatment will depend on the water quality as well as type of system. Water problems fall into three main categories:

1. Scale formation caused by hard water reduces the heat transfer rate and increases the water pressure drop through the heat exchanger. As water is heated, minerals and salts are precipitated from a solution and deposited on the inside surface of the pipe or tube.
2. Corrosion is caused by absorption of gases from the air coupled with water on exposed metal. Corrosion is also common in salt-water areas.
3. Organic growths such as algae can reduce the heat transfer rate by forming an insulating coating on the inside tube surface. Algae can also promote corrosion by pitting.

NOTE: In most commercial water loop applications, Aquazone™ WSHP units use copper water-to-refrigerant heat exchanger. Units can also be equipped with a cupronickel heat exchanger for applications where water is outside the standard contaminant limits for a copper heat exchanger.



WATER QUALITY GUIDELINES

CONDITION	HX MATERIAL*	CLOSED RECIRCULATING†	OPEN LOOP AND RECIRCULATING WELL**
Scaling Potential — Primary Measurement			
Above the given limits, scaling is likely to occur. Scaling indexes should be calculated using the limits below.			
pH/Calcium Hardness Method	All	N/A	pH < 7.5 and Ca Hardness, <100 ppm
Index Limits for Probable Scaling Situations (Operation outside these limits is not recommended.)			
Scaling indexes should be calculated at 150 F for direct use and HWG applications, and at 90 F for indirect HX use. A monitoring plan should be implemented.			
Ryznar Stability Index	All	N/A	6.0 - 7.5 If >7.5 minimize steel pipe use.
Langelier Saturation Index	All	N/A	-0.5 to +0.5 If <-0.5 minimize steel pipe use. Based upon 150 F HWG and direct well, 85 F indirect well HX.
Iron Fouling			
Iron Fe ²⁺ (Ferrous) (Bacterial Iron Potential)	All	N/A	<0.2 ppm (Ferrous) If Fe ²⁺ (ferrous) >0.2 ppm with pH 6 - 8, O ₂ <5 ppm check for iron bacteria.
Iron Fouling	All	N/A	<0.5 ppm of Oxygen Above this level deposition will occur.
Corrosion Prevention††			
pH	All	6 - 8.5 Monitor/treat as needed.	6 - 8.5 Minimize steel pipe below 7 and no open tanks with pH <8.
Hydrogen Sulfide (H ₂ S)	All	N/A	<0.5 ppm At H ₂ S>0.2 ppm, avoid use of copper and cupronickel piping or HXs. Rotten egg smell appears at 0.5 ppm level. Copper alloy (bronze or brass) cast components are okay to <0.5 ppm.
Ammonia Ion as Hydroxide, Chloride, Nitrate and Sulfate Compounds	All	N/A	<0.5 ppm
Maximum Chloride Levels	Maximum allowable at maximum water temperature.		
		50 F (10 C)	75 F (24 C)
	Copper	N/A	NR
	CuproNickel	N/A	NR
	304 SS	N/A	<250 ppm
	316 SS	N/A	<550 ppm
	Titanium	N/A	<1000 ppm
			>1000 ppm
			>550 ppm
			>375 ppm
			>375 ppm
Erosion and Clogging			
Particulate Size and Erosion	All	<10 ppm of particles and a maximum velocity of 6 fps. Filtered for maximum 800 micron size.	<10 ppm (<1 ppm "sandfree" for reinjection) of particles and a maximum velocity of 6 fps. Filtered for maximum 800 micron size. Any particulate that is not removed can potentially clog components.
Brackish	All	N/A	Use cupronickel heat exchanger when concentrations of calcium or sodium chloride are greater than 125 ppm are present. (Seawater is approximately 25,000 ppm.)

LEGEND

- HWG** — Hot Water Generator
- HX** — Heat Exchanger
- N/A** — Design Limits Not Applicable Considering Recirculating Potable Water
- NR** — Application Not Recommended
- SS** — Stainless Steel

*Heat exchanger materials considered are copper, cupronickel, 304 SS (stainless steel), 316 SS, titanium.

†Closed recirculating system is identified by a closed pressurized piping system.

**Recirculating open wells should observe the open recirculating design considerations.

††If the concentration of these corrosives exceeds the maximum allowable level, then the potential for serious corrosion problems exists.

Sulfides in the water quickly oxidize when exposed to air, requiring that no agitation occur as the sample is taken. Unless tested immediately at the site, the sample will require stabilization with a few drops of one Molar zinc acetate solution, allowing accurate sulfide determination up to 24 hours after sampling. A low pH and high alkalinity cause system problems, even when both values are within ranges shown. The term pH refers to the acidity, basicity, or neutrality of the water supply. Below 7.0, the water is considered to be acidic. Above 7.0, water is considered to be basic. Neutral water contains a pH of 7.0.

To convert ppm to grains per gallon, divide by 17. Hardness in mg/l is equivalent to ppm.

Application data (cont)



Acoustical design

Sound power levels represent the sound as it is produced by the source, the WSHP unit, with no regard to attenuation between the source and the space. Acoustical design goals are necessary to provide criteria for occupied spaces where people can be comfortable and communicate effectively over the background noise of the air-conditioning system and other background noise sources.

Acoustical design goals are desirable sound pressure levels within a given conditioned space and are represented by noise criteria (NC) curves. Noise criteria (NC) curve levels represent a peak over a full spectrum of frequencies. A high value in a low frequency band has the same effect on NC level as a lower value in a high frequency band. It is important that sound levels be balanced over the entire spectrum relative to the NC curve. The lower the NC criteria curve, the more stringent the room acoustical design must be to meet the design goals.

It is important to know how to convert NC levels from the unit ratings in terms of sound power (L_w). This conversion depends on the specifics of the acoustical environment of the installation.

The resulting calculations are compared to the NC curve selected for the area to assess the acoustical design.

Some of the factors that affect conversion of sound power to sound pressure and consequent NC level include:

- type of acoustical ceiling
- use of metal or flex duct
- absorption in the occupied space
- location in the occupied space
- open or closed layout plan
- use of open or ducted returns
- orientation of unit to occupant
- use of lined or unlined duct

WSHP sound control

The analysis of the projected sound level in the conditioned space caused by a WSHP unit located in a ceiling plenum is quite involved. The key is to have good sound power ratings (L_w) in dB on the equipment to determine the sound attenuation effect of the ductwork, ceiling and room. In combination with utilizing standard Aquazone™ equipment attenuating features or the advanced mute package features, suggestions for vertical unit sound design are provided to design around the WSHP units.

Vertical units

Since vertical units tend to be installed in small equipment rooms or closets, the following guidelines apply:

1. Mount the unit on a pad made of high-density sound absorbing material such as rubber or cork. Extend the pad beyond the WSHP unit footprint by at least 6 inches in each direction.
2. Since the unit returns airflow through a grille mounted in a closet door, provide a sound barrier or some other modification of the closet to prevent line-of-site noise into the space.
3. Follow good duct design practice in sizing and locating the connection of the WSHP discharge to the supply duct system. Use an elbow with turning vanes and bent in the direction of the fan rotation to minimize turbulence. Make any duct transitions as smooth and as gradual as possible to again minimize turbulence and loss of fan static pressure.

Solenoid valves

In applications using variable flow pumping, solenoid valves can be field installed and operated from the control board in the Aquazone WSHP unit.

Freeze protection

Applications where systems are exposed to outdoor temperatures below freezing (32 F) must be protected from freezing. The most common method of protecting water systems from freezing is adding glycol concentrations into the water. Design care should be used when selecting both the type and concentrations of glycol utilized due to the following:

- Equipment and performance may suffer with high concentrations of glycol and other antifreeze solutions.
- Loss of piping pressure may increase greatly, resulting in higher pumping costs.
- Higher viscosity of the mixture may cause excess corrosion and wear on the entire system.
- Acidity of the water may be greatly increased, promoting corrosion.
- Glycol promotes galvanic corrosion in systems of dissimilar metals. The result is corrosion of one metal by the other, causing leaks.

Guide specifications



Packaged Water Source Heat Pumps

HVAC Guide Specifications

Size Range: **9,200 to 32,700 Btuh**
Cooling Capacity
12,500 to 45,000 Btuh
Heating Capacity

Carrier Model Number: **50VS**

Part 1 — General

1.01 SYSTEM DESCRIPTION

- A. Install vertical stack water source heat pumps for furred-in or exposed cabinets that are floor mounted as indicated on the plans with capacities and characteristics as listed in the schedule and the specifications that follow.
- B. Units shall be supplied completely factory built and capable of operation with an entering water temperature range from 20 to 110 F as standard.
Equivalent units from other manufacturers can be proposed provided approval to bid is given 10 days prior to bid closing.
- C. Units shall be individually packaged with wooden skid covered with protective corner posts and plastic stretch wrapping for maximum protection.

1.02 QUALITY ASSURANCE

- A. All equipment listed in this section must be rated in accordance with ARI/ASHRAE/ISO 13256-1 performance standard and ETL. Units shall be sound tested in accordance with ARI standard 350-86. The units shall have ARI/ISO, NRTL, and ETL labels.
- B. All units shall be factory tested under normal operating conditions at nominal water flow rates. Insulation and adhesive shall meet NFPA-90A requirements for flame spread and smoke generation. All equipment wiring shall comply with NEC requirements.
- C. Serial numbers will be recorded by factory and furnished to contractor for ease of unit warranty status.
- D. Units which are tested without water flow rates are not acceptable.

Part 2 — Product

2.01 EQUIPMENT

A. General:

1. The vertical stack heat pumps shall be fabricated from heavy gage galvanized sheet metal. All interior surfaces shall be lined with 1/2-in. thick, 1 1/2-lb acoustic type fiberglass insulation. All fiberglass shall be coated and have exposed edges tucked under flanges to prevent the introduction of glass fibers into the airstream. All insulation must meet NFPA 90A.
2. Units shall be prewired and precharged in factory.

B. Unit Cabinet:

1. Furred-In Stack Unit:

The unit shall be constructed of 20-gage galvanized steel frame and 18-gage galvanized steel return panel. The fan coil is open or enclosed for furred-in installation. These units not are designed to have the wallboard applied directly to the unit surface and all openings have standard 1/2-in. thick fiberglass insulation. Units have double deflection aluminum discharge grille(s) and painted, stamped (standard) or bar-type aluminum (optional) return-air grille panel. Removable return-air grille provides access to all internal piping and wiring. Controls are provided with a quick disconnect plug for field mounting on front of unit.

2. Vertical stack units shall have one of the following airflow arrangements: single, double, triple, or no supply with front, right, or left return.

If units with these arrangements are not used, the contractor is responsible for any extra costs incurred by other trades.

3. Cabinets shall have separate openings and knockouts for entrance of line voltage and low voltage control wiring. Contractor must ensure that units can be easily removed for servicing and coordinate locations of electrical conduit and lights with the electrical contractor.

4. All units must have a removable chassis and blower motor assembly for serviceability of equipment.

If other arrangements make servicing difficult, the contractor must provide access panels and clear routes to ease service. Architect must approve any changes in layout.

5. All units must have an insulated panel separating the fan compartment from the compressor compartment.

6. Sound attenuation shall consist of 3 levels of isolation in addition to the compressor housing insulation. This shall include the compressor mounted on individual vibration pads under each connection point, the use of a vibration pad under the compressor mounting frame, and a blanket of insulation wrapped around the compressor.

7. Return air access panel shall be 18 gage heavy duty panel with stamped louvers to protect against impact. Tamper-resistant quarter-turn fasteners provided as standard. Attractive ivory epoxy powder coating is standard, but additional colors (optional) are available.

8. Supply air grilles are available in single deflection, double deflection, and double deflection-opposed damper.

Guide specifications (cont)



C. Fan and Motor Assembly:

1. All vertical stack units shall have a direct-drive centrifugal fan. The fan motor shall be 2-speed, permanently lubricated, PSC (permanent split capacitor) type with internal thermal overload protection.
2. Blower assembly must be removable with a motor quick connect.
3. Units supplied without permanently lubricated motors must provide external oilers for easy service.
4. Fan wheel shall be double-width type with forward-curved blades and shall be statically and dynamically balanced.
5. Fan wheel and scroll shall be constructed of galvanized steel.
6. The fan motor shall be isolated from the fan housing by torsionally flexible isolation grommets. The fan and motor assembly must be capable of overcoming the external static pressures as shown on the schedule.
7. Cfm/static pressure rating of the unit shall be based on a wet coil and a clean filter in place.

D. Refrigerant Components:

1. Units shall have a sealed Puron® (R-410A) refrigerant circuit including a high efficient scroll or rotary compressor designed for heat pump operation.
2. Units shall have a thermostatic expansion valve for refrigerant metering, an enhanced aluminum lanced fin and rifled copper tube refrigerant-to-air heat exchanger, a reversing valve, a coaxial (tube-in-tube) refrigerant-to-water heat exchanger.
3. Refrigerant-to-air heat exchangers shall utilize enhanced lanced aluminum fins and rifled copper tube construction rated to withstand 600 psig refrigerant working pressure.
4. Refrigerant-to-water heat exchangers shall be of copper inner-water tube and steel refrigerant outer tube design, rated to withstand 600 psig working refrigerant pressure and 600 psig working water pressure. Plate-to-plate heat exchangers cannot be used.
5. Refrigerant metering shall be accomplished by thermostatic expansion valve only. Units are intended for use within an operating range of entering water temperatures from 20 to 110 F.
6. Reversing valves shall be 4-way solenoid activated refrigerant valves which shall fail to heating operation should the solenoid fail to function. If the reversing valve solenoid fails to cooling, a low temperature thermostat must be provided to prevent over-cooling an already cold room.
7. Units shall include standard cupronickel coaxial water-to-refrigerant heat exchangers.

8. Optional 2-way water control valve shall be available.
9. Water circuit options to provide internally mounted 1.5 or 3.0 gpm per ton automatic flow regulating valves shall be available.

E. Drain Pan:

1. The drain pan shall be sloped and constructed of a painted, galvanized corrosion resistant steel to inhibit corrosion and must be fully insulated.
2. Drain outlet shall be located on pan as to allow complete and unobstructed drainage of condensate. The drain is factory piped to the drain riser which has a removable "P-trap" allowing easy cleaning.
3. Cabinet base shall contain secondary drain pan, fully insulated with pressure drain trap connected to condensate riser.
4. The standard unit will be supplied with solid-state electronic condensate overflow protection. Mechanical float switches are not acceptable.

F. Filter:

Units shall have a factory-installed 1-in. cleanable aluminum mesh filter complete with aluminum frame and drain holes.

G. Risers:

1. Standard factory-furnished and installed risers shall range from 104-in. to 115-in. long with 3-in. belled ends at the top such that only one sweat connection shall be required at each floor to join one riser to another.
2. Risers shall be type M or type L copper insulated with 1/2 or 3/4-in. thick synthetic rubber.
3. Standard supply and return risers shall be 3/4, 1, 1 1/4, 1 1/2, 2, or 2 1/2-in. diameter; drain riser shall be 1-in. diameter.
4. Riser extensions shall be available in various sizes.

H. Valves:

The factory furnished and installed piping shall include flow regulators sized as per the specification.

I. Controls and Safeties:

1. Electrical:
 - a. A control box shall be located within the unit compressor compartment and shall contain a 75-v transformer, 24-v activated, 2 or 3 pole compressor contactor, terminal block for thermostat wiring and solid-state controller for complete unit operation. Electro-mechanical operation is not acceptable.
 - b. Units shall be nameplated for use with time-delay fuses or HACR circuit breakers. Unit controls shall be 24-v and provide heating or cooling as required by the remote thermostat/sensor.



2. Piping:
 - a. Supply and return water connections shall be copper FPT fittings and shall be securely mounted to the chassis corner post allowing for connection to a flexible hose with the use of a back-up wrench.
 - b. All water connections and electrical knock-outs must be in the compressor compartment corner post as to not interfere with the serviceability of unit. Contractor shall be responsible for any extra costs involved in the installation of units that do not have this feature.
3. Unit Controls:
 - a. Safety controls shall include a high-pressure switch, a low-pressure sensor, and a low water and low air-temperature sensor. Access fittings shall be factory installed on high and low pressure refrigerant lines to facilitate field service.
 - b. Activation of any safety device shall prevent compressor operation via a lockout device. The lockout shall be reset at the thermostat or at the contractor-supplied disconnect switch.
 - c. Units which may be reset at the disconnect switch only shall not be acceptable.
4. The standard microprocessor electronic control system shall interface with a heat pump (Y,O) wall thermostat (mechanical or electronic). The control system microprocessor board shall be specifically designed to protect against building electrical system noise contamination, EMI, and RFI interference. The control system shall have the following features:
 - a. 75-va transformer.
 - b. Performance monitor (PM).

The PM warns when the heat pump is running inefficiently.
 - c. Anti-short cycle time delay on compressor.

Operation time delay shall be 5 minutes minimum.
 - d. Random start on power up mode.
 - e. Unit protection.
 - 1) Low voltage protection.
 - 2) High voltage protection.
 - 3) Water coil freeze protection (selectable for water or antifreeze).
 - 4) Air coil freeze protection (check filter switch).
 - f. Unit shutdown.
 - 1) High or low refrigerant pressures.
 - 2) Low water temperature.
 - 3) Condensate overflow.
 - g. Option to reset unit at thermostat or disconnect. Fault type shall be retained in memory if reset at thermostat.
 - h. Automatic intelligent reset.

Unit shall automatically reset 5 minutes after trip if the fault has cleared. Should a fault reoccur 3 times sequentially then permanent lockout will occur.
 - i. Ability to defeat time delays for servicing.
 - j. Light-emitting diodes (LEDs) to indicate high pressure, low pressure, low voltage, high voltage, air/water freeze protection, condensate overflow, and control status.
 - k. Low-pressure switch.

The switch SHALL NOT be monitored for the first 90 seconds after a compressor start command to prevent nuisance safety trips.
 - l. Remote fault type indication at thermostat.
 - m. Outputs.
 - 1) Selectable 24-v or pilot duty dry contact alarm output.
 - 2) A 24-v output to cycle a motorized water valve with compressor contactor.
 - n. Service test mode for troubleshooting and service.
 - o. A removable thermostat connector.
 - p. Night setback.
 - 1) Random start on return from night setback.
 - 2) Night setback control from low temperature thermostat, with 2-hour override initiated by a momentary signal from the thermostat.
 - 3) Dry contact night setback output for digital night setback thermostats.
 - q. Intelligent reversing valve operation for extended life and quiet operation.
 - r. Ability to work with both heat/cool (Y, W) thermostats and with heat pump thermostats using O or B reversing valve control.
 - s. Single grounded wire to initiate night setback, or emergency shutdown.
 - t. Boilerless system control.

Control can switch automatically to electric heat at low loop water temperature.
 - u. Dehumidistat input providing fan control for dehumidification operating.
 - v. Multiple units connected to one sensor providing communication for up to 3 water source heat pumps.
 - w. Selection of boilerless changeover temperature set point.
 - x. Compressor relay staging for dual stage units or in master/slave applications.
5. LON or BACNet interface shall be made available for factory installation to provide DDC capability.

Guide specifications (cont)



J. Special Features:

1. Integral hose kits.
2. Non-fused disconnect switch shall be factory installed. Switch shall be suitable for single phase, 60 Hz service for 208-v as specified on the equipment schedule.
3. Supply grilles shall be available in 4 sizes as single deflection, double deflection, or double deflection opposed damper.
4. Front panels shall be available in the following designs: quarter turn fastener, removable perimeter bypass return panel; quarter turn fastener, hinged perimeter bypass return panel; keylock hinged perimeter bypass return panel; quarter turn fastener, removable louvered return panel.
5. Thermostat Controls:
 - a. Programmable multi-stage thermostat with 7-day clock, holiday scheduling, large backlit display, and remote sensor capability.
 - b. Programmable 7-day light activated thermostat offers occupied comfort settings with lights on, unoccupied energy savings with lights off.
 - c. Programmable 7-day flush mount thermostat offers locking coverplate with tamper proof screws, flush to wall mount, dual point with adjustable deadband, O or B terminal, and optional remote sensor.
 - d. Programmable 5-day thermostat offers 2 stage heat, 2 stage cool, auto changeover, 5-minute built-in compressor protection, and included locking cover.
 - e. Non-programmable thermostat with 2 heat stages, 2 cool stages, auto changeover, 5-minute built-in compressor protection, and included locking cover.
6. Loop controller with six stages (2 stages for heating and 4 stages for heat rejection).
7. Filter rack (2-in.) to enhance the filtration system of the water source heat pump.
NOTE: Filter rack does not include filters.
8. Fire-rated hose kits with a fixed MPT on one end and a swivel with an adapter on the other end. Hose kits can be either stainless steel or galvanized.
9. Ball valves (brass body) for shut off and balancing water flow. Available with memory, with memory stop, and pressure temperature ports.
10. Strainers (bronze body) "Y" type configuration with a brass cap. Maximum operating pressure rating of 450 psi. Strainer screen made of stainless steel.
11. Hose kit assemblies include a ported ball valve with pressure temperature (P/T) plug ports and flexible stainless steel hose with swivel and nipple. Return hose includes a ball valve, pre-set measure flow (gpm) with two P/T ports, and flexible stainless steel hose with a swivel and nipple.
12. Remote sensors for Aquazone™ flush-mount thermostats.

