



## VERTICAL STACK (VHS) SERIES



SIZE 10 - 36 (2.6kW - 10.6kW)  
VERTICAL HI-RISE  
R22 - 60Hz STANDARD RANGE



## VERTICAL STACK (VHS) SERIES



RSS - 60Hz STANDARD  
VERTICAL HI-RISE  
SIZE 10 - 36 (5.6kW - 10.6kW)

### THE VERTICAL STACK (VHS) SERIES

The VHS series offers an innovative, labor-saving solution for spaces where individual, quiet control of the heating and cooling system is important. VHS units' pre-piped risers and pre-wired cabinets are especially ideal for multi-story buildings. Cabinets can operate as stand-alone "ductless" systems, or can be ducted to an adjacent room, making them convenient for low-rise buildings as well. The VHS series meets ASHRAE 90.1 efficiencies, yet maintains small cabinet dimensions.

Available in sizes 3/4 ton (2.6 kW) through 3 tons (10.6 kW) with numerous cabinet, water piping and control choices, the VHS series offers a wide range of units for most any installation. The VHS has an extended range refrigerant circuit with a TXV refrigerant metering device. Standard features are many. Microprocessor controls, galvanized steel cabinet, torsion-flex blower motor mounting, and e-coated air coil are just some of the features of the innovative VHS series.

ClimateMaster's exclusive double isolation compressor mounting system makes the VHS series the quietest vertical stack units on the market. Compressors are mounted on vibration isolation springs to a heavy gauge mounting plate, which is then isolated from the cabinet base with rubber grommets for maximized vibration/sound attenuation. Options such as high static fan motor for ducted applications, DDC controls, internal pump and factory-installed water solenoid valves allow customized design solutions.

The VHS Series console water-source heat pumps are designed to meet the challenges of today's HVAC demands with a low cost/high value solution.

### UNIT FEATURES

- Sizes 010 (3/4 ton, 2.76 kW) through 036 (3 ton, 10.6 kW)
- Efficient rotary and reciprocating compressors
- Meets ASHRAE 90.1 efficiencies
- Removable chassis allows staged installation and ease of maintenance
- Galvanized steel cabinet
- Unique double isolation compressor mounting for quiet operation
- TXV metering device
- Unit or remote-mounted controls available
- Microprocessor controls standard (optional DXM and/or DDC controls)
- LonWorks, BACnet, Modbus and Johnson N2 compatibility options for DDC controls
- Unit Performance Sentinel performance monitoring system (remote controls)
- Integrated drain pan with condensate overflow sensor
- Attractive return air panel with hinged access door ("G" panel)
- Multiple supply air discharge options
- Stainless steel braided hose kits for connection from piping risers to chassis
- Eight Safeties Standard
- Wide variety of options including disconnect switch and internal pumps



New EarthPure® HFC-410A chassis now available in the Tranquility Modular (TRM) Series.

## Selection Procedure

### Reference Calculations

Heating	Cooling
$LWT = EWT - \frac{HE}{GPM \times 500}$	$LWT = EWT + \frac{HR}{GPM \times 500}$
$LAT = EAT + \frac{HC}{CFM \times 1.08}$	$LAT (DB) = EAT (DB) - \frac{SC}{CFM \times 1.08}$
	$LC = TC - SC$
	$S/T = \frac{SC}{TC}$

### Legend and Glossary of Abbreviations

BTUH = BTU( British Thermal Unit) per hour	HWC = hot water generator (desuperheater) capacity, Mbtuh
CFM = airflow, cubic feet/minute	IPT = internal pipe thread
COP = coefficient of performance = BTUH output/BTUH input	KW = total power unit input, kilowatts
DB = dry bulb temperature (°F)	LAT = leaving air temperature, °F
EAT = entering air temperature, Fahrenheit (dry bulb/wet bulb)	LC = latent cooling capacity, BTUH
EER = energy efficiency ratio = BTUH output/Watt input	LWT = leaving water temperature, °F
EPT = external pipe thread	MBTUH = 1000 BTU per hour
ESP = external static pressure (inches w.g.)	S/T = sensible to total cooling ratio
EWT = entering water temperature	SC = sensible cooling capacity, BTUH
GPM = water flow in U.S. gallons/minute	TC = total cooling capacity, BTUH
HE = total heat of extraction, BTUH	WB = wet bulb temperature (°F)
HC = air heating capacity, BTUH	WPD = waterside pressure drop (psi & ft. of hd.)
HR = total heat of rejection, BTUH	

### Conversion Table - to convert inch-pound (English) to SI (Metric)

Air Flow	Water Flow	Ext Static Pressure	Water Pressure Drop
Airflow (L/s) = CFM x 0.472	Water Flow (L/s) = gpm x 0.0631	ESP (Pa) = ESP (in of wg) x 249	PD (kPa) = PD (ft of hd) x 2.99



## Selection Procedure

- Step 1 Determine the actual heating and cooling loads at the desired dry bulb and wet bulb conditions.
- Step 2 Obtain the following design parameters: Entering water temperature, water flow rate in GPM, air flow in CFM, water flow pressure drop and design wet and dry bulb temperatures. Air flow CFM should be between 300 and 450 CFM per ton. Unit water pressure drop should be kept as close as possible to each other to make water balancing easier. Go to the appropriate tables and find the proper indicated water flow and water temperature.
- Step 3 Select a unit based on total and sensible cooling conditions. Select a unit which is closest to, but no larger than, the actual cooling load.
- Step 4 Enter tables at the design water flow and water temperature. Read the total and sensible cooling capacities (Note: interpolation is permissible, extrapolation is not).
- Step 5 Read the heating capacity. If it exceeds the design criteria it is acceptable. It is quite normal for Water-Source Heat Pumps to be selected on cooling capacity only since the heating output is usually greater than the cooling capacity.
- Step 6 Determine the correction factors associated with the variable factors of dry bulb and wet bulb (page 14).
- Corrected Total Cooling =  
tabulated total cooling x wet bulb correction.  
Corrected Sensible Cooling =  
tabulated sensible cooling x wet/dry bulb correction.
- Step 7 Compare the corrected capacities to the load requirements. Normally if the capacities are within 10% of the loads, the equipment is acceptable. It is better to undersize than oversize, as undersizing improves humidity control, reduces sound levels and extends the life of the equipment.
- Step 8 When completed, calculate water temperature rise and assess the selection. If the units selected are not within 10% of the load calculations, then review what effect changing the GPM, water temperature and/or air flow and air temperature would have on the corrected capacities. If the desired capacity cannot be achieved, select the next larger or smaller unit and repeat the procedure. Remember, when in doubt, undersize slightly for best performance.

## Example Equipment Selection For Cooling

## Step 1 Load Determination:

Assume we have determined that the appropriate cooling load at the desired dry bulb 80°F and wet bulb 64°F conditions is as follows:

Total Cooling ..... 17,500 BTUH  
Sensible Cooling ..... 15,500 BTUH  
Entering Air Temp.... 80°F Dry Bulb / 64°F Wet Bulb

## Step 2 Design Conditions:

Similarly, we have also obtained the following design parameters:

Entering Water Temp ..... 90°F  
Water Flow (Based upon 10°F rise in temp.) 5 GPM  
Air Flow ..... 590 CFM

## Step 3, 4 &amp; 5 HP Selection:

After making our preliminary selection (816020), we enter the tables at design water flow and water temperature and read Total Cooling, Sens. Cooling and Heat of Rej. capacities:

Total Cooling ..... 18,300 BTUH  
Sensible Cooling ..... 13,700 BTUH  
Heat of Rejection ..... 23,700 BTUH

## Step 6 &amp; 7 Entering Air and Airflow Corrections:

Next, we determine our correction factors.

	Table	Ent Air	Air Flow	Corrected
Corrected Total Cooling =	18,300	x 0.940	x 0.986	= 16,961
Corrected Sens Cooling =	13,700	x 1.150	x 0.969	= 15,267
Corrected Heat of Reject =	23,700	x 0.954	x 0.969	= 22,248

## Step 8 Water Temperature Rise Calculation &amp; Assessment:

Actual Temperature Rise ..... 8.9°F

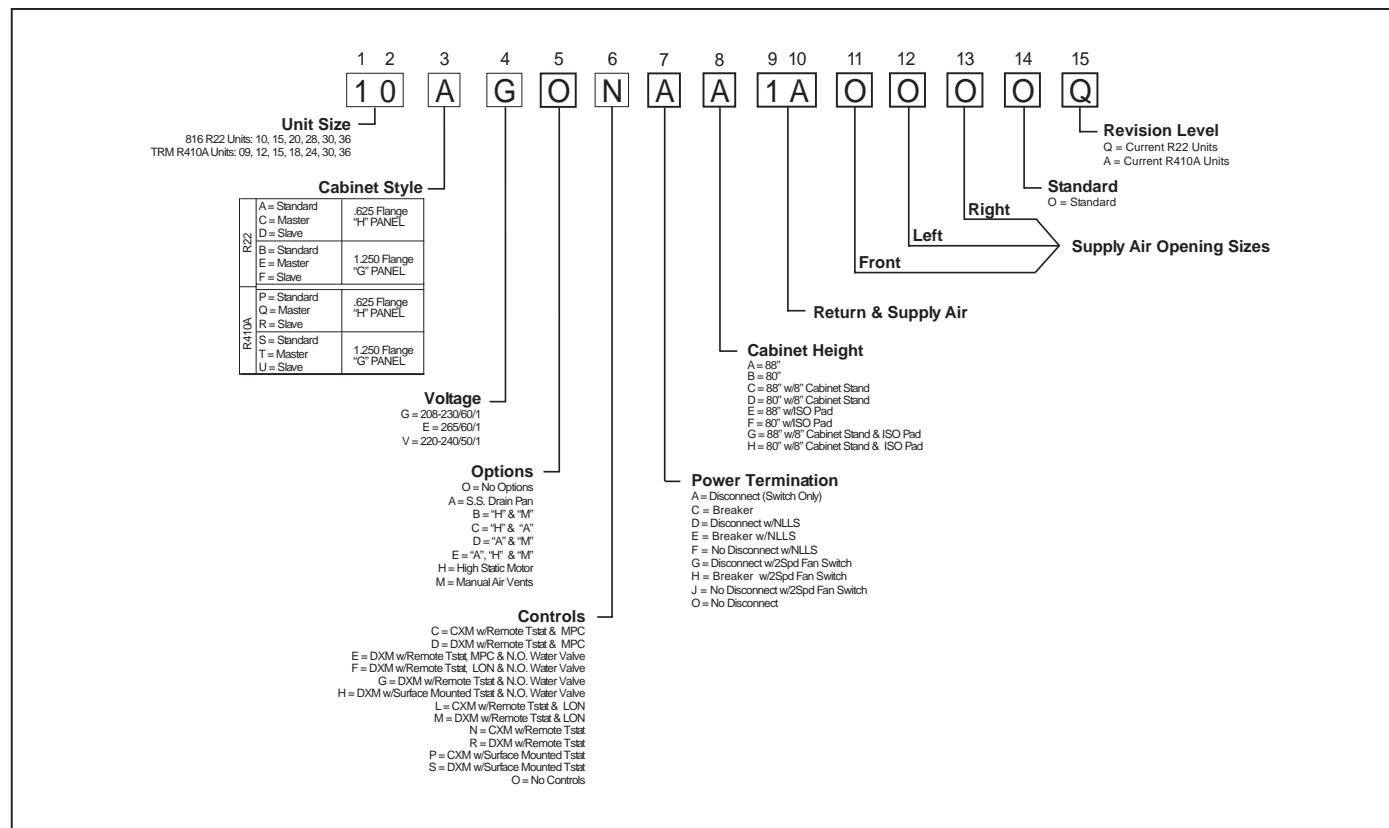
When we compare the Corrected Total Cooling and Corrected Sensible Cooling figures with our load requirements stated in Step 1, we discover that our selection is within +/- 10% of our sensible load requirement. Furthermore, we see that our Corrected Total Cooling figure is slightly undersized as recommended, when compared to the actual indicated load.

## Vertical Stack (VHS) Series

Rev.: 05/23/07D

## VHS Series Nomenclature

## Cabinet



## VHS Series Nomenclature

## Chassis

1 2 3 4 5 6 7 8 9 10 11 12 13

**8 1 6 1 0 G S P S S C O Q**

**Model Type**  
816 Chassis

**Unit Size**  
10, 15, 20, 28, 30, 36

**Voltage**  
E = 265/60/1  
G = 208-230/60/1

**Options**  
S = Standard  
A = Stainless Steel Drain Pan  
B = Insulated Tubing  
C = Return Air Sensor  
D = A & B  
E = A & C  
F = B & C  
G = A, B & C

**Controls**  
P = Standard (24V N.C. Safeties) for use with CXM or DXM

**Revision Level**  
Q = Current Revision

**Standard**  
O = Standard

**Heat Exchanger Options**  
C = Copper Coax w/Coated Air Coil  
N = Cupro-Nickel Coax w/Coated Air Coil  
L = Copper Coax w/Non-Coated Air Coil  
M = Cupro-Nickel Coax w/Non-Coated Air Coil  
H = Copper, RV Energized in Heating w/Coated Air Coil (Replacement Only)  
J = Cupro-Nickel, RV Energized in Heating w/Coated Air Coil (Replacement Only)

**Water Valve & Pump Option**  
S = No Water valve  
M = Normally Closed Water Valve  
N = Normally Open Water Valve  
P = Secondary Circulating Pump

**Automatic Flow Regulator (US gpm)**

	5/8SWEAT			7/8 SWEAT		
	UNIT 10	UNIT 15	UNIT 20	UNIT 28	UNIT 30	UNIT 36
C	1.5					
D	2.0	2.0				
E	2.5	2.5	2.5			
F	3.0	3.0	3.0			
G		3.5	3.5			
H		4.0	4.0	4.0		
J		5.0	5.0	5.0	5.0	
K		6.0	6.0	6.0	6.0	6.0
L				7.0	7.0	7.0
M				8.0	8.0	8.0
N				9.0	9.0	9.0
P					10.0	10.0
S	NO FLOW REGULATOR					

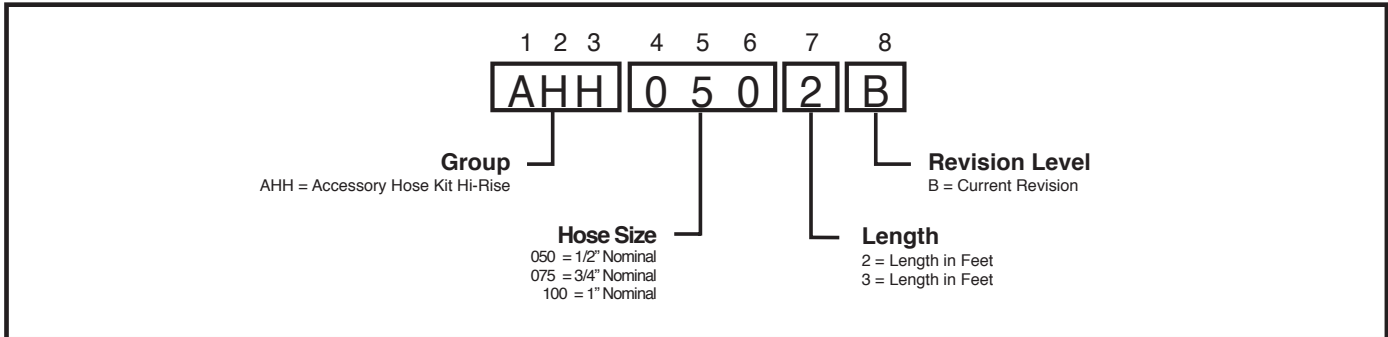
Rev.: 15 May, 2007D

## Vertical Stack (VHS) Series

Rev.: 05/23/07D

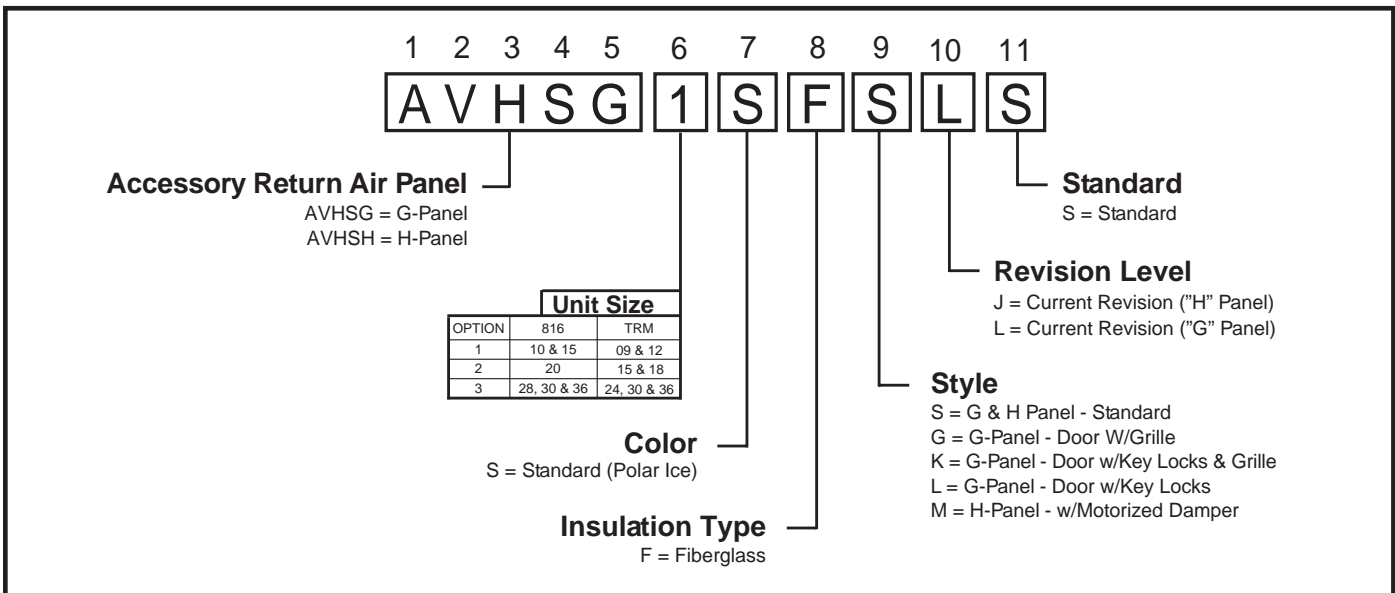
## VHS Series Nomenclature

## Hose Kit



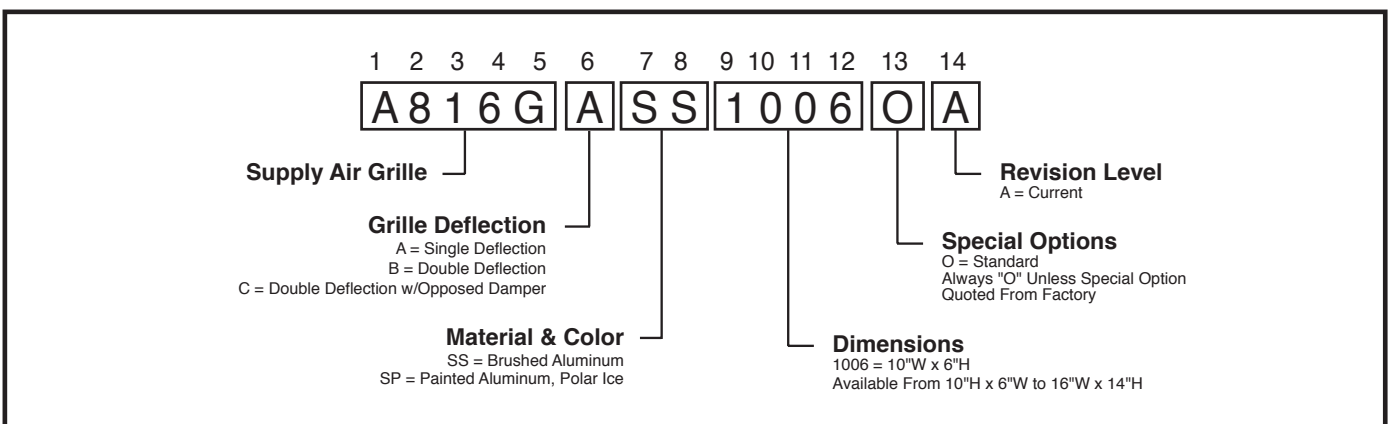
Rev.: 10/04/05D

## Return Air Panel



Rev.: 10/23/06D

## Supply Air Grille



Rev.: 10/04/05D



**Performance Data**  
**ARI/ASHRAE/ISO 13256-1**

ASHRAE/ARI/ISO 13256-1. English (IP) Units

Model	Water Loop Heat Pump				Ground Water Heat Pump				Ground Loop Heat Pump			
	Cooling 86°F		Heating 68°F		Cooling 59°F		Heating 50°F		Cooling 77°F		Heating 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
816-10	8,500	11.6	11,500	4.2	Please see the TRM Series for extended range applications.				Please see the TRM Series for extended range applications.			
816-15	12,000	12.3	14,700	4.2								
816-20	18,500	12.0	23,600	4.2								
816-28	25,200	12.0	32,000	4.2								
816-30	28,100	12.5	36,000	4.2								
816-36	32,600	12.5	42,500	4.2								

Cooling capacities based upon 80.6°F DB, 66.2°F WB entering air temperature

Heating capacities based upon 68°F DB, 59°F WB entering air temperature

All air flow is rated on high speed

All ratings based upon operation at lower voltage of dual voltage rated models

ASHRAE/ARI/ISO 13256-1. Metric (SI) Units

Model	Water Loop Heat Pump				Ground Water Heat Pump				Ground Loop Heat Pump			
	Cooling 30°C		Heating 20°C		Cooling 15°C		Heating 10°C		Cooling 25°C		Heating 0°C	
	Capacity Watts	EER W/W	Capacity Watts	COP	Capacity Watts	EER W/W	Capacity Watts	COP	Capacity Watts	EER W/W	Capacity Watts	COP
816-10	2,491	3.4	3,370	4.2	Please see the TRM Series for extended range applications.				Please see the TRM Series for extended range applications.			
816-15	3,516	3.6	4,307	4.2								
816-20	5,421	3.5	6,915	4.2								
816-28	7,384	3.5	9,376	4.2								
816-30	8,233	3.7	10,518	4.2								
816-36	9,552	3.7	12,452	4.2								

Cooling capacities based upon 27°C DB, 19°C WB entering air temperature

Heating capacities based upon 20°C DB, 15°C WB entering air temperature

All air flow is rated on high speed

All ratings based upon operation at lower voltage of dual voltage rated models

## Performance Data Selection Notes

For operation in the shaded area when water is used in lieu of an anti-freeze solution, the LWT (Leaving Water Temperature) must be calculated. Flow must be maintained to a level such that the LWT is maintained above 42°F [5.6°C] when the JW3 jumper is not clipped (see example below). This is due to the potential of the refrigerant temperature being as low as 32°F [0°C] with 40°F [4.4°C] LWT, which may lead to a nuisance cutout due to the activation of the Low Temperature Protection. JW3 should never be clipped for standard range equipment or systems without antifreeze.

### Example:

At 50°F EWT (Entering Water Temperature) and 1.5 gpm/ton, a 3 ton unit has a HE of 22,500 Btuh. To calculate LWT, rearrange the formula for HE as follows:

$HE = TD \times GPM \times 500$ , where HE = Heat of Extraction (Btuh); TD = temperature difference (EWT - LWT) and GPM = U.S. Gallons per Minute.

$$TD = HE / (GPM \times 500)$$

$$TD = 22,500 / (4.5 \times 500)$$

$$TD = 10^\circ\text{F}$$

$$LWT = EWT - TD$$

$$LWT = 50 - 10 = 40^\circ\text{F}$$

In this example, a higher flow rate will be required for EWTs at or below 50°F without antifreeze. At 2 gpm/ton, the calculation above results in a TD of 7.5.  $LWT = 50 - 7.5 = 42.5^\circ\text{F}$ , which is above 42°F EWT, and is acceptable for this application.

		Heating - EAT 70°F				
	EER	HC	kW	HE	LAT	COP
23.1	23.1	Operation Not Recommended				
25.3	25.3					
26.7	26.7					
27.5	27.5	8.6	0.72	6.1	94.8	3.48
19.7	19.7	9.1	0.74	6.5	96.2	3.60
21.7	21.7	9.4	0.75	6.9	97.3	3.69
22.9	22.9	9.7	0.76	7.1	97.9	3.74
23.7	23.7	9.8	0.76	7.2	98.4	3.77
16.6	16.6	10.2	0.77	7.5	99.4	3.86
10.6	10.6	10.6	0.78	7.9	100.6	3.95
10.8	10.8	10.8	0.79	8.1	101.4	4.01
8.3	8.3	10.8	0.83	8.3	102.4	4.08

Performance Data  
816-10

320 CFM Nominal (Rated) Airflow

Performance capacities shown in thousands of Btuh

*WPD Adder for Motorized Valve, 816-10 (Cv = 4.9, MOPD = 125 psi)			EWT °F	GPM	WPD*		Cooling - EAT 80/67°F						Heating - EAT 70°F				
					PSI	FT	TC	SC	Sens/Tot Ratio	kW	HR	EER	HC	kW	HE	LAT	COP
GPM	WPD Adder		40	1.2	0.7	1.7	11.0	7.0	0.64	0.48	12.7	23.1	Operation Not Recommended				
				1.7	1.1	2.5	11.4	7.2	0.63	0.45	12.9	25.3					
				2.2	2.0	4.7	11.6	7.3	0.63	0.44	13.1	26.7					
	PSI	FT		2.7	2.9	6.6	11.7	7.3	0.63	0.43	13.2	27.5	8.6	0.72	6.1	94.8	3.48
1.2	0.06	0.14	50	1.2	0.7	1.7	10.4	6.7	0.65	0.53	12.2	19.7	9.1	0.74	6.5	96.2	3.60
1.7	0.17	0.40		1.7	1.1	2.5	10.8	6.9	0.64	0.50	12.5	21.7	9.4	0.75	6.9	97.3	3.69
2.2	0.38	0.87		2.2	2.0	4.6	11.0	7.0	0.64	0.48	12.6	22.9	9.7	0.76	7.1	97.9	3.74
2.7	0.60	1.38		2.7	2.8	6.5	11.1	7.1	0.63	0.47	12.7	23.7	9.8	0.76	7.2	98.4	3.77
			60	1.2	0.7	1.6	9.8	6.5	0.66	0.59	11.8	16.6	10.2	0.77	7.5	99.4	3.86
				1.7	1.0	2.4	10.2	6.6	0.65	0.55	12.1	18.4	10.6	0.78	7.9	100.6	3.95
				2.2	1.9	4.5	10.4	6.7	0.65	0.54	12.2	19.4	10.8	0.79	8.1	101.4	4.01
				2.7	2.8	6.4	10.5	6.8	0.64	0.52	12.3	20.1	11.0	0.80	8.3	101.8	4.05
			70	1.2	0.7	1.6	9.2	6.2	0.67	0.66	11.5	13.9	11.2	0.80	8.5	102.5	4.10
				1.7	1.0	2.3	9.6	6.3	0.66	0.62	11.7	15.4	11.7	0.82	8.9	103.9	4.20
				2.2	1.9	4.4	9.8	6.4	0.66	0.60	11.8	16.3	12.0	0.82	9.2	104.7	4.26
				2.7	2.7	6.3	9.9	6.5	0.66	0.59	11.9	16.9	12.2	0.83	9.3	105.2	4.30
			80	1.2	0.6	1.5	8.6	5.9	0.69	0.74	11.1	11.7	12.3	0.83	9.5	105.6	4.33
				1.7	1.0	2.3	8.9	6.0	0.68	0.70	11.3	13.0	12.8	0.84	9.9	107.0	4.44
				2.2	1.9	4.3	9.1	6.1	0.67	0.67	11.4	13.7	13.1	0.85	10.2	107.9	4.50
				2.7	2.6	6.1	9.2	6.2	0.67	0.66	11.5	14.2	13.3	0.86	10.4	108.4	4.54
			85	1.2	0.6	1.5	8.3	5.7	0.69	0.79	11.0	10.5	12.8	0.85	9.9	107.1	4.44
				1.7	1.0	2.2	8.6	5.9	0.68	0.74	11.1	11.6	13.3	0.86	10.4	108.6	4.55
				2.2	1.8	4.2	8.8	6.0	0.68	0.71	11.2	12.3	13.6	0.86	10.7	109.4	4.62
				2.7	2.6	6.0	8.9	6.0	0.68	0.70	11.3	12.8	13.8	0.87	10.9	110.0	4.66
			90	1.2	0.6	1.4	7.9	5.6	0.70	0.83	10.8	9.5	13.3	0.86	10.4	108.5	4.55
				1.7	1.0	2.2	8.3	5.7	0.69	0.78	11.0	10.6	13.9	0.87	10.9	110.1	4.67
				2.2	1.8	4.1	8.5	5.8	0.69	0.76	11.1	11.2	14.2	0.88	11.2	111.0	4.73
				2.7	2.5	5.8	8.6	5.9	0.68	0.74	11.1	11.6	14.4	0.88	11.4	111.6	4.78
			100	1.2	0.6	1.3	7.3	5.2	0.72	0.93	10.5	7.8	Operation Not Recommended				
				1.7	0.9	2.1	7.6	5.4	0.71	0.88	10.6	8.7					
				2.2	1.7	4.0	7.8	5.5	0.70	0.85	10.7	9.2					
				2.7	2.4	5.6	7.9	5.6	0.70	0.83	10.8	9.5					
			110	2.2	1.6	3.8	7.2	5.2	0.72	0.96	10.4	7.5	Operation Not Recommended				
				2.7	2.3	5.4	7.3	5.2	0.72	0.94	10.5	7.8					

Interpolation is permissible; extrapolation is not.

All entering air conditions are 80°F DB and 67°F WB in cooling, and 70°F DB in heating.

ARI/ISO certified conditions are 80.6°F DB and 66.2°F WB in cooling and 68°F DB in heating.

Table does not reflect fan or pump power corrections for ARI/ISO conditions.

All performance is based upon the lower voltage of dual voltage rated units.

\* Pressure drop with valve =  $PSI + (GPM/3.5)^2$  (Valve has a CV of 3.5 & MOPD of 30psi)

Operation below 60°F EWT requires optional insulated water/refrigerant circuit.

See performance correction tables for operating conditions other than those listed above.

See Performance Data Selection Notes for operation in the shaded areas.

## CLIMATEMASTER WATER-SOURCE HEAT PUMPS

## Vertical Stack (VHS) Series

Rev.: 05/23/07D

Performance Data  
816-15

410 CFM Nominal (Rated) Airflow

Performance capacities shown in thousands of Btu/h

*WPD Adder for Motorized Valve, 816-15 (Cv = 4.9, MOPD = 125 psi)			EWT °F	GPM	WPD*		Cooling - EAT 80/67°F						Heating - EAT 70°F				
					PSI	FT	TC	SC	Sens/Tot Ratio	kW	HR	EER	HC	kW	HE	LAT	COP
GPM	WPD Adder		40	1.6	1.0	2.4	14.8	10.0	0.67	0.61	16.9	24.4	Operation Not Recommended				
				2.5	2.5	5.7	15.4	10.2	0.66	0.56	17.3	27.6					
				3.3	4.2	9.7	15.6	10.3	0.66	0.54	17.5	29.1					
	1.6	0.11	0.25	4.1	6.7	15.4	15.8	10.3	0.65	0.52	17.6	30.1	10.8	0.91	7.7	94.4	3.50
2.5	0.37		50	1.6	1.0	2.4	14.1	9.6	0.69	0.68	16.4	20.7	11.5	0.92	8.3	96.0	3.65
				2.5	2.4	5.6	14.6	9.9	0.68	0.62	16.8	23.4	12.1	0.94	8.9	97.4	3.79
				3.3	4.2	9.6	14.9	10.0	0.67	0.60	16.9	24.7	12.4	0.95	9.2	98.1	3.85
	4.1	1.61	3.72	4.1	6.6	15.2	15.0	10.0	0.67	0.59	17.0	25.6	12.6	0.95	9.4	98.5	3.89
3.3	0.85		60	1.6	1.0	2.3	13.3	9.3	0.70	0.76	15.9	17.5	13.1	0.96	9.8	99.5	3.98
				2.5	2.4	5.5	13.9	9.6	0.69	0.70	16.3	19.8	13.8	0.98	10.5	101.2	4.12
				3.3	4.1	9.5	14.1	9.7	0.69	0.68	16.4	20.9	14.1	0.99	10.8	101.9	4.19
	4.1	6.5	15.0	4.1	6.5	15.0	14.3	9.7	0.68	0.66	16.5	21.6	14.3	0.99	10.9	102.4	4.23
4.1	1.61		70	1.6	1.0	2.3	12.6	8.9	0.71	0.86	15.5	14.7	14.6	1.00	11.2	102.9	4.27
				2.5	2.3	5.4	13.1	9.2	0.70	0.79	15.8	16.6	15.3	1.02	11.9	104.7	4.41
				3.3	4.1	9.4	13.3	9.3	0.70	0.76	15.9	17.5	15.7	1.03	12.2	105.4	4.47
	4.1	6.4	14.8	4.1	6.4	14.8	13.5	9.4	0.70	0.74	16.0	18.1	15.9	1.03	12.4	105.9	4.51
1.6	0.11		80	1.6	1.0	2.2	11.8	8.5	0.72	0.96	15.1	12.5	16.0	1.04	12.5	106.1	4.52
				2.5	2.3	5.4	12.4	8.8	0.71	0.89	15.4	14.1	16.8	1.06	13.2	107.9	4.66
				3.3	4.0	9.3	12.6	8.9	0.71	0.86	15.5	14.9	17.1	1.07	13.5	108.7	4.72
	4.1	6.3	14.6	4.1	6.3	14.6	12.7	9.0	0.71	0.84	15.6	15.4	17.4	1.07	13.7	109.2	4.75
2.5	0.37		85	1.6	1.0	2.2	11.5	8.3	0.73	1.01	14.9	11.3	16.7	1.05	13.1	107.6	4.64
				2.5	2.3	5.3	12.0	8.6	0.72	0.94	15.2	12.8	17.5	1.07	13.8	109.4	4.77
				3.3	4.0	9.2	12.2	8.7	0.72	0.91	15.3	13.4	17.8	1.08	14.1	110.3	4.83
	4.1	6.2	14.4	4.1	6.2	14.4	12.3	8.8	0.71	0.89	15.4	13.9	18.1	1.09	14.3	110.8	4.86
3.3	0.85		90	1.6	0.9	2.1	11.1	8.1	0.73	1.07	14.7	10.4	17.3	1.07	13.7	109.1	4.74
				2.5	2.3	5.3	11.6	8.4	0.72	0.99	15.0	11.7	18.1	1.09	14.4	110.9	4.87
				3.3	3.9	9.1	11.8	8.5	0.72	0.96	15.1	12.3	18.5	1.10	14.7	111.7	4.93
	4.1	6.1	14.2	4.1	6.1	14.2	12.0	8.6	0.72	0.94	15.2	12.7	18.7	1.10	14.9	112.2	4.96
4.1	1.61		100	1.6	0.9	2.1	10.3	7.6	0.74	1.19	14.4	8.7	Operation Not Recommended				
				2.5	2.3	5.2	10.8	7.9	0.73	1.11	14.6	9.7					
				3.3	3.9	9.0	11.0	8.1	0.73	1.08	14.7	10.3					
	4.1	6.1	14.0	4.1	6.1	14.0	11.2	8.2	0.73	1.06	14.8	10.6					
3.3	0.85		110	3.3	3.9	8.9	10.3	7.6	0.74	1.20	14.4	8.5	Operation Not Recommended				
				4.1	6.0	13.8	10.4	7.7	0.74	1.18	14.4	8.8					

Interpolation is permissible; extrapolation is not.

All entering air conditions are 80°F DB and 67°F WB in cooling, and 70°F DB in heating.

ARI/ISO certified conditions are 80.6°F DB and 66.2°F WB in cooling and 68°F DB in heating.

Table does not reflect fan or pump power corrections for ARI/ISO conditions.

All performance is based upon the lower voltage of dual voltage rated units.

\* Pressure drop with valve =  $\text{PSI} + (\text{GPM}/3.5)^2$  (Valve has a CV of 3.5 & MOPD of 30psi)

Operation below 60°F EWT requires optional insulated water/refrigerant circuit.

See performance correction tables for operating conditions other than those listed above.

See Performance Data Selection Notes for operation in the shaded areas.

# Performance Data 816-20

680 CFM Nominal (Rated) Airflow

Performance capacities shown in thousands of Btu/h

*WPD Adder for Motorized Valve, 816-20 (Cv = 4.9, MOPD = 125 psi)				EWT °F	GPM	WPD*		Cooling - EAT 80/67°F						Heating - EAT 70°F				
						PSI	FT	TC	SC	Sens/Tot Ratio	kW	HR	EER	HC	kW	HE	LAT	COP
GPM		WPD Adder		40	2.2	1.5	3.5	23.1	15.8	0.69	1.16	27.0	19.9	Operation Not Recommended				
					3.6	3.2	7.5	24.2	16.1	0.67	1.04	27.7	23.3					
		PSI	FT		5.0	5.6	12.9	24.6	16.2	0.66	0.98	28.0	25.1					
2.2	0.20	0.47			6.4	8.6	19.8	24.9	16.2	0.65	0.95	28.2	26.2	16.1	1.36	11.4	91.9	3.46
3.6	0.77	1.79																
5.0	1.94	4.49		50	2.2	1.5	3.5	21.9	15.4	0.70	1.27	26.3	17.2	17.1	1.40	12.3	93.2	3.58
6.4	3.92	9.06			3.6	3.2	7.4	23.0	15.8	0.69	1.16	27.0	19.8	18.5	1.45	13.5	95.1	3.74
					5.0	5.5	12.8	23.5	16.0	0.68	1.11	27.3	21.2	19.1	1.47	14.1	96.1	3.81
					6.4	8.5	19.6	23.8	16.0	0.67	1.08	27.5	22.0	19.5	1.49	14.5	96.6	3.85
				60	2.2	1.5	3.4	20.7	14.9	0.72	1.39	25.4	14.9	19.9	1.50	14.8	97.1	3.89
					3.6	3.2	7.4	21.8	15.4	0.71	1.28	26.2	17.0	21.4	1.55	16.1	99.1	4.04
					5.0	5.5	12.7	22.3	15.6	0.70	1.23	26.5	18.1	22.0	1.57	16.7	100.0	4.11
					6.4	8.4	19.4	22.6	15.7	0.69	1.21	26.7	18.8	22.4	1.59	17.0	100.5	4.15
				70	2.2	1.5	3.4	19.4	14.3	0.74	1.49	24.5	13.0	22.4	1.58	17.0	100.5	4.14
					3.6	3.2	7.3	20.5	14.9	0.72	1.40	25.3	14.7	23.8	1.63	18.2	102.4	4.28
					5.0	5.5	12.6	21.1	15.1	0.72	1.35	25.7	15.6	24.4	1.65	18.8	103.2	4.34
					6.4	8.3	19.2	21.4	15.2	0.71	1.33	25.9	16.1	24.7	1.66	19.1	103.7	4.37
				80	2.2	1.4	3.3	18.0	13.5	0.75	1.59	23.5	11.4	24.5	1.65	18.8	103.3	4.34
					3.6	3.1	7.2	19.2	14.2	0.74	1.51	24.3	12.9	25.7	1.69	19.9	105.0	4.46
					5.0	5.4	12.5	19.7	14.5	0.73	1.46	24.7	13.6	26.2	1.70	20.4	105.6	4.51
					6.4	8.2	19.0	20.0	14.6	0.73	1.44	24.9	14.1	26.4	1.71	20.6	106.0	4.54
				85	2.2	1.4	3.3	17.3	13.1	0.76	1.64	22.9	10.6	25.4	1.68	19.6	104.5	4.43
					3.6	3.1	7.2	18.5	13.8	0.75	1.56	23.8	11.9	26.4	1.71	20.6	106.0	4.54
					5.0	5.4	12.4	19.0	14.1	0.74	1.52	24.2	12.5	26.8	1.71	21.0	106.5	4.59
					6.4	8.1	18.8	19.3	14.3	0.74	1.50	24.4	12.9	27.0	1.72	21.2	106.8	4.61
				90	2.2	1.4	3.2	16.6	12.7	0.76	1.69	22.4	9.8	26.1	1.70	20.3	105.6	4.51
					3.6	3.1	7.1	17.8	13.4	0.75	1.61	23.3	11.0	27.0	1.72	21.2	106.8	4.61
					5.0	5.3	12.3	18.3	13.7	0.75	1.57	23.7	11.7	27.3	1.72	21.4	107.2	4.65
					6.4	8.1	18.6	18.6	13.9	0.74	1.55	23.9	12.0	27.5	1.72	21.6	107.4	4.67
				100	2.2	1.4	3.2	15.1	11.7	0.77	1.78	21.2	8.5	Operation Not Recommended				
					3.6	3.1	7.1	16.3	12.5	0.76	1.71	22.1	9.5					
					5.0	5.3	12.2	16.8	12.8	0.76	1.67	22.5	10.1					
					6.4	7.9	18.3	17.1	13.0	0.76	1.65	22.8	10.4					
				110	5.0	5.2	12.1	15.3	11.8	0.77	1.77	21.3	8.6	Operation Not Recommended				
					6.4	7.8	18.1	15.6	12.0	0.77	1.75	21.6	8.9					

Interpolation is permissible; extrapolation is not.

All entering air conditions are 80°F DB and 67°F WB in cooling, and 70°F DB in heating.

ARI/ISO certified conditions are 80.6°F DB and 66.2°F WB in cooling and 68°F DB in heating.

Table does not reflect fan or pump power corrections for ARI/ISO conditions.

All performance is based upon the lower voltage of dual voltage rated units.

\* Pressure drop with valve = PSI + (GPM/3.5)<sup>2</sup> (Valve has a CV of 3.5 & MOPD of 30psi)

Operation below 60°F EWT requires optional insulated water/refrigerant circuit.

See performance correction tables for operating conditions other than those listed above.

See Performance Data Selection Notes for operation in the shaded areas.

## CLIMATEMASTER WATER-SOURCE HEAT PUMPS

## Vertical Stack (VHS) Series

Rev.: 05/23/07D

Performance Data  
816-28

940 CFM Nominal (Rated) Airflow

Performance capacities shown in thousands of Btu/h

*WPD Adder for Motorized Valve, 816-28 (Cv = 10.3, MOPD = 125 psi)			EWT °F	GPM	WPD*		Cooling - EAT 80/67°F						Heating - EAT 70°F				
					PSI	FT	TC	SC	Sens/Tot Ratio	kW	HR	EER	HC	kW	HE	LAT	COP
GPM	WPD Adder		40	3.3	1.6	3.6	31.3	20.0	0.64	1.50	36.4	20.8	Operation Not Recommended				
	PSI	FT		5.1	3.5	8.0	32.3	20.3	0.63	1.36	36.9	23.7					
3.3	0.32	0.75		6.5	6.3	14.5	32.7	20.3	0.62	1.30	37.1	25.1					
5.1	0.88	2.04		8.7	9.3	21.5	33.0	20.4	0.62	1.25	37.3	26.5	23.3	1.90	16.8	92.9	3.60
6.5	1.61	3.71	50	5.1	3.5	8.0	29.9	19.5	0.65	1.67	35.6	17.9	24.8	1.95	18.1	94.4	3.73
8.7	3.18	7.36		6.5	6.2	14.3	31.4	20.0	0.64	1.49	36.5	21.1	25.4	1.97	18.7	95.0	3.79
				8.7	9.1	21.1	31.8	20.1	0.63	1.43	36.7	22.2	26.0	1.99	19.3	95.7	3.84
				3.3	1.6	3.6	28.3	18.9	0.67	1.83	34.5	15.4	27.1	2.02	20.1	96.6	3.92
			60	5.1	3.4	7.9	29.5	19.4	0.66	1.71	35.3	17.2	28.7	2.08	21.6	98.3	4.05
				6.5	6.1	14.1	30.0	19.5	0.65	1.66	35.6	18.0	29.4	2.10	22.2	98.9	4.10
				8.7	9.0	20.7	30.4	19.7	0.65	1.61	35.9	18.8	30.0	2.12	22.8	99.6	4.14
				3.3	1.6	3.6	26.6	18.1	0.68	1.99	33.4	13.4	30.5	2.14	23.2	100.0	4.18
			70	5.1	3.4	7.8	27.9	18.7	0.67	1.87	34.3	14.9	32.2	2.19	24.7	101.7	4.30
				6.5	6.0	13.9	28.4	18.9	0.67	1.83	34.6	15.5	32.8	2.22	25.3	102.3	4.34
				8.7	8.8	20.4	28.8	19.1	0.66	1.78	34.9	16.2	33.5	2.24	25.8	103.0	4.39
				3.3	1.5	3.5	24.8	17.2	0.69	2.13	32.0	11.7	33.6	2.24	25.9	103.0	4.39
			80	5.1	3.3	7.7	26.1	17.8	0.68	2.03	33.0	13.0	35.2	2.29	27.3	104.6	4.50
				6.5	5.9	13.7	26.6	18.1	0.68	1.99	33.4	13.5	35.8	2.31	27.9	105.3	4.54
				8.7	8.7	20.0	27.1	18.3	0.68	1.94	33.7	14.1	36.4	2.33	28.4	105.8	4.57
				3.3	1.5	3.5	23.8	16.7	0.70	2.20	31.3	10.8	34.9	2.28	27.1	104.4	4.48
			85	5.1	3.3	7.6	25.1	17.4	0.69	2.10	32.3	11.9	36.5	2.33	28.5	105.9	4.58
				6.5	5.8	13.5	25.7	17.6	0.69	2.06	32.7	12.4	37.1	2.35	29.1	106.5	4.62
				8.7	8.5	19.7	26.1	17.9	0.68	2.02	33.0	12.9	37.6	2.37	29.6	107.1	4.65
				3.3	1.5	3.4	22.8	16.1	0.71	2.27	30.5	10.1	36.2	2.33	28.3	105.7	4.56
			90	5.1	3.3	7.6	24.1	16.9	0.70	2.18	31.6	11.1	37.7	2.37	29.6	107.1	4.66
				6.5	5.8	13.3	24.7	17.1	0.69	2.14	32.0	11.5	38.3	2.39	30.1	107.7	4.69
				8.7	8.4	19.4	25.2	17.4	0.69	2.10	32.3	12.0	38.8	2.41	30.5	108.2	4.72
				3.3	1.5	3.4	20.7	14.9	0.72	2.40	28.9	8.6	Operation Not Recommended				
			100	5.1	3.2	7.5	22.1	15.7	0.71	2.32	30.0	9.5					
				6.5	5.7	13.1	22.6	16.0	0.71	2.28	30.4	9.9					
				8.7	8.3	19.1	23.1	16.3	0.70	2.25	30.8	10.3					
				110	6.5	5.6	12.9	20.4	14.7	0.72	2.42	28.6	8.4				
			8.7		8.1	18.7	20.9	15.0	0.72	2.39	29.1	8.8					

Interpolation is permissible; extrapolation is not.

All entering air conditions are 80°F DB and 67°F WB in cooling, and 70°F DB in heating.

ARI/ISO certified conditions are 80.6°F DB and 66.2°F WB in cooling and 68°F DB in heating.

Table does not reflect fan or pump power corrections for ARI/ISO conditions.

All performance is based upon the lower voltage of dual voltage rated units.

\* Pressure drop with valve = PSI + (GPM/3.5)<sup>2</sup> (Valve has a CV of 3.5 & MOPD of 30psi)

Operation below 60°F EWT requires optional insulated water/refrigerant circuit.

See performance correction tables for operating conditions other than those listed above.

See Performance Data Selection Notes for operation in the shaded areas.



# Performance Data 816-30

1000 CFM Nominal (Rated) Airflow

Performance capacities shown in thousands of Btu/h

*WPD Adder for Motorized Valve, 816-30 (Cv = 10.3, MOPD = 125 psi)			EWT °F	GPM	WPD*		Cooling - EAT 80/67°F						Heating - EAT 70°F					
					PSI	FT	TC	SC	Sens/Tot Ratio	kW	HR	EER	HC	kW	HE	LAT	COP	
GPM		WPD Adder		40	3.6	1.7	4.0	34.3	20.7	0.60	1.81	40.5	18.9	Operation Not Recommended				
		5.6	3.8		8.7	35.1	21.0	0.60	1.69	40.8	20.8							
		PSI	FT		7.5	6.6	15.2	35.3	21.1	0.60	1.62	40.8	21.7					
					9.6	10.0	23.2	35.4	21.1	0.60	1.58	40.8	22.4					
3.6	0.39	0.89	50	3.6	1.7	3.9	32.9	20.0	0.61	1.94	39.6	16.9	24.2	2.08	17.1	92.4	3.40	
5.6	1.06	2.46		5.6	3.7	8.6	34.0	20.5	0.60	1.84	40.3	18.5	26.2	2.14	18.9	94.3	3.59	
7.5	2.14	4.94		7.5	6.5	15.0	34.5	20.7	0.60	1.79	40.6	19.3	28.1	2.20	20.6	96.0	3.75	
9.6	3.88	8.96		9.6	9.9	22.9	34.7	20.9	0.60	1.75	40.7	19.8	29.1	2.23	21.5	96.9	3.82	
			60	3.6	1.7	3.9	31.3	19.3	0.62	2.06	38.3	15.2	29.7	2.25	22.0	97.5	3.86	
				5.6	3.7	8.5	32.6	19.9	0.61	1.97	39.3	16.5	30.7	2.29	22.9	98.4	3.93	
				7.5	6.4	14.8	33.1	20.1	0.61	1.93	39.7	17.2	32.6	2.35	24.5	100.2	4.06	
				9.6	9.8	22.6	33.5	20.3	0.61	1.90	39.9	17.7	33.4	2.39	25.3	101.0	4.11	
			70	3.6	1.6	3.8	29.5	18.5	0.63	2.19	37.0	13.5	34.0	2.41	25.8	101.5	4.14	
				5.6	3.6	8.4	30.9	19.1	0.62	2.09	38.0	14.7	36.1	2.48	27.6	103.4	4.26	
				7.5	6.3	14.6	31.5	19.4	0.62	2.05	38.5	15.3	36.8	2.51	28.3	104.1	4.30	
				9.6	9.7	22.3	31.9	19.6	0.61	2.02	38.8	15.8	37.3	2.53	28.7	104.5	4.33	
			80	3.6	1.6	3.7	27.7	17.8	0.64	2.32	35.6	12.0	37.3	2.56	29.8	105.7	4.40	
				5.6	3.6	8.3	29.0	18.3	0.63	2.22	36.6	13.1	38.7	2.57	30.0	105.9	4.42	
				7.5	6.2	14.4	29.7	18.6	0.63	2.18	37.1	13.7	39.4	2.58	30.5	106.4	4.47	
				9.6	9.5	22.0	30.1	18.8	0.62	2.15	37.4	14.0	39.7	2.59	30.9	106.8	4.50	
			85	3.6	1.6	3.7	26.9	17.5	0.65	2.39	35.0	11.2	38.5	2.56	29.8	105.7	4.40	
				5.6	3.5	8.2	28.1	18.0	0.64	2.29	35.9	12.3	39.8	2.59	31.0	106.9	4.51	
				7.5	6.1	14.2	28.7	18.2	0.63	2.24	36.4	12.8	40.4	2.59	31.5	107.4	4.57	
				9.6	9.4	21.7	29.1	18.4	0.63	2.21	36.7	13.1	40.7	2.59	31.9	107.7	4.61	
			90	3.6	1.6	3.6	26.0	17.3	0.66	2.47	34.4	10.5	39.6	2.59	30.8	106.7	4.49	
				5.6	3.5	8.1	27.2	17.6	0.65	2.36	35.3	11.5	40.8	2.59	31.9	107.7	4.62	
				7.5	6.1	14.0	27.8	17.8	0.64	2.31	35.7	12.0	41.3	2.58	32.5	108.2	4.69	
				9.6	9.3	21.4	28.2	18.0	0.64	2.28	36.0	12.3	41.6	2.57	32.8	108.5	4.75	
			100	3.6	1.5	3.5	24.5	17.0	0.69	2.66	33.6	9.2	Operation Not Recommended					
				5.6	3.5	8.0	25.5	17.1	0.67	2.53	34.1	10.1						
				7.5	6.0	13.8	26.0	17.3	0.66	2.47	34.4	10.5						
				9.6	9.0	20.9	26.4	17.4	0.66	2.44	34.7	10.8						
			110	7.5	5.9	13.6	24.5	16.9	0.69	2.66	33.6	9.2	Operation Not Recommended					
				9.6	8.9	20.6	24.8	17.0	0.69	2.62	33.7	9.4						

Interpolation is permissible; extrapolation is not.

All entering air conditions are 80°F DB and 67°F WB in cooling, and 70°F DB in heating.

ARI/ISO certified conditions are 80.6°F DB and 66.2°F WB in cooling and 68°F DB in heating.

Table does not reflect fan or pump power corrections for ARI/ISO conditions.

All performance is based upon the lower voltage of dual voltage rated units.

\* Pressure drop with valve = PSI + (GPM/3.5)<sup>2</sup> (Valve has a CV of 3.5 & MOPD of 30psi)

Operation below 60°F EWT requires optional insulated water/refrigerant circuit.

See performance correction tables for operating conditions other than those listed above.

See Performance Data Selection Notes for operation in the shaded areas.

## Vertical Stack (VHS) Series

Rev.: 05/23/07D

Performance Data  
816-36

1200 CFM Nominal (Rated) Airflow

Performance capacities shown in thousands of Btuh

*WPD Adder for Motorized Valve, 816-36 (Cv = 10.3, MOPD = 125 psi)			EWT °F	GPM	WPD*		Cooling - EAT 80/67°F						Heating - EAT 70°F				
					PSI	FT	TC	SC	Sens/Tot Ratio	kW	HR	EER	HC	kW	HE	LAT	COP
GPM	WPD Adder		40	4.2	1.9	4.5	40.8	29.6	0.72	2.06	47.9	19.8	Operation Not Recommended				
				6.2	4.2	9.8	41.5	30.0	0.72	1.94	48.1	21.4					
	PSI	FT		8.4	7.5	17.4	41.6	30.0	0.72	1.86	48.0	22.3					
4.2	0.53	1.22		10.6	11.4	26.4	41.6	29.9	0.72	1.82	47.8	22.8	28.6	2.46	20.2	92.1	3.41
6.2	1.30	3.01	50	4.2	1.9	4.4	39.2	28.6	0.73	2.22	46.8	17.6	31.1	2.53	22.5	94.0	3.60
8.4	2.68	6.19		6.2	4.2	9.7	40.5	29.3	0.73	2.11	47.7	19.2	33.2	2.60	24.4	95.6	3.75
10.6	4.73	10.92		8.4	7.4	17.1	41.0	29.7	0.72	2.04	48.0	20.1	34.5	2.64	25.5	96.6	3.83
				10.6	11.3	26.0	41.3	29.8	0.72	2.00	48.1	20.6	35.2	2.66	26.1	97.2	3.88
			60	4.2	1.9	4.4	37.0	27.3	0.74	2.38	45.1	15.5	36.4	2.70	27.2	98.1	3.95
				6.2	4.2	9.6	38.6	28.3	0.73	2.27	46.3	17.0	38.4	2.78	29.0	99.7	4.06
				8.4	7.3	16.8	39.4	28.7	0.73	2.21	46.9	17.9	39.6	2.82	30.0	100.5	4.11
				10.6	11.1	25.7	39.9	29.0	0.73	2.17	47.2	18.4	40.2	2.84	30.5	101.0	4.15
			70	4.2	1.9	4.3	34.6	26.0	0.75	2.54	43.3	13.6	40.7	2.86	30.9	101.4	4.17
				6.2	4.1	9.5	36.3	26.9	0.74	2.43	44.5	14.9	42.5	2.93	32.5	102.8	4.25
				8.4	7.2	16.6	37.2	27.4	0.74	2.37	45.3	15.7	43.5	2.96	33.4	103.5	4.30
				10.6	11.0	25.3	37.7	27.8	0.74	2.33	45.7	16.2	44.0	2.98	33.8	104.0	4.33
			80	4.2	1.8	4.2	32.2	24.9	0.77	2.70	41.5	12.1	44.1	2.98	33.9	104.0	4.33
				6.2	4.1	9.4	33.8	25.6	0.76	2.60	42.6	13.1	45.6	3.03	35.3	105.2	4.42
				8.4	7.1	16.3	34.7	26.1	0.75	2.53	43.3	13.8	46.4	3.04	36.0	105.8	4.47
				10.6	10.8	24.9	35.2	26.4	0.75	2.50	43.8	14.2	46.9	3.05	36.5	106.2	4.51
			85	4.2	1.8	4.2	31.2	24.4	0.78	2.79	40.7	11.2	45.5	3.03	35.2	105.1	4.41
				6.2	4.0	9.3	32.6	25.0	0.77	2.68	41.7	12.2	46.9	3.05	36.5	106.2	4.51
				8.4	7.0	16.1	33.4	25.4	0.76	2.62	42.4	12.8	47.7	3.05	37.3	106.8	4.58
				10.6	10.6	24.6	34.0	25.7	0.76	2.58	42.8	13.1	48.1	3.05	37.7	107.1	4.63
			90	4.2	1.8	4.1	30.2	24.0	0.80	2.88	40.0	10.5	46.8	3.05	36.4	106.1	4.50
				6.2	4.0	9.2	31.4	24.5	0.78	2.77	40.9	11.4	48.1	3.05	37.7	107.1	4.62
				8.4	6.8	15.8	32.2	24.8	0.77	2.71	41.5	11.9	48.8	3.03	38.5	107.7	4.72
				10.6	10.5	24.3	32.7	25.1	0.77	2.67	41.8	12.3	49.3	3.02	39.0	108.0	4.78
			100	4.2	1.8	4.1	28.8	23.9	0.83	3.08	39.3	9.4	Operation Not Recommended				
				6.2	3.9	9.1	29.6	23.9	0.81	2.96	39.6	10.0					
				8.4	6.7	15.5	30.1	24.0	0.80	2.89	40.0	10.4					
				10.6	10.3	23.9	30.5	24.1	0.79	2.85	40.2	10.7					
			110	8.4	6.6	15.2	28.7	23.9	0.83	3.09	39.3	9.3					
				10.6	10.2	23.6	28.9	23.9	0.82	3.05	39.3	9.5					

Interpolation is permissible; extrapolation is not.

All entering air conditions are 80°F DB and 67°F WB in cooling, and 70°F DB in heating.

ARI/ISO certified conditions are 80.6°F DB and 66.2°F WB in cooling and 68°F DB in heating.

Table does not reflect fan or pump power corrections for ARI/ISO conditions.

All performance is based upon the lower voltage of dual voltage rated units.

\* Pressure drop with valve =  $\text{PSI} + (\text{GPM}/3.5)^2$  (Valve has a CV of 3.5 & MOPD of 30psi)

Operation below 60°F EWT requires optional insulated water/refrigerant circuit.

See performance correction tables for operating conditions other than those listed above.

See Performance Data Selection Notes for operation in the shaded areas.

## Performance Data Correction Tables

### Air Flow Correction Table

Airflow	Cooling				Heating		
	Total Capacity	Sensible Capacity	Power	Heat of Rejection	Heating Capacity	Power	Heat of Extraction
67%	0.966	0.927	0.966	0.962	0.966	1.114	0.943
74%	0.969	0.933	0.968	0.965	0.969	1.091	0.947
80%	0.972	0.939	0.970	0.968	0.972	1.068	0.951
87%	0.986	0.969	0.986	0.984	0.986	1.045	0.976
94%	0.993	0.985	0.993	0.992	0.993	1.023	0.988
100%	1.000	1.000	1.000	1.000	1.000	1.000	1.000
107%	1.006	1.012	1.006	1.006	1.006	0.977	1.009
113%	1.016	1.033	1.016	1.017	1.016	0.954	1.026

### Entering Air Correction Table

Heating				Cooling										
Entering Air DB°F	Heating Capacity	Power	Heat of Extraction	Entering Air WB°F	Total Capacity	Sensible Cooling Capacity Multiplier - Entering DB °F							Power	Heat of Rejection
						70	75	80	80.6	85	90	95		
60	1.050	0.940	1.096											
65	1.027	0.970	1.053											
68	1.007	0.992	1.014											
70	1.000	1.000	1.000											
75	0.971	1.030	0.951											
80	0.938	1.060	0.981											
				61	0.875	0.871	1.086	1.275	1.363	*	*	*	0.981	0.898
				64	0.940	0.719	0.935	1.150	1.176	1.365	*	*	0.949	0.954
				66.2	0.984	0.564	0.826	1.041	1.066	1.256	*	*	0.986	0.988
				67	1.000	0.507	0.785	1.000	1.026	1.215	1.369	*	1.000	1.000
				70	1.054		0.637	0.852	0.878	1.067	1.282	1.353	1.009	1.045
				73	1.102			0.706	0.732	0.921	1.136	1.283	1.018	1.081

\* = Sensible capacity equals total capacity  
ARI/ISO/ASHRAE 13256-1 uses entering air conditions of Cooling - 80.6°F DB/66.2°F WB, 1 and Heating - 68°F DB/59°F WB entering air temperature

## Vertical Stack (VHS) Series

Rev.: 05/23/07D

## Blower Performance Data

Airflow in CFM with wet coil and clean air filter.

Model	Fan Speed	Rated Airflow	Min CFM	Airflow (cfm) at External Static Pressure (in. wg)															
				0.00	0.05	0.10	0.15	0.20	0.25	0.30	0.35	0.40	0.45	0.50	0.60	0.70	0.80	0.90	1.00
816-10	HI	320	215	320	290	260	240												
816-10	LOW	320	215	280	260	240													
816-10	HS HI	320	215	350	320	290	260	230											
816-10	HS LOW	320	215	270	250	220													
816-15	HI	410	275	410	380	350	320	300											
816-15	LOW	410	275																
816-15	HS HI	410	275	430	400	370	340	310											
816-15	HS LOW	410	275	350	310														
816-20	HI	680	460	680	650	610	570	520	460										
816-20	LOW	680	460	570	540	510	490	460											
816-20	HS HI	680	460	800	750	700	660	610	570	520	460								
816-20	HS LOW	680	460	670	620	570	540	510	490	460									
816-28	HI	940	630	940	900	860	810	760	710	650									
816-28	LOW	940	630	750	730	700	680	650	650										
816-28	HS HI	940	630	1000	980	950	920	890	860	830	800	770	740	700					
816-28	HS LOW	940	630	850	830	800	780	750	720	680	640								
816-30	HI	1000	670	1000	980	950	920	890	860	830	810	780							
816-30	LOW	1000	670	850	830	800	780	750	710	670									
816-30	HS HI	1000	670	1250	1230	1200	1170	1140	1110	1080	1050	1010	980	940	870	790			
816-30	HS LOW	1000	670	1040	1020	1000	980	950	930	900	820	740	690						
816-36	HI	1200	805	1200	1150	1100	1050	1000	970	940	910	870	840						
816-36	LOW	1200	805	1000	980	950	930	900	870	830	810								
816-36	HS HI	1200	805	1250	1230	1200	1170	1140	1110	1080	1050	1010	980	940	870				
816-36	HS LOW	1200	805	1040	1020	1000	980	950	930	900	820								

Units factory shipped on high speed. Other speed required field selection.

All airflow is rated at lowest Voltage if unit is dual Voltage rated, i.e. 208V for 208-230V units.

All units ARI/ISO/ASHRAE 13256-1 rated on high fan speed.

## Physical Data

Model	10	15	20	28	30	36
Compressor (1 Each)	Rotary		Reciprocating			Scroll
Factory Charge R22 (oz) [kg]	16 [0.45]	23 [0.65]	29 [0.82]	44 [1.25]	55 [1.56]	50 [1.42]
<b>PSC Fan Motor &amp; Blower (2 Speeds)</b>						
Fan Motor (hp) [W]	1/30 [25]	1/30 [25]	1/6 [124]	1/4 [187]	1/4 [187]	1/4 [187]
High Static Fan Motor (hp) [W]	1/15 [50]	1/15 [50]	1/6 [124] w/ 9 x 7 blower [229 x 178]	1/2 [373]	1/2 [373]	1/2 [373]
Blower Wheel Size (dia x w) - (in) [mm]	6.75 x 7.25 [174 x 184]	6.75 x 7.25 [174 x 184]	7.62 x 7 [194 x 178]	9 x 8.06 [229 x 205]	9 x 8.06 [229 x 205]	9 x 8.06 [229 x 205]
<b>Hose Kit (AHH Series Required)</b>						
IPT (in)	1/2	1/2	1/2	3/4	3/4	3/4
<b>Chassis Air Coil</b>						
Air Coil Dimensions (h x w) - (in) [mm]	16 x 11.5 [406 x 292]	20 x 11.5 [508 x 292]	27 x 14 [686 x 356]	26 x 17.25 [660 x 438]	26 x 17.25 [660 x 438]	26 x 17.25 [660 x 438]
Standard Filter - 1" [25.4mm] Throwaway, qty (in) [mm]	12.5 x 21.25 [318 x 540]	12.5 x 21.25 [318 x 540]	16.25 x 28.5 [413 x 724]	20 x 25.5 [508 x 648]	20 x 25.5 [508 x 648]	20 x 25.5 [508 x 648]
<b>Weight</b>						
Chassis - (lbs) [kg]	73 [33]	81 [37]	141 [64]	171 [78]	191 [87]	177 [80]
Cabinet - (lbs) [kg]	174 [79]	174 [79]	189 [86]	243 [110]	243 [110]	243 [110]

## Vertical Stack (VHS) Series

Rev.: 05/23/07D

## Electrical Data

All 816 Units							Standard 816 Unit				816 unit with Secondary Pump			
Model	Voltage Code	Voltage	Min/Max Voltage	Compressor			Fan Motor FLA	Total Unit FLA	Min Circuit Amps	Max Fuse/HACR	Pump FLA	Total Unit FLA	Min Circuit Amp	Max Fuse/HACR
				QTY	RLA	LRA								
816-10	G	208-230/60/1	197/254	1	4.5	20.0	0.31	4.8	5.9	15	0.43	5.2	6.4	15
	E	265/60/1	239/292	1	3.3	18.6	0.30	3.6	4.4	15	N/A	N/A	N/A	N/A
816-10 High Static	G	208-230/60/1	197/254	1	4.5	20.0	0.70	5.2	6.3	15	0.43	5.6	6.8	15
	E	265/60/1	239/292	1	3.3	18.6	0.60	3.9	4.7	15	N/A	N/A	N/A	N/A
816-15	G	208-230/60/1	197/254	1	4.9	28.0	0.31	5.2	6.4	15	0.43	5.6	6.9	15
	E	265/60/1	239/292	1	4.4	26.3	0.30	4.7	5.8	15	N/A	N/A	N/A	N/A
816-15 High Static	G	208-230/60/1	197/254	1	4.9	28.0	0.70	5.6	6.8	15	0.43	6.0	7.3	15
	E	265/60/1	239/292	1	4.4	26.3	0.60	5.0	6.1	15	N/A	N/A	N/A	N/A
816-20	G	208-230/60/1	197/254	1	8.6	49.0	1.00	9.6	11.8	20	0.8	10.4	12.6	20
	E	265/60/1	239/292	1	8.1	44.0	0.86	9.0	11.0	15	0.7	9.7	11.7	15
816-20 High Static	G	208-230/60/1	197/254	1	8.6	49.0	1.00	9.6	11.8	20	0.8	10.4	12.6	20
	E	265/60/1	239/292	1	8.1	44.0	0.86	9.0	11.0	15	0.7	9.7	11.7	15
816-28	G	208-230/60/1	197/254	1	10.5	56.0	1.50	12.0	14.6	25	0.8	12.8	15.4	25
	E	265/60/1	239/292	1	9.5	55.0	1.30	10.8	13.2	20	0.7	11.5	13.9	20
816-28 High Static	G	208-230/60/1	197/254	1	10.5	56.0	2.00	12.5	15.1	25	0.8	13.3	15.9	25
	E	265/60/1	239/292	1	9.5	55.0	1.66	11.2	13.5	20	0.7	11.9	14.2	20
816-30	G	208-230/60/1	197/254	1	11.2	61.0	1.50	12.7	15.4	25	0.8	13.5	16.3	25
	E	265/60/1	239/292	1	9.8	58.0	1.30	11.1	13.6	20	0.7	11.8	14.3	20
816-30 High Static	G	208-230/60/1	197/254	1	11.2	61.0	2.00	13.2	16.0	25	0.8	14.0	16.8	25
	E	265/60/1	239/292	1	9.8	58.0	1.66	11.2	13.9	20	0.7	12.2	14.6	20
816-36	G	208-230/60/1	197/254	1	14.7	83.0	1.50	16.2	19.9	30	0.8	17.0	20.7	35
	E	265/60/1	239/292	1	12.8	76.0	1.30	14.1	17.3	30	0.7	14.8	18.0	30
816-36 High Static	G	208-230/60/1	197/254	1	14.7	83.0	2.00	16.7	20.4	35	0.8	17.5	21.2	35
	E	265/60/1	239/292	1	12.8	76.0	1.66	14.5	17.7	30	0.7	15.2	18.4	30





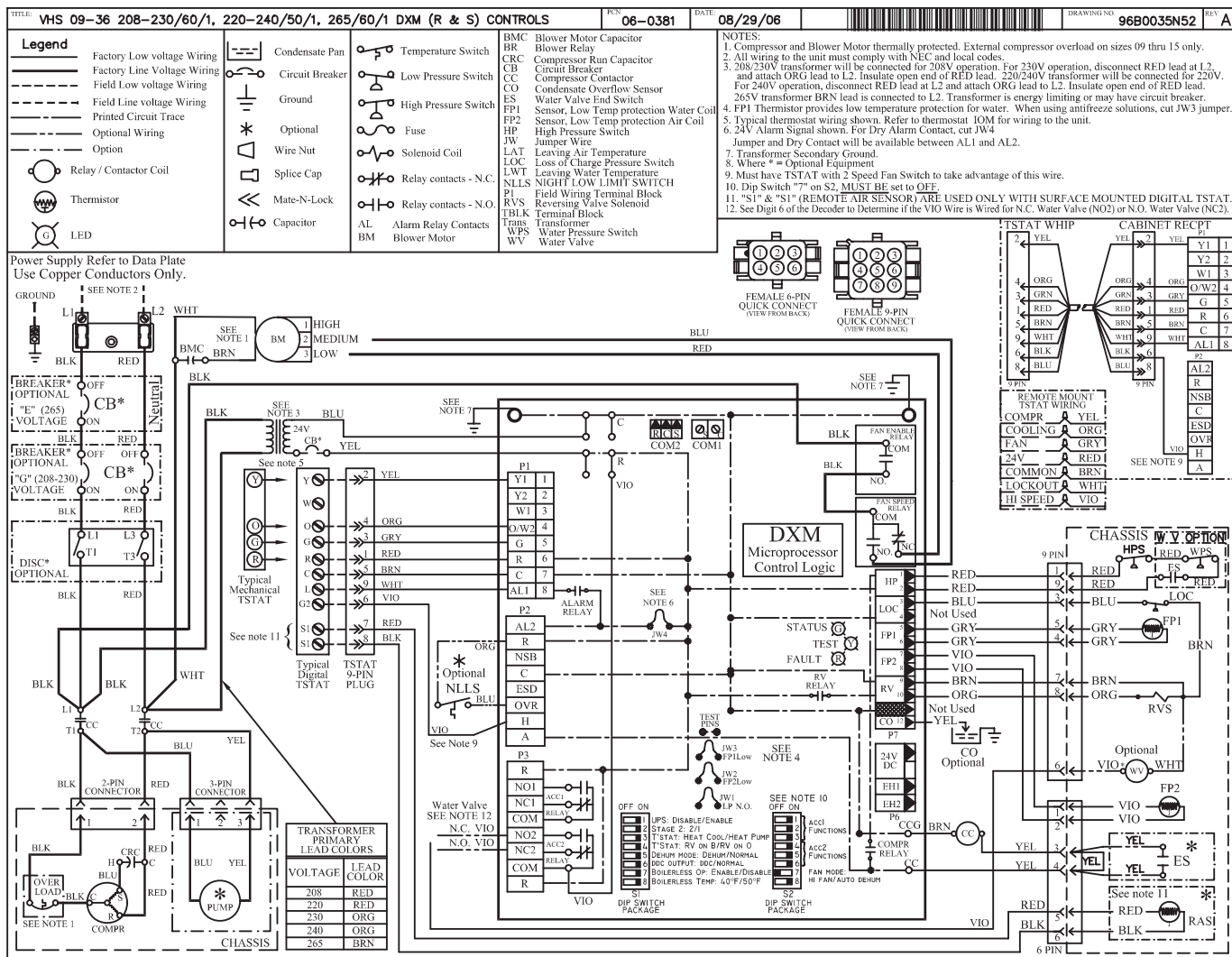
## Vertical Stack (VHS) Series

Rev.: 05/23/07D

# Typical Wiring Diagram

## Single Phase VHS Units

### With DXM Controller



## DXM CONTROLLER FAULT CODES

OPERATION	STATUS LED (GREEN)	TEST LED (YELLOW)	FAULT LED (RED)	ALARM RELAY
NORMAL MODE	ON	OFF	OFF	OPEN
DXM IS NON-FUNCTIONAL	OFF	OFF	NOTE: 2	OPEN
TEST MODE	—	ON	NOTE: 2	Cycle (Note 3)
NIGHT SETBACK	FLASHING CODE 2	—	NOTE: 2	—
EMERGENCY SHUT DOWN	FLASHING CODE 3	—	NOTE: 2	—
INVALID T-STAT INPUTS	FLASHING CODE 4	—	NOTE: 2	—
NO FAULT IN MEMORY	ON	OFF	FLASHING CODE 1	OPEN
HP: FAULT / (LOCKOUT) NOTE: 1	SLOW FLASH / (FAST FLASH)	OFF	FLASHING CODE 2	OPEN / (CLOSED)
LP: FAULT / (LOCKOUT) NOTE: 2	SLOW FLASH / (FAST FLASH)	OFF	FLASHING CODE 3	OPEN / (CLOSED)
FPI: FAULT / (LOCKOUT) NOTE: 1	SLOW FLASH / (FAST FLASH)	OFF	FLASHING CODE 4	OPEN / (CLOSED)
FP2: FAULT / (LOCKOUT) NOTE: 1	SLOW FLASH / (FAST FLASH)	OFF	FLASHING CODE 5	OPEN / (CLOSED)
CO: FAULT / (LOCKOUT) NOTE: 1	SLOW FLASH / (FAST FLASH)	OFF	FLASHING CODE 6	OPEN / (CLOSED)
OVER-UNDER VOLTAGE	SLOW FLASH	OFF	FLASHING CODE 7	OPEN (NOTE 4)
NORMAL MODE w/UPS	ON	OFF	FLASHING CODE 8	CYCLE (NOTE 5)
SWAPPED FP1/FP2 LOCKOUT	FAST FLASH	OFF	FLASHING CODE 9	CLOSED

1. STATUS LED (GREEN) : SLOW FLASH — CONTROLLER IN FAULT RETRY MODE, FAST FLASH — CONTROLLER IN LOCKOUT MODE SLOW FLASH = 1 FLASH PER EVERY 2 SECONDS. FAST FLASH = 2 FLASHES PER EVERY 1 SECOND.

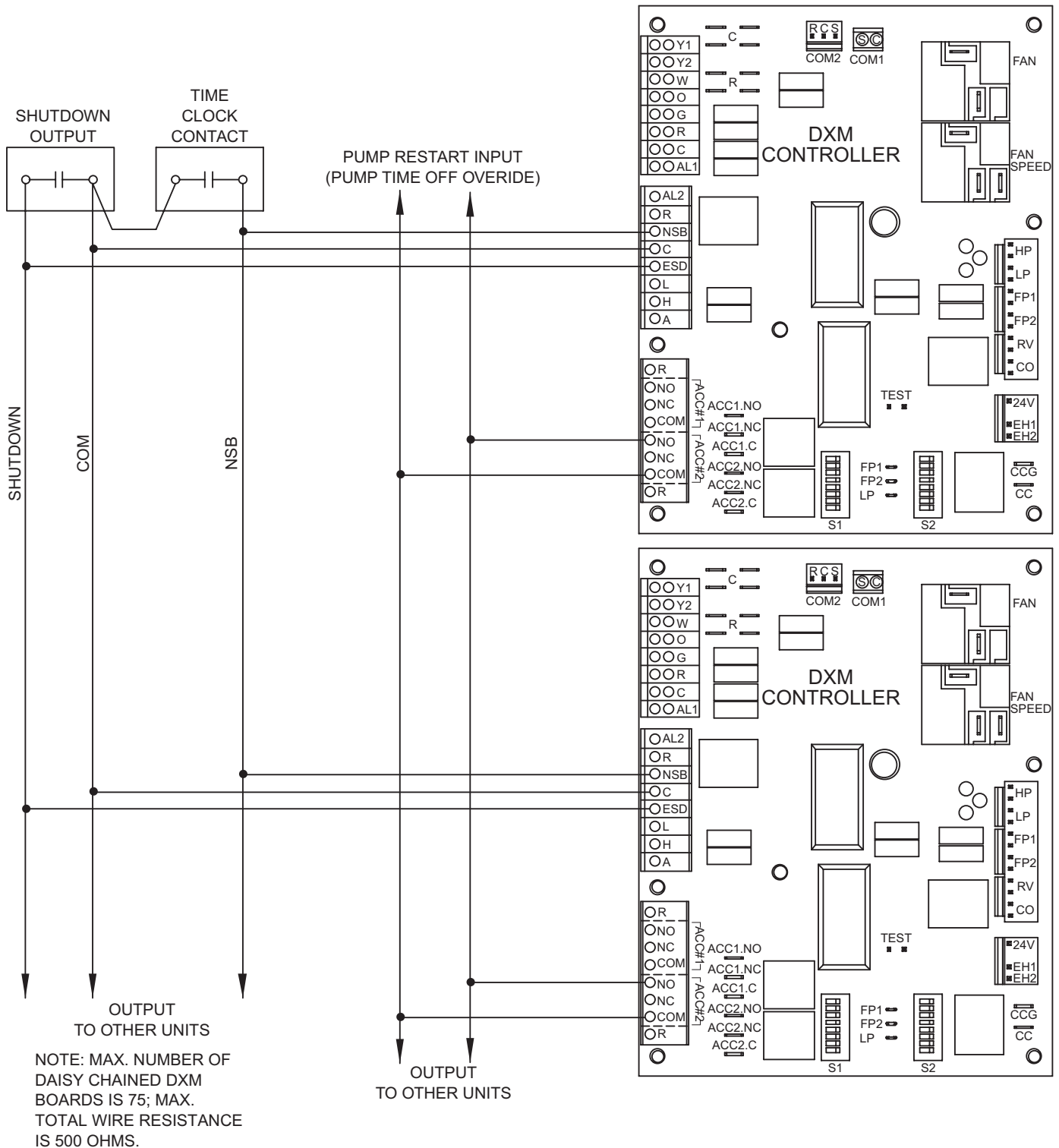
2. FAULT LED (RED) FLASHES A CODE REPRESENTING LAST FAULT IN MEMORY. IF NO FAULT IN MEMORY, CODE 1 IS FLASHED.

3. CYCLES APPROPRIATE CODE, BY CYCLING ALARM RELAY IN THE SAME SEQUENCE AS FAULT LED.

4. ALARM RELAY CLOSING AFTER 15 MINUTES.

5. ALARM RELAY CYCLES : CLOSED FOR 5 SECONDS AND OPEN FOR 25 SECONDS. . . .

**Typical Wiring Diagram  
Single Phase VHS Units  
With DXM Controller with  
Night Setback, Emergency Shutdown,  
& Pump Restart**



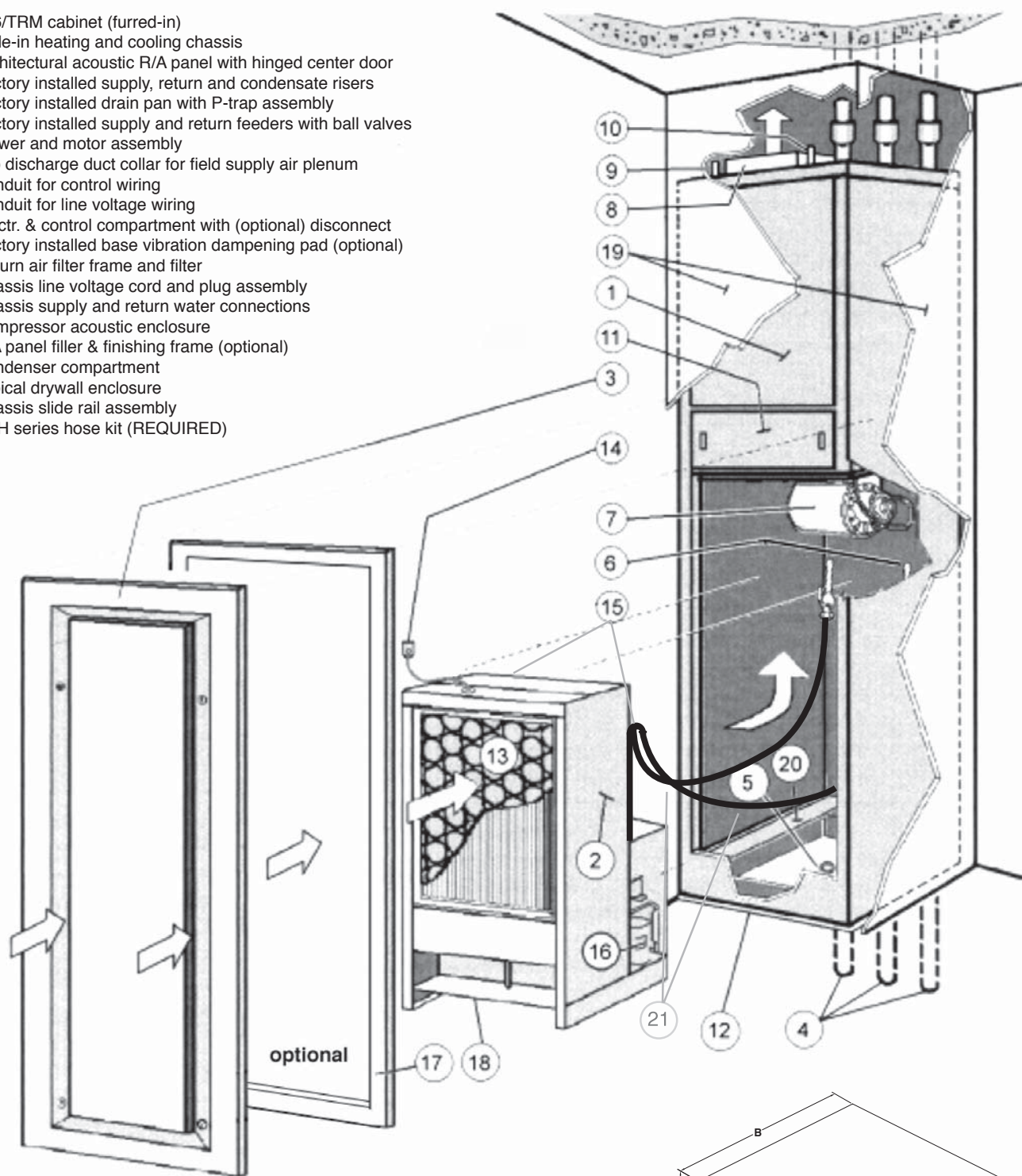
## Vertical Stack (VHS) Series

Rev.: 05/23/07D

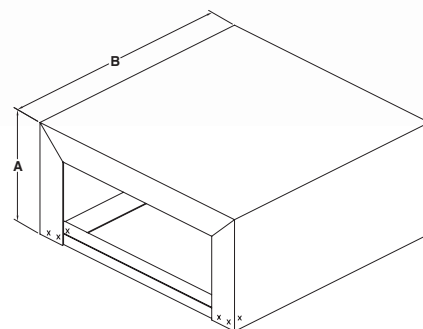
## Typical Unit - Exploded View

### Single Unit: Furred In & Ducted

- 1 816/TRM cabinet (furred-in)
- 2 Slide-in heating and cooling chassis
- 3 Architectural acoustic R/A panel with hinged center door
- 4 Factory installed supply, return and condensate risers
- 5 Factory installed drain pan with P-trap assembly
- 6 Factory installed supply and return feeders with ball valves
- 7 Blower and motor assembly
- 8 Top discharge duct collar for field supply air plenum
- 9 Conduit for control wiring
- 10 Conduit for line voltage wiring
- 11 Electr. & control compartment with (optional) disconnect
- 12 Factory installed base vibration dampening pad (optional)
- 13 Return air filter frame and filter
- 14 Chassis line voltage cord and plug assembly
- 15 Chassis supply and return water connections
- 16 Compressor acoustic enclosure
- 17 R/A panel filler & finishing frame (optional)
- 18 Condenser compartment
- 19 Typical drywall enclosure
- 20 Chassis slide rail assembly
- 21 AHH series hose kit (REQUIRED)



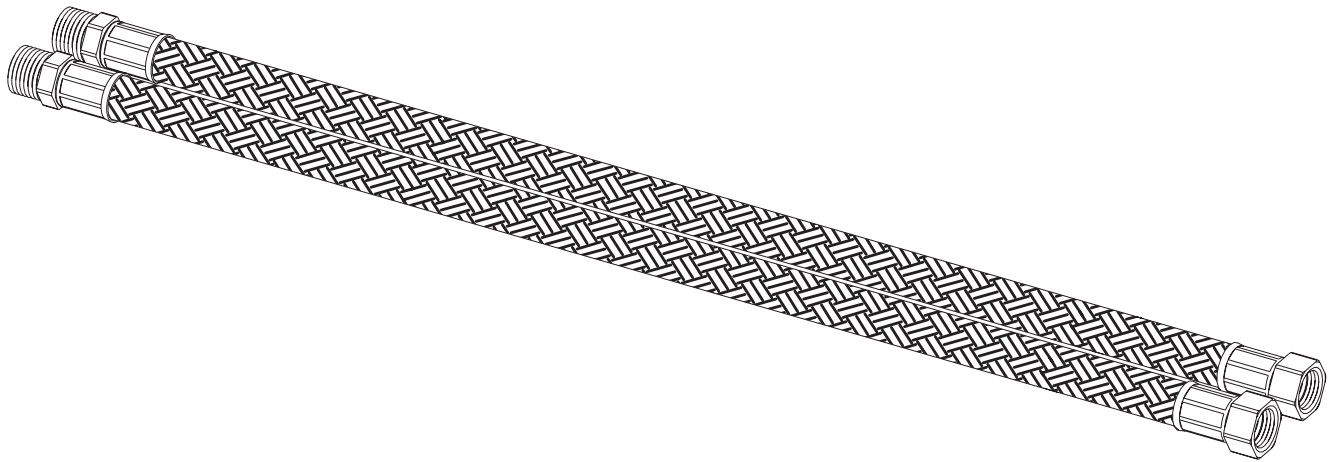
Optional Cabinet Stand		
Model	A	B
10/15	8" [203mm]	17.1" [434mm]
20	8" [203mm]	20.1" [511mm]
28-36	8" [203mm]	24.1" [612mm]



## AHH Series Stainless Steel Braided Hose Kit

### Specifications:

- Designed for water source heat pump applications.
- Kevlar® reinforced EPDM core with ANSI 302/304 stainless steel outer braid.
- Fire rated materials per ASTM E 84-00 (NFPA 255, ANSI/UL 723 & UBC 8-1).
- EPT (External Pipe Thread) fitting at one end; swivel connector with IPT (Internal Pipe Thread) at the other end (IPT connection via fiber or EPDM gasket, shipped inside connection).
- Swivel connection provides union between chassis and risers.
- Brass fittings, stainless steel ferrules.
- Temperature range of 35°F [2°C] to 180°F [82°C].
- Max. working pressure of 400 psi [2756 kPa].
- Min. burst pressure of four times working pressure.

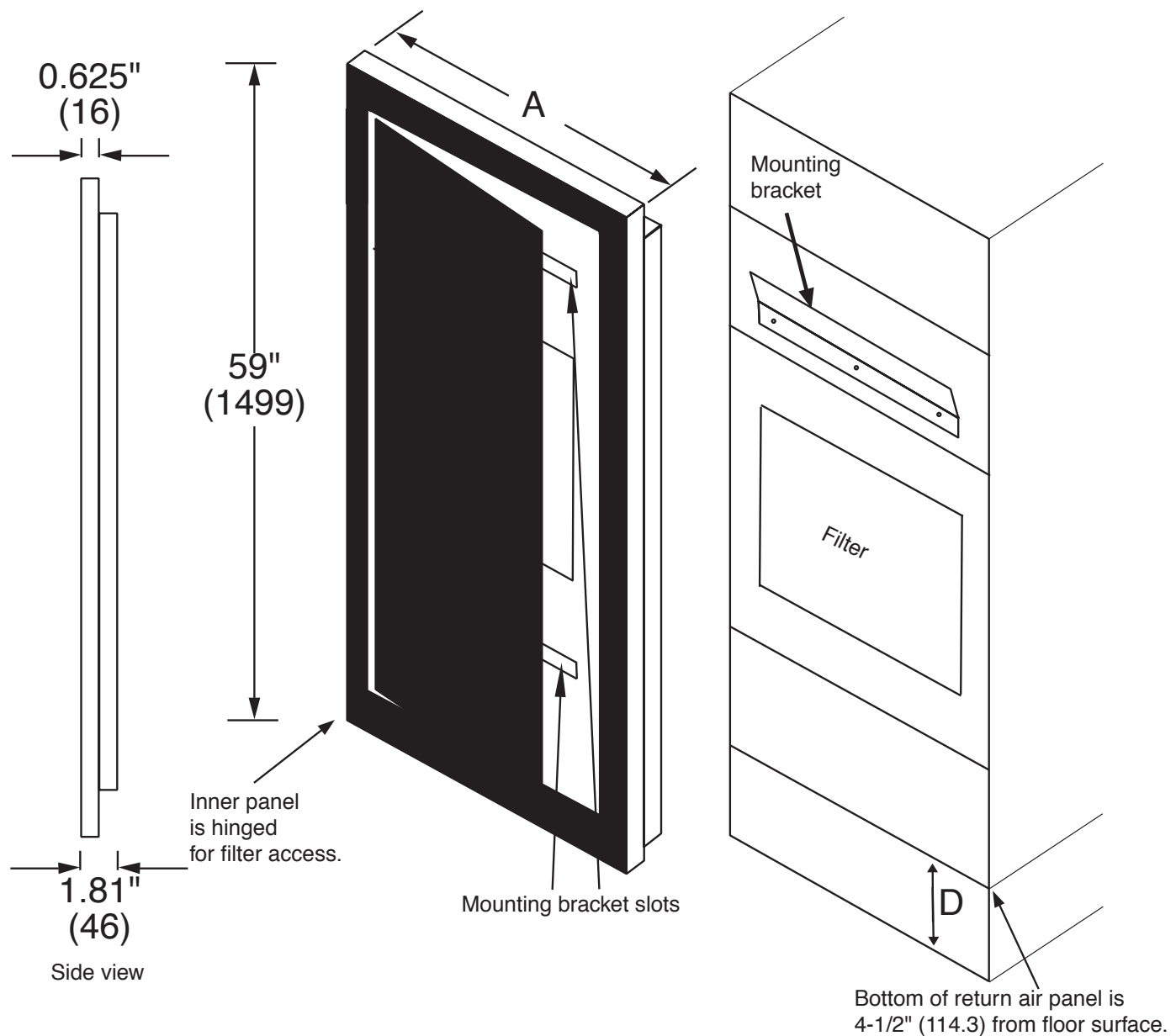


### Physical Data

Part #	Inside Diameter inches	Length feet [cm]	Working Pressure psi [kPa]	Min. Burst Pressure psi [kPa]	Min. Bend Radius inches [mm]
AHH0502B	0.50	2 [61]	400 [2756]	1600 [11024]	2.0 [50.8]
AHH0753B	0.75	3 [91]	400 [2756]	1600 [11024]	3.2 [81.3]
AHH1003B	1.00	3 [91]	350 [2413]	1600 [11024]	3.9 [99]



## Hinged "G" Style Return Air Panel



## Notes:

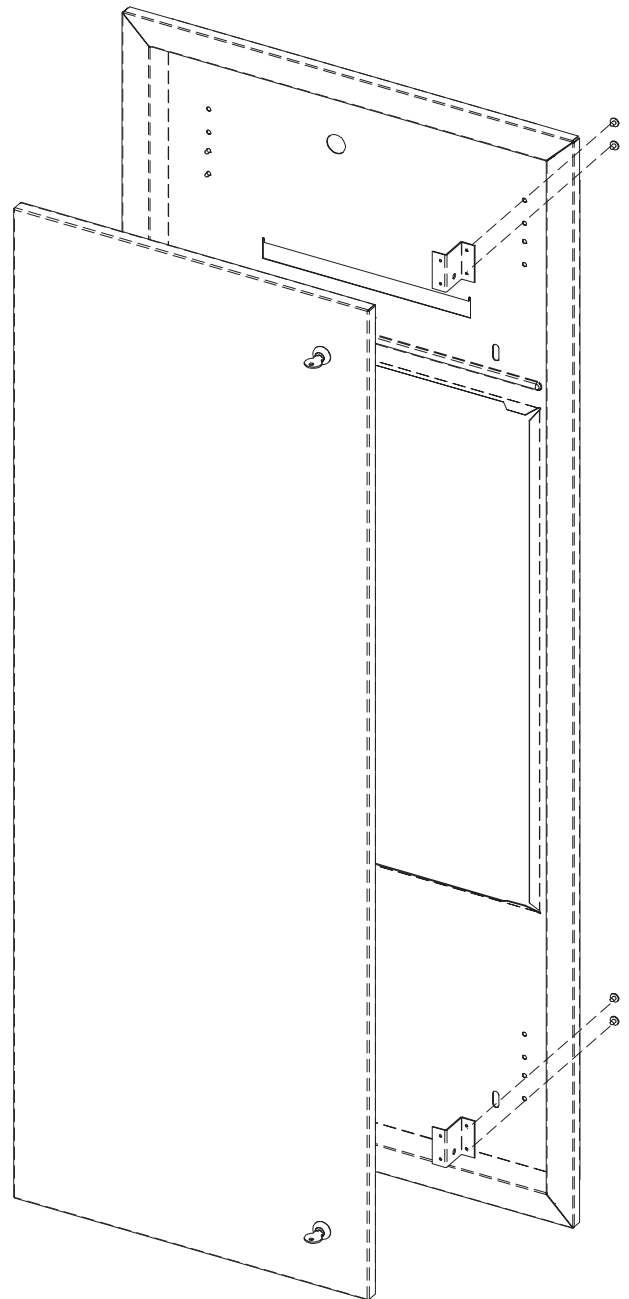
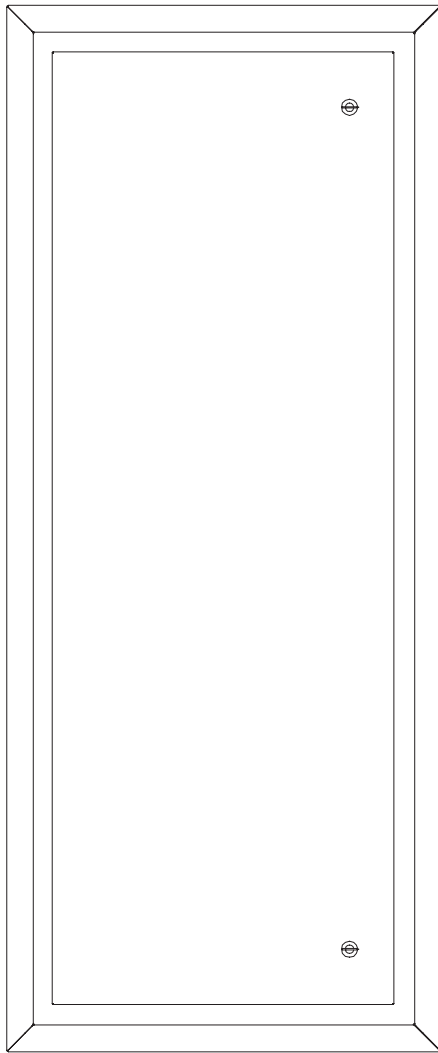
1. Panel Fits over mounting bracket for self alignment, then 4 bolts driven through panels slots into nuts on chassis.
2. Panel is painted Polar Ice White
3. All measurements are in inches, millimeters are in parenthesis.

Unit Size	A
10 - 15	18-1/2" [470]
20	21-1/2" [546]
28 - 36	25-1/2" [648]

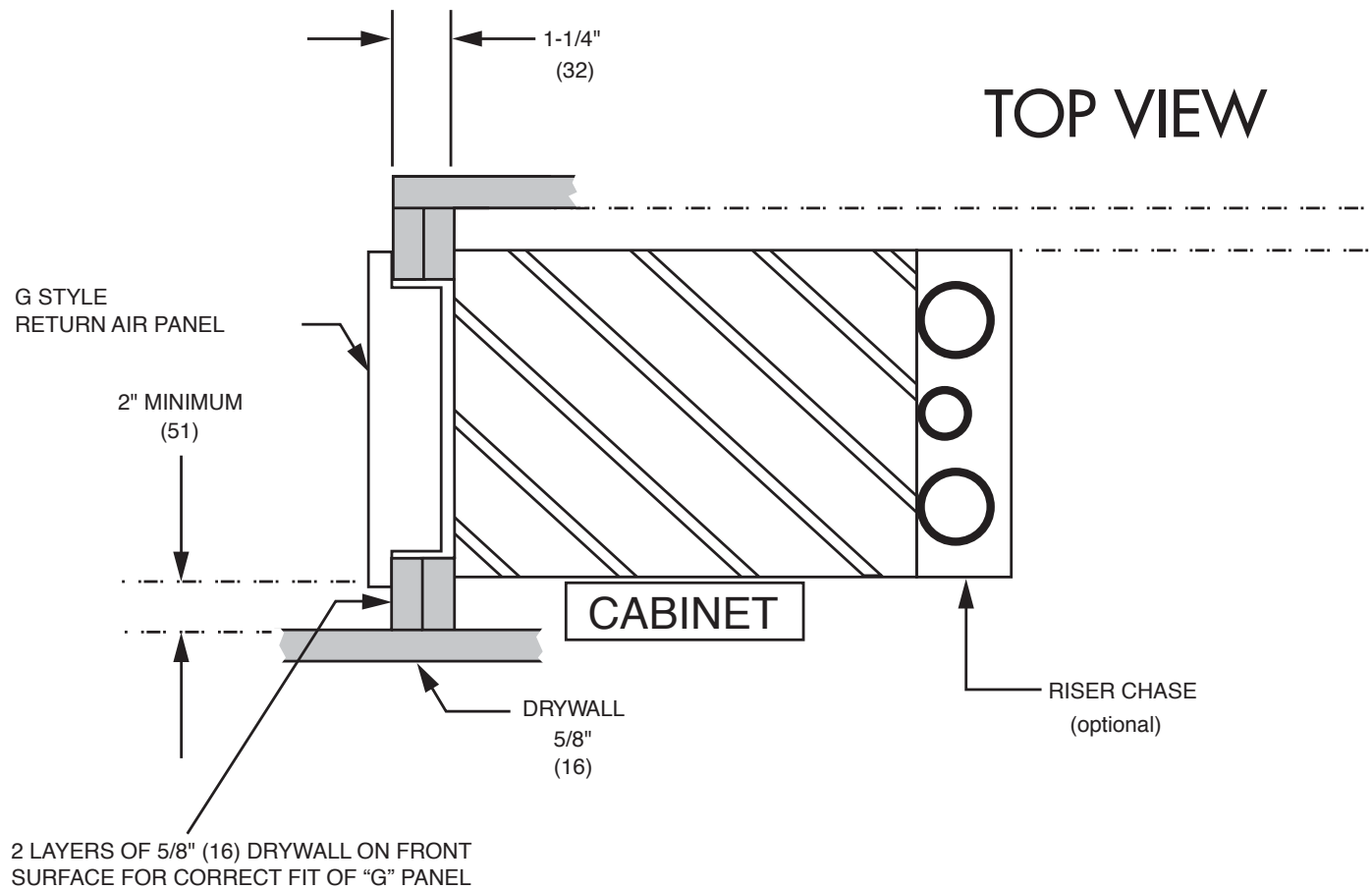
1.25" (32) drywall flanges must be used on cabinet.



### Hinged "G" Style Return Air Panel With Keyed Locks



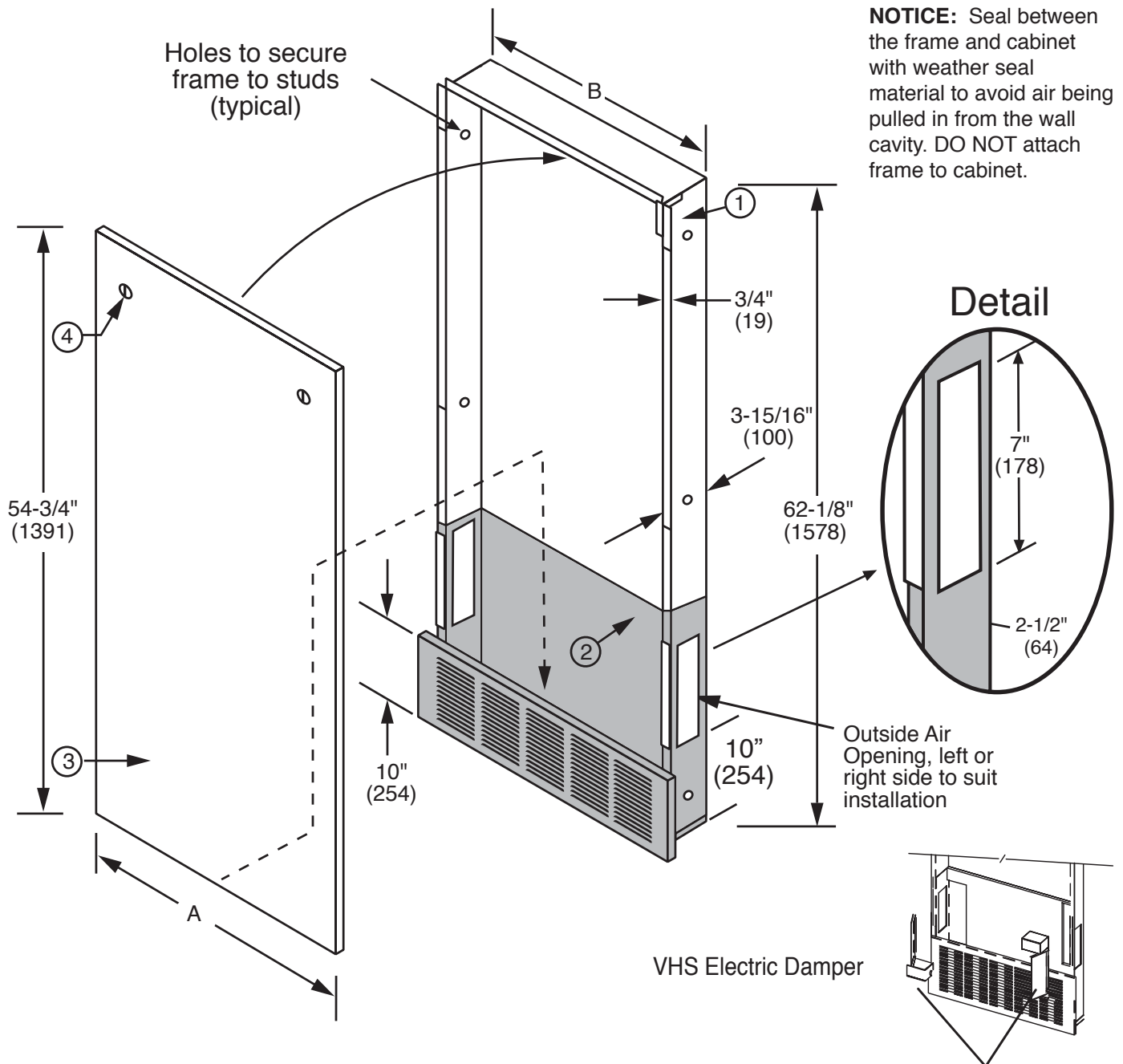
## Hinged "G" Style Return Air Panel



Drywall can be applied directly to unit surfaces, however, for best sound attenuation, a furred in stud wall installation is recommended.

**Note: All measurements are in inches, millimeters are in parenthesis.**

## Hinged "H" Style Return Air Panel



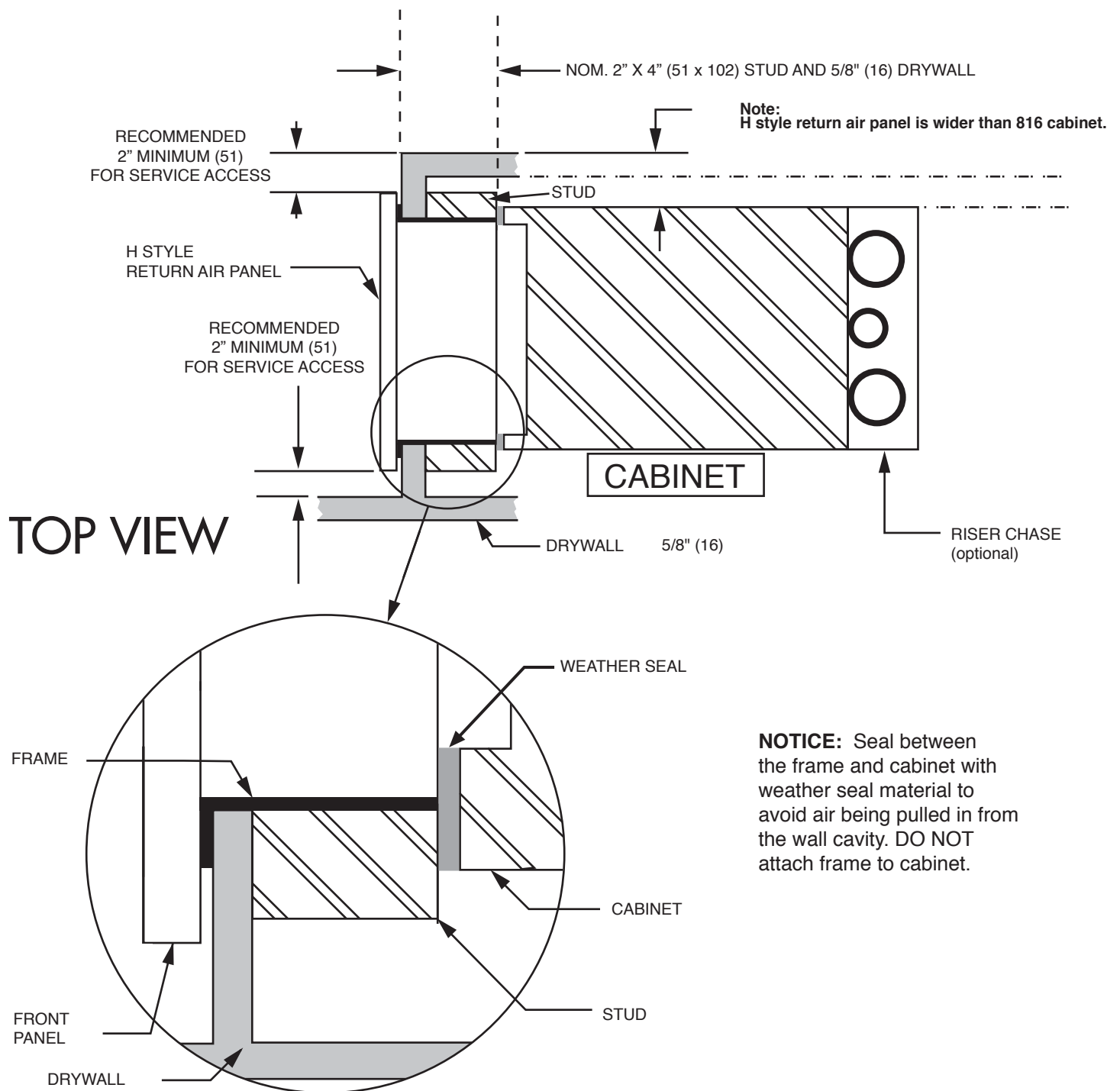
Notes: When outside air is used, contractor must supply outside air duct and cut hole in stud.

Item	QTY	Description
1	1	Frame assembly
2	1	Lower block-off assembly
3	1	Insulated front panel
4	2	1/4 turn fastener

Unit Size	A	B
10 - 15	18 5/8" [473]	16 3/4" [425]
20	21 5/8" [549]	19 3/4" [502]
28 - 36	25 5/8" [650]	23 3/4" [603]

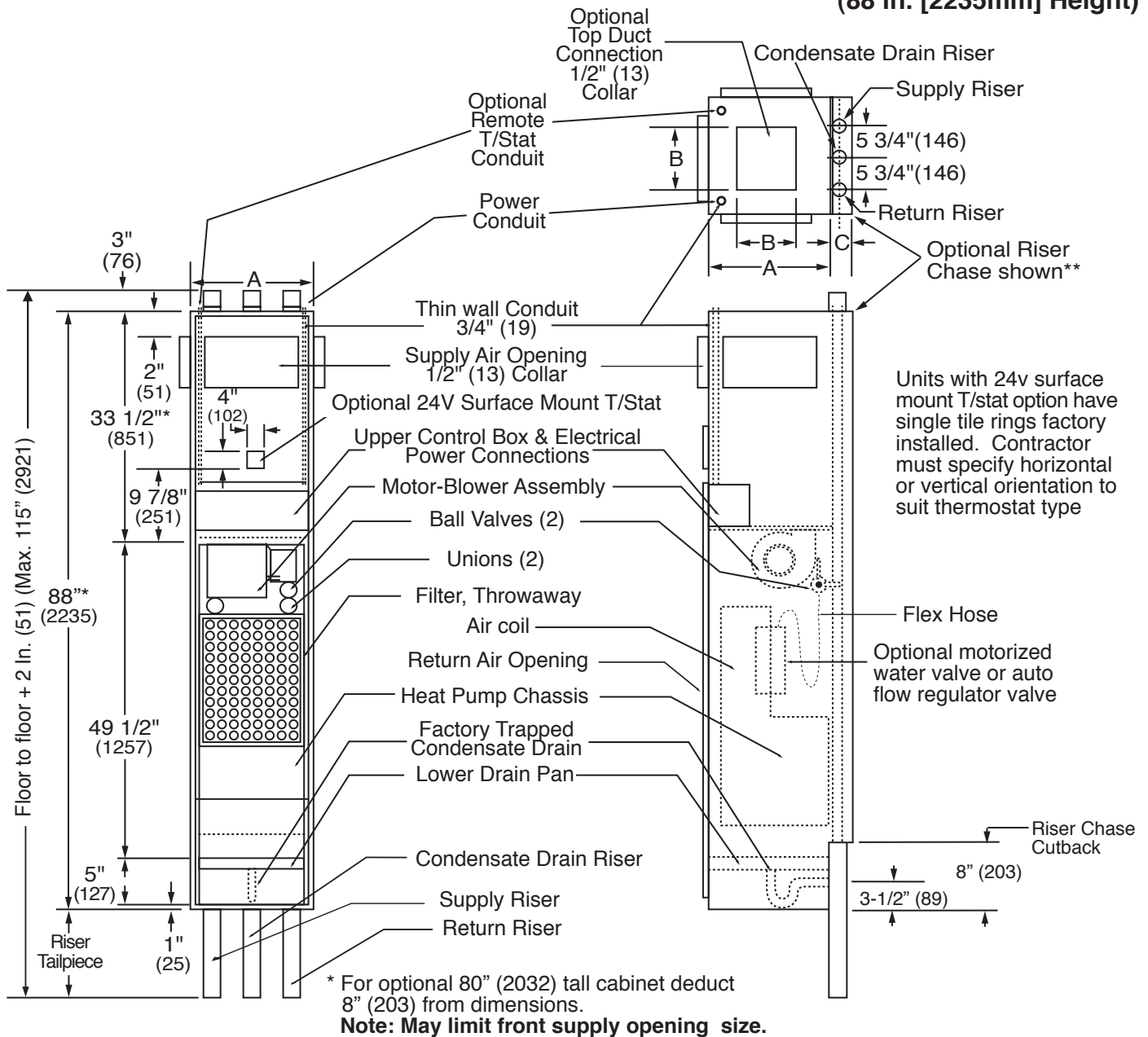
**Note: All measurements are in inches, millimeters are in parenthesis. Asy = Assembly**

## Hinged "H" Style Return Air Panel



**Note:** All measurements are in inches, millimeters are in parenthesis.

## VHS Unit Dimensions Single Unit, Furred In Cabinet (88 in. [2235mm] Height)



Unit Size	A	B	C**
816-10	17 [432]	10 [254]	4-1/4 [92]
816-15	17 [432]	10 [254]	4-1/4 [92]
816-20	20 [508]	13 [330]	4-1/4 [92]
816-28	24 [610]	17 [432]	4-1/4 [92]
816-30	24 [610]	17 [432]	4-1/4 [92]
816-36	24 [610]	17 [432]	4-1/4 [92]

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.  
 \*\* C Dimension = 4-1/4" (92) for risers up to 2-1/2" (64) diameter.  
 Consult factory for larger diameter risers.

**Note: All measurements are in inches, millimeters are in parenthesis.**

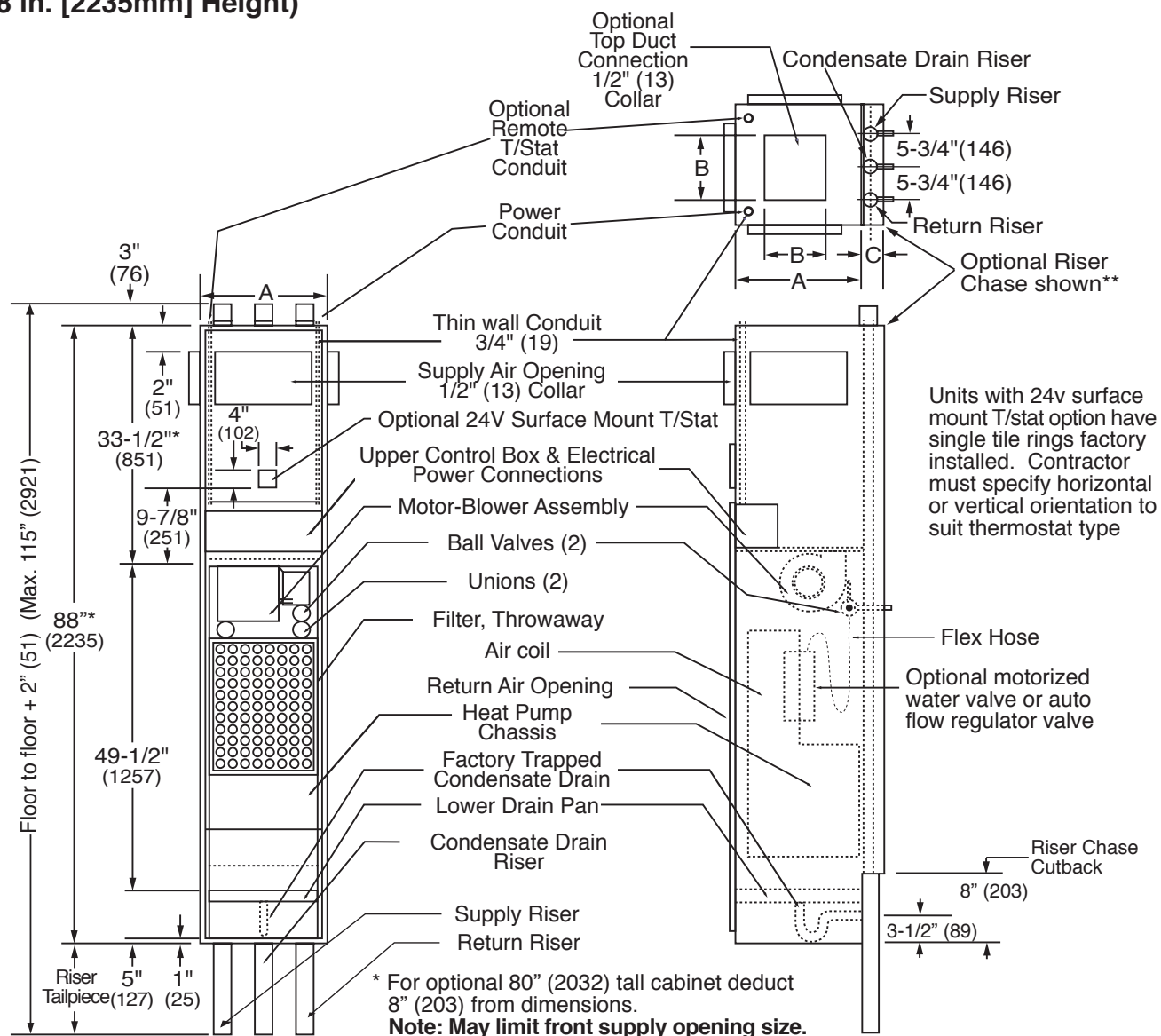
## Vertical Stack (VHS) Series

Rev.: 05/23/07D

## VHS Unit Dimensions

### Master Unit, Furred In Cabinet

(88 in. [2235mm] Height)

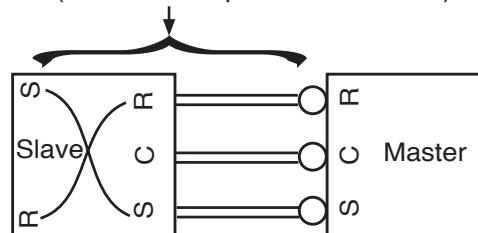


Unit Size	A	B	C**
816-10	17 [432]	10 [254]	4-1/4 [92]
816-15	17 [432]	10 [254]	4-1/4 [92]
816-20	20 [508]	13 [330]	4-1/4 [92]
816-28	24 [610]	17 [432]	4-1/4 [92]
816-30	24 [610]	17 [432]	4-1/4 [92]
816-36	24 [610]	17 [432]	4-1/4 [92]

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. Must provide crossover water piping from Master to Slave unit. Master unit has no riser chase.

\*\* C Dimension = 4 1/4" (92) for risers up to 2 1/2" (64) diameter. Consult factory for larger diameter risers.

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

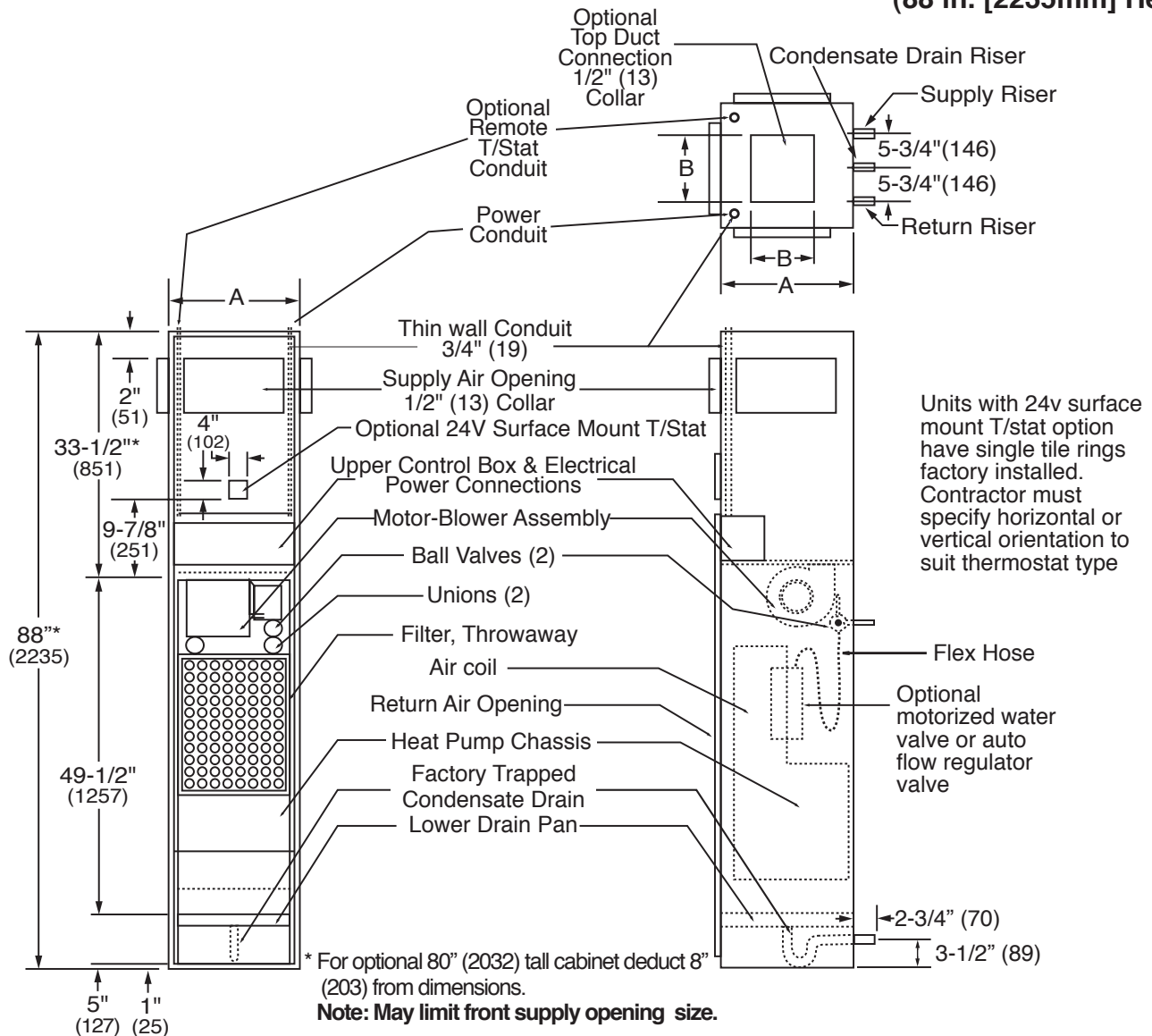


Dimension to suit local codes  
and installer

**Note: All measurements are in inches, millimeters are in parenthesis.**



# **VHS Unit Dimensions** **Slave Unit, Furred In Cabinet** **(88 in. [2235mm] Height)**

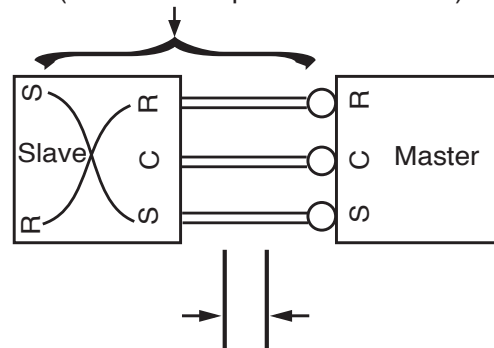


Unit Size	A	B
816-10	17 [432]	10 [254]
816-15	17 [432]	10 [254]
816-20	20 [508]	13 [330]
816-28	24 [610]	17 [432]
816-30	24 [610]	17 [432]
816-36	24 [610]	17 [432]

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. Must provide crossover water piping from Master to Slave unit. Master unit has no riser chase (stub-outs only).

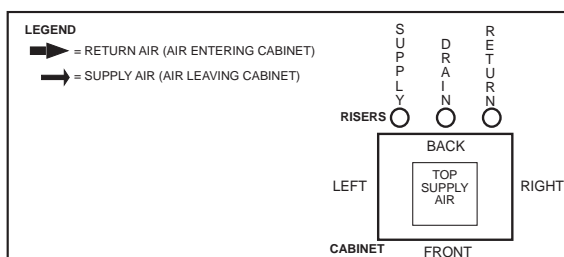
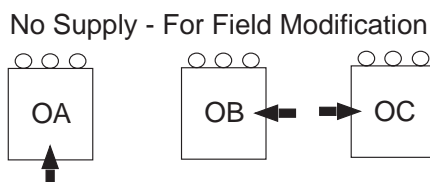
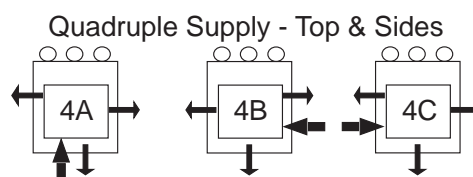
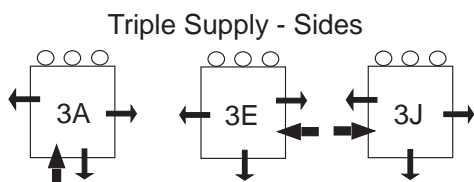
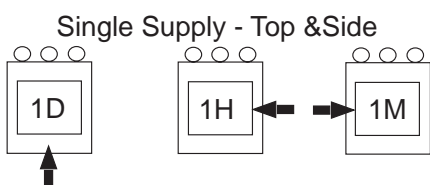
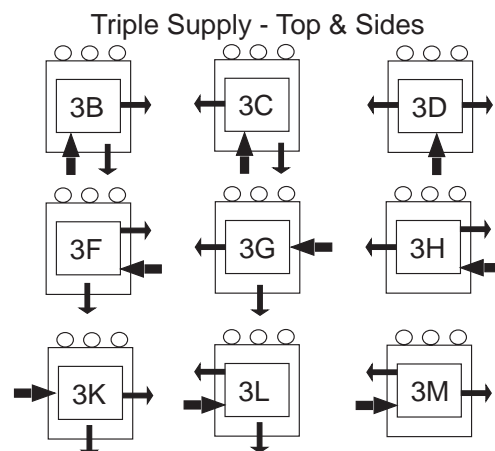
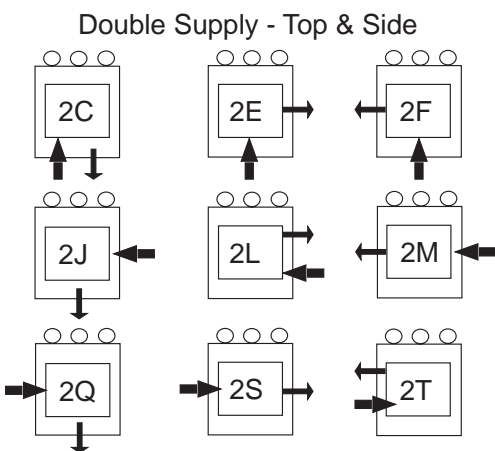
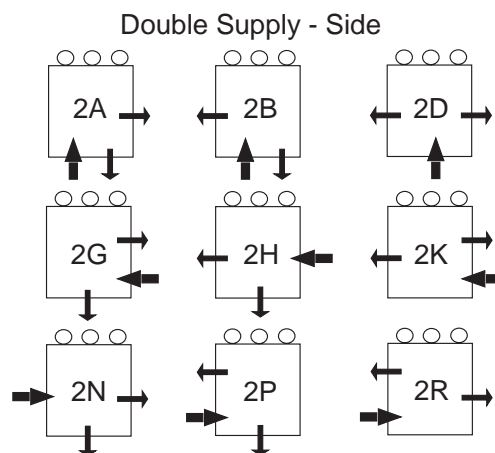
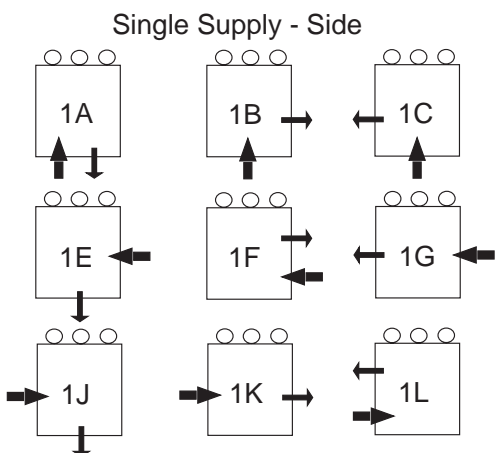
**Note: All measurements are in inches, millimeters are in parenthesis.**

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



Dimension to suit local codes and installer

## VHS Cabinet Configurations



## NOTES:

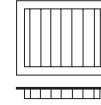
- 1: The riser compartment is defined as being the rear of each unit. Supply air grilles and return air/access panel can be any side except rear.
- 2: Return air side also defines control location and service access.
- 3: Triple discharge openings are not recommended for sizes 816-10, & 15. Single discharge openings are not recommended for sizes 816-28, 30, & 36.
- 4: Solid plenum option for field conversion of discharge air arrangement is available.

## Air Flow vs. Grille Selection

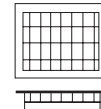
\* Grilles are shipped loose for field installation after drywall has been applied to cabinets that are furred in.

\*\* Grilles are brushed aluminum or painted (polar ice).

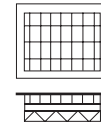
Single Deflection- Adjustable vertical blades for controlling horizontal path of discharge air.



Double Deflection- Adjustable vertical and horizontal blades for controlling horizontal and vertical path of discharge air. (Recommended for all standard applications.)



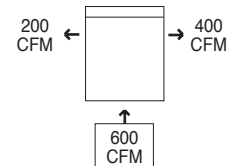
Double Deflection with Opposed Blade Damper- Addition of opposed blade damper to grille allows control of air volume (CFM) and path of discharge air. (Recommended for applications requiring unequal air flow or side discharge grille(s) with additional top discharge air opening.)



Unequal Air Flow- Air discharges requiring different air volumes (CFM). Use double deflection grilles with opposed blade damper.



Note: Units with adjacent grilles and opposed blade dampers may require special grilles. Consult factory with specific application.



Top Discharge- Units are designed to operate against relatively low air resistance (external static). Use of liberal duct sizing is recommended to maximize total unit air flow (CFM). Top duct outlet will offer more resistance to air flow than side outlets on the same cabinet. Therefore side outlet grille(s) must have opposed blade dampers to field balance the air flow.

Multiple Discharge/Top Grille & Opening  
Sizing When Air Flow Is Divided Equally

Multiple Discharge/Top Discharge Grille & Opening  
Sizing When Air Flow Is Divided Unequally

Unit Size	Single Discharge	Double Discharge	Triple Discharge
816-10	12" x 10" [305 x 254]	10" x 6" [254 x 152]	Not Recommended
816-15	12" x 12" [305 x 305]	10" x 8" [254 x 203]	Not Recommended
816-20	16" x 12" [406 x 305]	14" x 8" [356 x 203]	14" x 6" [356 x 152]
816-28	Not Recommended	16" x 10" [406 x 254]	16" x 6" [406 x 152]
816-30	Not Recommended	16" x 12" [406 x 305]	12" x 10" [305 x 254]
816-36	Not Recommended	16" x 14" [406 x 356]	16" x 10" [406 x 254]

Model	Specified Discharge CFM	Grille Selection Chart												Top Discharge Opening Size (Up to 100% Unit CFM)
		10" [254] Wide x			12" [305] Wide x			14" [356] Wide x		16" [406] Wide x				
		6"H	8"H	10"H	6"H	10"H	12"H	6"H	8"H	6"H	10"H	12"H	14"H	
10 15	100 - 150	X			X									10 x 10 [254 x 254]
	175 - 225		X											
	250 - 275			X			X							
20	150 - 200							X						13 x 13 [330 x 330]
	250 - 325								X					
	400 - 450										X			
28 30 36	200 - 275									X				17 x 17 [432 x 432]
	300 - 350					X								
	375 - 450										X			
	500 - 600											X		
	625 - 725												X	

## Vertical Stack (VHS) Series

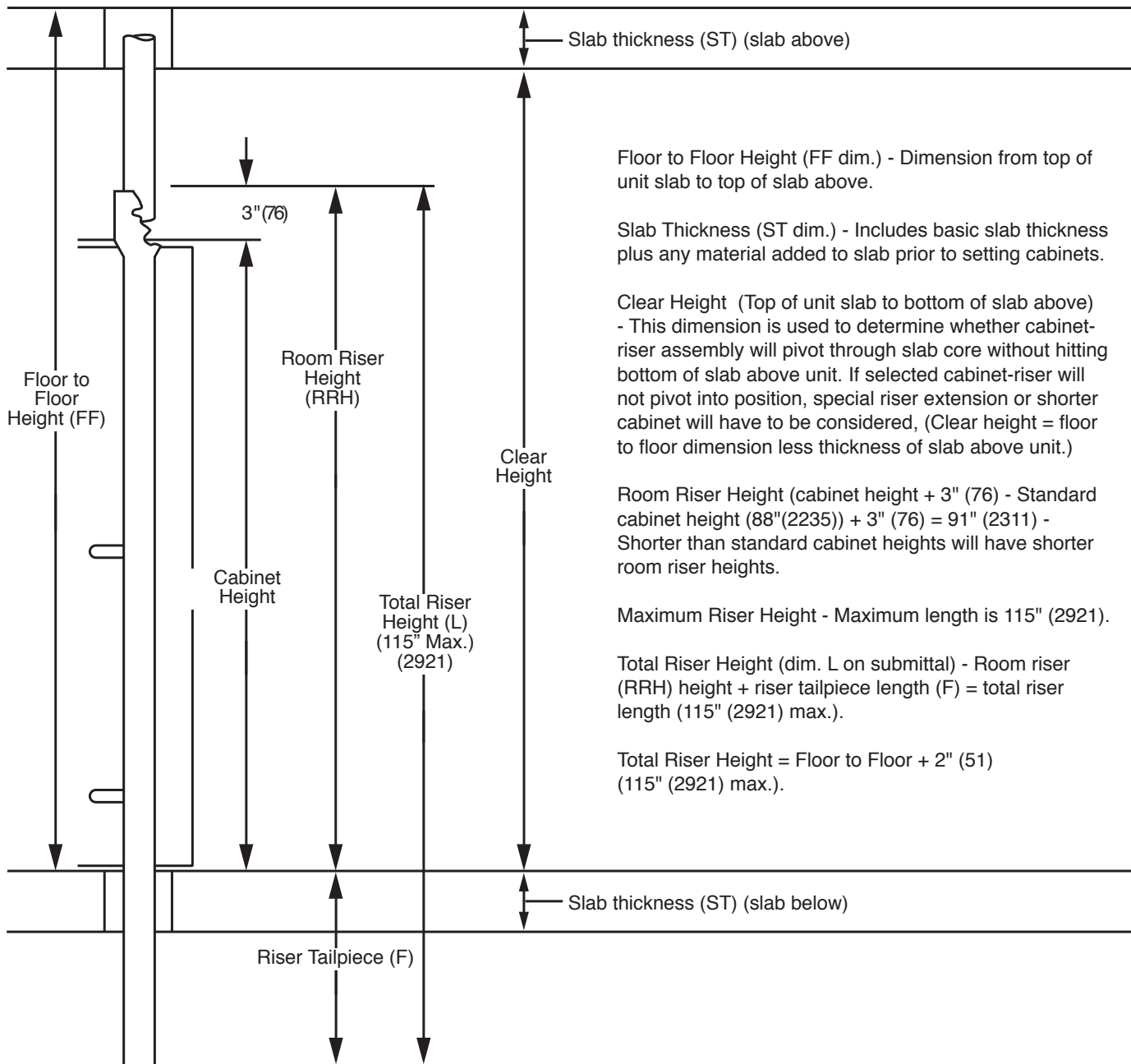
Rev.: 05/23/07D

## Riser Definitions

Riser Tailpiece (length of riser that extends down from cabinet bottom) -

Dimension F on submittal drawing- Riser tailpiece sized for 2" (51) insertion into 3" (76) expanded section at top of cabinet. Actual job fit may be 1" (25) to 3" (76) insertion (built-in +1" (25) floor to floor tolerance). Riser tailpiece should extend beneath bottom of slab a minimum of 5" (127) to facilitate brazing.

3" Expanded Section - Riser expanded at top of unit to accept a pipe diameter from unit above. (Top of riser always 3" (76) above top of unit.)



## Riser Arrangements Top Floor Units

1. All Risers Capped At Cabinet Run-Outs
- System piping is bottom supply & return

Standard for bottom supply & return unless otherwise specified.



2. All Risers Open At Top
- Bottom supply & return piping for supplying water to other units
  - Bottom supply & return piping for drain vent to roof, flushing crossover
  - Top supply & return piping

Standard for top supply & return unless otherwise specified.



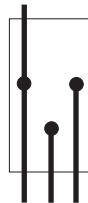
3. Supply & Return Open, Drain Capped At Cabinet Run-Out
- Bottom supply & return piping with open top for venting or flushing crossover
  - Top supply & return



4. Capped Supply and Return, Drain Open At Top
- Bottom supply & return piping with open drain riser for venting to roof or picking up drain from other equipment above



5. Supply Or Return Open At Top, Others Capped At Cabinet Run- Out
- Bottom supply & top return piping
  - Top supply & bottom return piping



Note: Check system flushing & air venting specifications.

## Riser Arrangements Bottom Floor Units

### 1. All Riser Through Slab At Bottom

- Bottom supply & return
- Top supply & return feeding other equipment below

Standard for bottom supply & return unless otherwise specified.



### 2. Supply & Return Capped At Cabinet Run-Out, Drain Through Slab

- Top supply & return
- Supply & return mains above these units on "Between-Floors" main piping

Standard for top supply & return unless otherwise specified.



### 3. All Risers Capped At Cabinet Run-Out, Drain Through Slab

- Isolated unit top supply & return from adjacent riser with separate drain
- Check riser venting



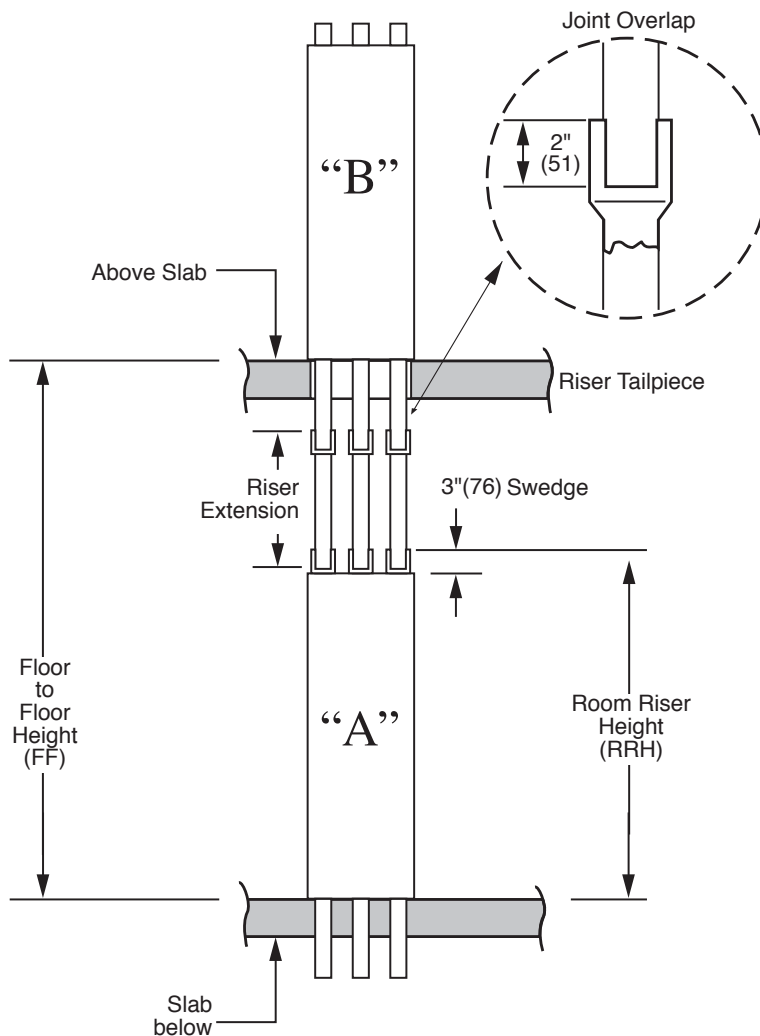
### 4. Supply Or Return Capped At Cabinet Run-Out, Other Risers Extend Through Slab

- Bottom supply, top return piping
- Bottom return, top supply piping



Note: Check system flushing and air venting specifications.

## Riser Extension Sizing



**Riser Tail Piece:** Length of riser extending down from the cabinet. Riser tail piece must extend a minimum of 5" (127) below slab.

**Room Riser Height (RRH):** Cabinet height + 3" (76). Standard Cabinet is 88" (2235) + 3" (76) = 91" (2311).

**Floor To Floor Height (FF):** Distance from top of unit slab to top of above slab.

**Riser Extension Length:** Start with the floor to floor Dim. (FF) From this subtract the room riser height and tail piece length. Then add 4" (102) to the two joint overlaps.

**Riser Extension:**  $FF - (\text{tailpiece} + \text{RRH}) + 4" (102)$ .

Example: Floor to floor (FF) = 120" (3048)

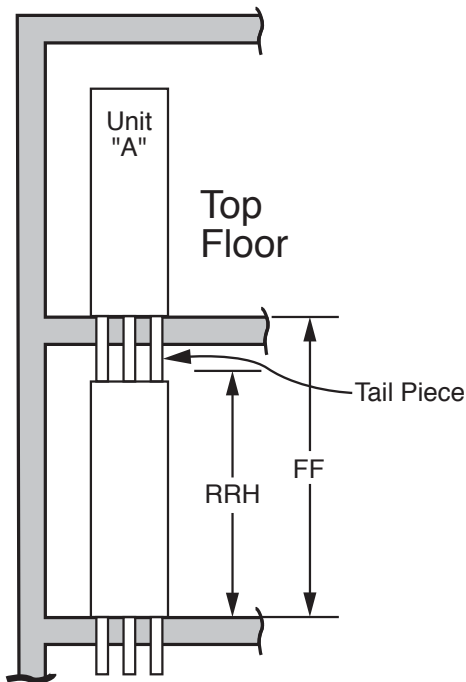
Room Riser Height (RRH) = 91" (2311)

Tail Piece = 13" (330).

Riser Extension:  $120" (3048) - (13" (330) + 91" (2311)) + 4" (102) = 20" (508)$ .

NOTE: Riser extensions are ordered for unit on floor above (example shown - riser extensions would be for Unit "B")

## Riser Length Sizing



To determine the riser tail piece length of a unit (unit "A").

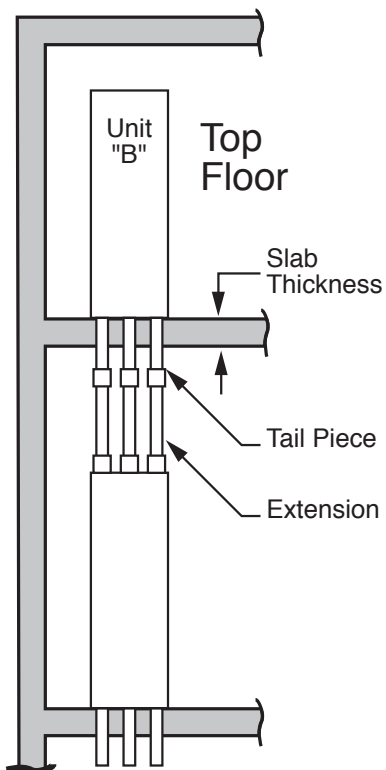
Riser Tail Piece ( of unit A)=  $FF - RRH + 2"$  (51).

RRH: Room riser height is cabinet height + 3" (76).

Standard cabinet height is 88" (2235).

$RRH = 88" (2235) + 3" (76) = 91" (2311)$ .

FF: Floor to Floor height is the dimension from the top of the slab above to the top of the slab below.



To determine the riser tail piece length of a unit (unit "B") that will require riser extensions to a unit below.

Minimum Tail Piece Length (of unit "B") = slab thickness + 5" (127).

To determine riser extensions lengths see page Riser Extension Sizing.

Note: If riser length exceeds 115" (2921), riser extensions must be used. See Riser Extension Sizing. The riser tail piece must extend through the slab a minimum of 5" (127) to facilitate brazing. Special care must be taken in sizing riser lengths and tail piece lengths when:

- A) Riser extensions are used.
- B) Floor to floor heights vary.
- C) Slab thickness varies from floor to floor.

See Riser Arrangement for selection of top floor riser applications.



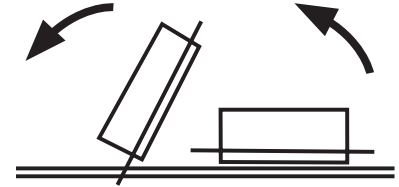
## Cabinet Height & Slab Slot Size

To determine the slab slot size required for the risers and to determine if clear height is OK for unit installation, use the cabinet height and slab slot charts on the next page.

To use the charts you will need the clear height in the room the unit is in, size of unit, number of risers, riser dimensions and type of installation. (See below)

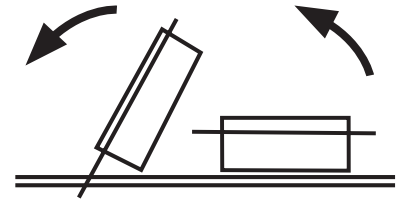
### Type 1 Single Units

With a minimum clear height of 94" (2388). Start with the unit lying on the chase.



### Type 2 Single Units

With a minimum clear height of 96" (2438). Start with the unit lying with the chase on top.



### Type 3 Single

With a minimum clear height of 94" (2388). Start with the unit lying on its side as shown.



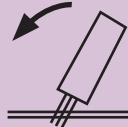


If any clear height is less than 96" (2438) check the minimum cabinet height and slot size chart to determine if the size unit you need will fit. If the standard 88" (2235) cabinet does not fit check the short 80" (2032) cabinet height and slot size chart. Call the factory if the short 80" (2032) cabinet does not fit. Check with the contractor for OK to use 80" (2032) cabinet.

Clear Height (swing height) = Floor to Floor Dimensions - Slab Thickness of Slab above the unit.  $CH = FF - ST$ .

## Slab Slot Chart - 3 Pipe

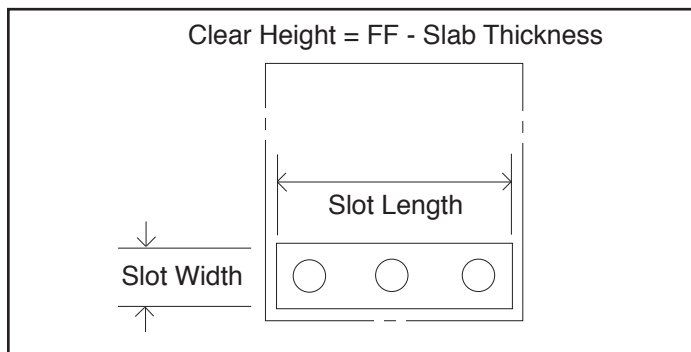
## 3 Pipe Standard 88" Cabinet

Model	Clear Height	Slab Slot Size		
		Type of Installation		
		Type 1	Type 2	Type 3
		 W x L	 W x L	 W x L
10 - 15	96	5 7/8" X 15" [149 X 381]	5 7/8" X 15" [149 X 381]	5" X 15" [127 X 381]
	95	6 1/4" X 15" [159 X 381]	5 3/8" X 15" [137 X 381]	5" X 15" [127 X 381]
	94	6 5/8" X 15" [168 X 381]	5 3/8" X 15" [137 X 381]	5" X 15" [127 X 381]
	93	7" X 15" [179 X 381]	Not Recommended	5" X 15" [127 X 381]
	92	7 1/2" X 15" [191 X 381]	Not Recommended	Not Recommended
20	96	6 1/4" X 18" [159 X 457]	5 1/8" X 18" [130 X 457]	5" X 18" [127 X 457]
	95	6 3/4" X 18" [171 X 457]	5 3/8" X 18" [137 X 457]	5" X 18" [127 X 457]
	94	7 1/8" X 18" [181 X 457]	Not Recommended	5" X 18" [127 X 457]
	93	7 5/8" X 18" [194 X 457]	Not Recommended	5" X 18" [127 X 457]
28 - 36	96	7" X 22" [178 X 559]	5 1/8" X 22" [130 X 599]	5" X 22" [149 X 599]
	95	7 1/2" X 22" [191 X 559]	Not Recommended	5" X 22" [149 X 599]
	94	8" X 22" [203 X 559]	Not Recommended	5" X 22" [149 X 599]
10 - 15	91 or less	Not Recommended	Not Recommended	Not Recommended
20	92 or less	Not Recommended	Not Recommended	5" X 18" [149 x 457]
28 - 36	93 or less	Not Recommended	Not Recommended	5" X 22" [127 x 599]

To use this chart look down the model column to find the model. Then look across to find the clear height. If your clear height exceeds 96" use the 96" slab slot size. Then under the type of installation read the slab slot size.

Above charts allow 1" tolerance in clear height to allow for variance in floor to floor dimensions.

Clear height is the floor to floor dimension of the floor the unit is on minus the slab thickness above.



## Shipping

### Units Are Shipped FOB Factory

ClimateMaster Hi-Rise Cabinets are normally shipped to the jobsite on dedicated open flatbeds trailers, palletized for maximum shipping density, grouped together by building, size and floor where possible, wrapped and covered with tarp for protection (Figure 1). The size of each pallet depends upon the cabinet size and number of cabinets (Figure 2).

Special shipping accommodations can be provided by ClimateMaster. Examples might include:

- Closed truck or container shipping, on special end fork pallets.
- Reduced height, width or weight pallets.
- Unit grouped on pallets by riser instead of floor (for example, a retrofit job).
- Export or over-crating.
- Risers shipped separately from cabinets.

However, any such special shipping needs must be included with the order of the units. ClimateMaster will charge extra for any accommodations which significantly increase the cost of the shipment.

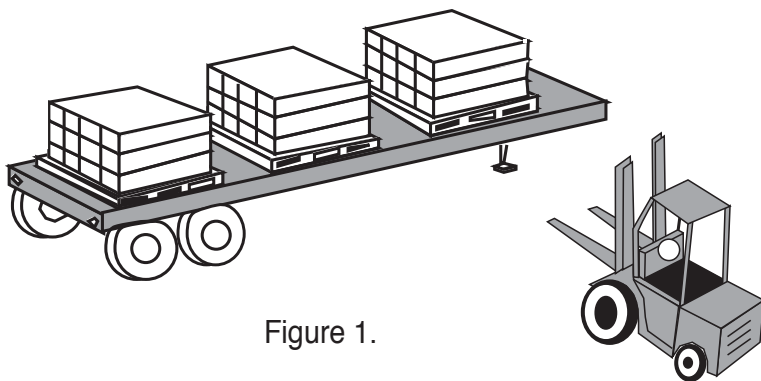


Figure 1.

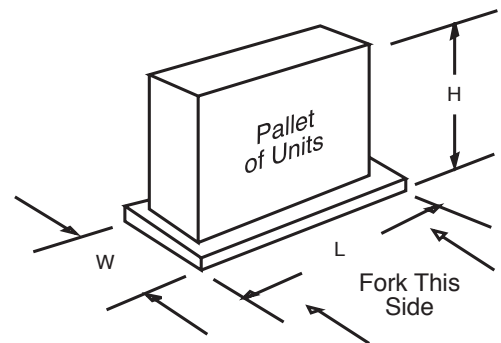


Figure 2.

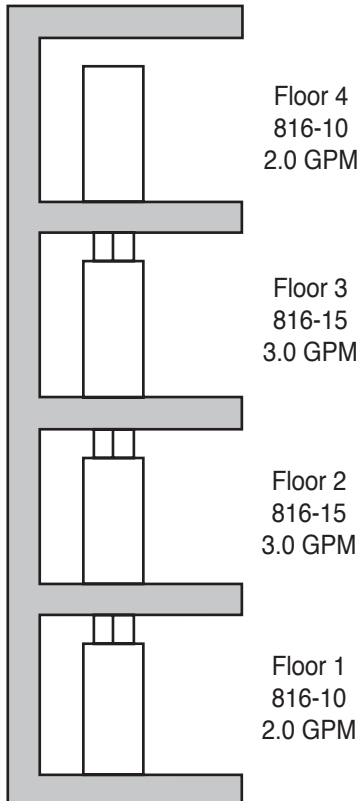
Cabinet Size	# of Cabinets	L (in.)	W (in.)	H (in.)	Approx. Weight per pallet	Approx. Quantity per truck
10/15	4	106*	22	84	725	80
	8	106*	44	84	1450	80
20	4	106*	25	96	785	80
	8	106*	50	96	1570	80
28/30/36	3	106*	29	87	750	60
	6	106*	58	87	1500	60

\* 106" for standard, 104" long risers (typically add 2" to riser length.)

## Riser GPM Sizing

Riser GPM requirements and individual Unit GPM requirements are necessary to select the proper Riser Piping diameters. Refer to this page to determine GPM requirement, then refer to Riser Diameter Sizing Table to determine Riser Piping diameters.

Example is for bottom supply - bottom return system feed loop. GPM's are dependent upon unit load and system loop water temperatures. Please refer to Performance Charts for individual Unit GPM requirements.



Unit GPM (UGPM) = Required gallon per minute from "Performance Charts," in "Vertical Stacked Design Guide."

Total Riser GPM (TRGPM) = The sum of, all Units, GPM on each Riser.

Total GPM Per Floor (TGF) = Total GPM minus the sum of Unit GPM from all floors below.  $TGF = TRGPM - (\text{sum UGPM from units below})$ .

Example: Four floors, Consisting of units sizes 816-10 and 816-15, as shown in diagram. GPM's are 2.0 and 3.0 respectively.

$TRGPM = 2.0 + 3.0 + 3.0 + 2.0 = 10 \text{ GPM}$ .

Floor 4:  $TGF = 10 - (3.0 + 3.0 + 2.0) = 2 \text{ GPM}$  needed at floor 4.

Floor 3:  $TGF = 10 - (3.0 + 2.0) = 5 \text{ GPM}$  needed at floor 3.

Floor 2:  $TGF = 10 - (2.0) = 8 \text{ GPM}$  needed at floor 2.

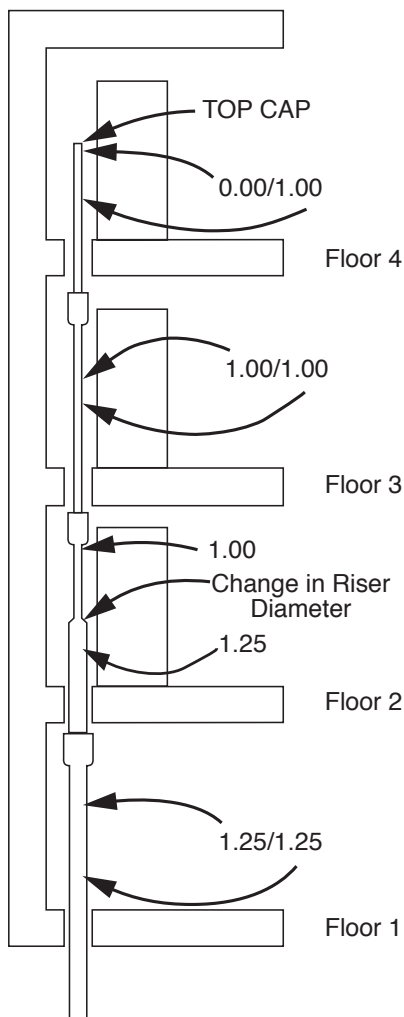
Floor 1:  $TGF = 10 - (\text{no floors below}) = 10 \text{ GPM}$  needed at floor 1.

Refer to Riser Diameter Sizing page.

## Riser Diameter Sizing

Refer to Riser GPM Sizing for the prefix to this example.

Each 816 Vertical Stack unit has three 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 two riser pipes.



From Table 1 (below) determine the proper riser diameter needed to satisfy the required GPM's at each unit. Refer to Table 2 (below) 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.

0.00/0.75 - Indicates top cap/3/4" bottom.

0.75/1.00 - Indicates 3/4" top/1" bottom.

1.00/0.00 - Indicates 1" top/bottom cap.

(from this we develop Table 3)

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

**Table 1**

Maximum GPM	12	20	34	70	125	300
Nominal Riser Diameter	1"	1-1/4"	1-1/2"	2"	2-1/2"	3"

**Table 2**

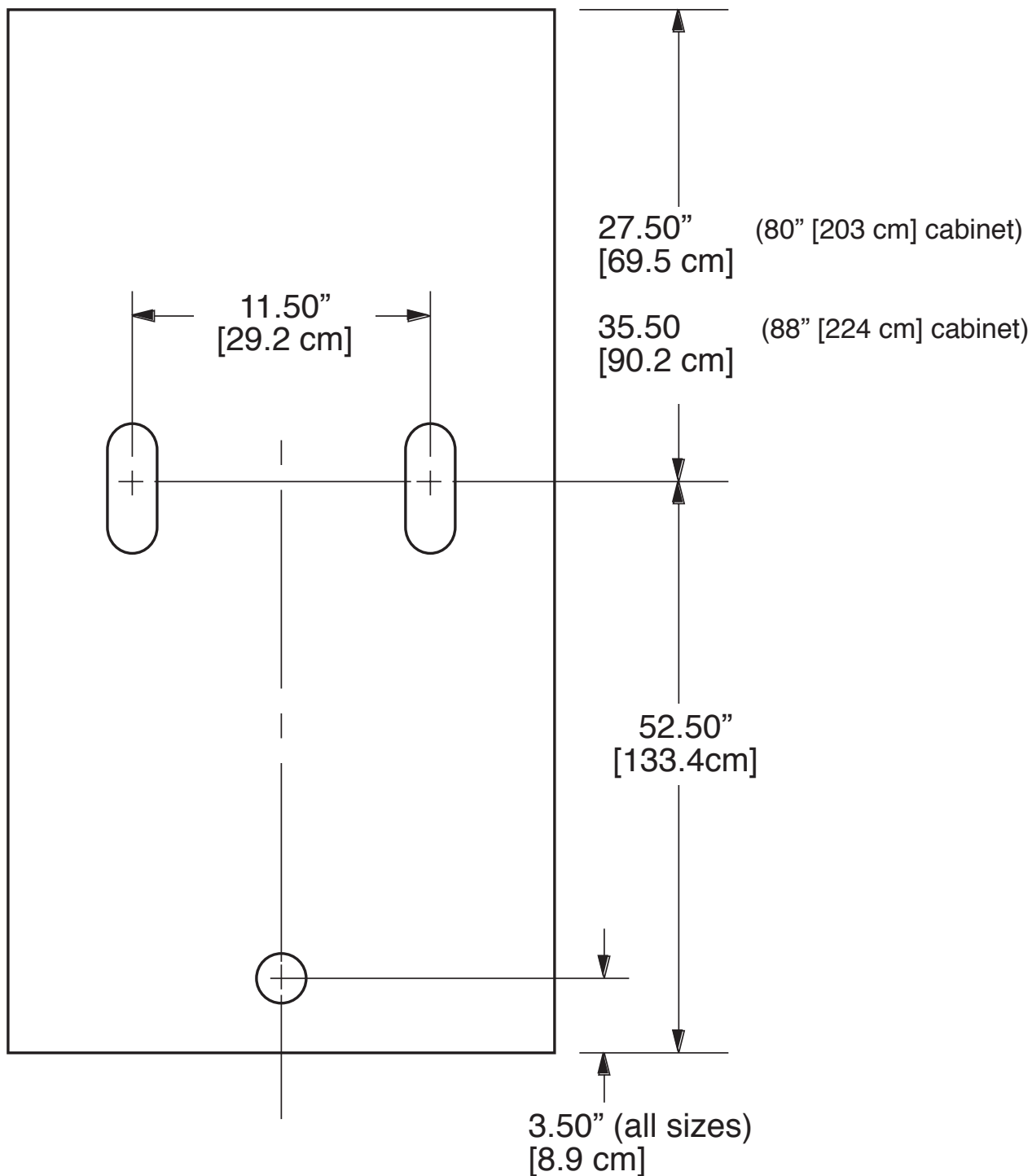
Floor	GPM	Diameter From Table 1
4	2	1" [25.4]
3	5	1" [25.4]
2	8	1" [25.4]
1	20	1.25" [25.4]

**Table 3**

Nomenclature per Unit	Description
0.00/1.00	Top Cap, w/1" Bot Feed
1.00/1.00	1" Full Length Riser
1.00/1.25	1" Top, 1.25" to 1st Floor
1.25/1.25	1" Full Length Riser

Values from Table 3 are to be entered on the Riser Piping Schedule. Top diameter must match bottom diameter of floor above.

## Riser Slot Arrangements



Always figure riser extension from the bottom of the cabinet, total extension length is effective length plus 2" [5.1 cm]

Standard riser arrangement is 3" [7.6 cm] above and 13" [33 cm] below to 24" [61 cm] below (overall riser=115" [292.1 cm] Max.)

Type M and L copper available

## Vertical High Rise - VHS Series

### Engineering Specifications Rev.: 04/02/07

#### General:

Furnish and install ClimateMaster Water Source Heat Pumps, as indicated on the plans with capacities and characteristics as listed in the schedule and the specifications that follow.

#### Vertical Stack Water Source Heat Pumps:

Units shall be low range, 40° to 110°F (4.4° to 43.3°C) entering water temperature for low temperature application. Equivalent units from other manufacturers can be proposed provided approval to bid is given 10 days prior to bid closing. All equipment listed in this section must be rated and certified in accordance with American Refrigeration Institute / International Standards Organization (ARI / ISO) and Environmental Testing Laboratories for United States and Canada (ETL-US-C). The units shall have ARI / ISO and ETL-US-C labels. All cabinets shall be factory tested under normal operating conditions, risers shall be pressure tested and chassis shall be factory tested under normal operating conditions and water flow rates. **Units tested without water flow are not acceptable.**

#### Basic Construction:

The cabinet panels shall be fabricated from heavy gauge galvanized steel. The rigid one-piece cabinet shall be constructed so that it is self-supporting, and can be installed long before the chassis arrival, and to be able to avoid damage during construction. Top, base, fan deck, and other metal structural parts are to be 16 gauge construction, while exterior panels to be 20 gauge; unit further strengthened by structural breaks at corners. **Units not constructed of a minimum of these thicknesses are not acceptable. Cabinet shall have a top panel and a bottom panel for structural rigidity of the cabinet; no "open" top or "open" bottom designs allowed.**

The cabinet base shall contain a secondary drain pan fully insulated with a pressure differential drain trap connected to the condensate riser pipe, and guide rails for the slide in refrigeration chassis. Drain pan(s) shall be easily accessible for cleaning. All interior surfaces shall be lined with 1/2 inch (12.7mm) thick, dual density 1-3/4 lb/ft<sup>3</sup> (28 kg/m<sup>3</sup>) acoustic type fiberglass insulation. All fiberglass shall be coated and have exposed edges butted up to flanges to prevent the introduction of glass fibers into the air stream.

Standard cabinet panel insulation must meet NFPA 90A requirements, air erosion and mold growth limits of UL-181, stringent fungal resistance test per ASTM-C1071 and ASTM G21, and shall meet zero level bacteria growth per ASTM G22. **Unit insulation must meet these stringent requirements or unit(s) will not be accepted.**

Cabinet arrangements shall allow symmetrical placement of riser piping on any of the three sides of the cabinet not used for the chassis access. All Cabinet openings shall have dry wall flanges on all sides. Supply air openings shall be factory cut and flanged as shown on plans. For air noise attenuation purposes, the discharge air from fan shall discharge into insulated plenum that also contains insulated air baffles at all cabinet supply air openings. **Units not having supply air noise baffles are not acceptable.** Cabinet design shall allow a full height base board (5 inches/127mm) beneath the chassis access. The cabinet shall contain an easily removable motor/blower assembly.

Full length supply, return, and insulated condensate water risers shall be type M copper with integral internal piping including ball valves (for shut off purposes at unit). Field installed hose kits are required to connect the chassis piping to the cabinet piping. The condensate riser shall be insulated with 3/8" (9.5mm) Armaflex type insulation. The top of each riser shall be deeply swaged (3 in./ 76.2mm) to accept connection to the riser above/below, allowing for a floor to floor dimensional variance of ± one inch (25.4mm). **Units not having swaged riser-piping connections shall not be acceptable. Couplings and trim pieces shall not be allowed.**

*Option: Type L riser piping.*

*Option: Unit mounted Thermostat provisions -- includes insulated junction box mounted inside discharge plenum that is connected to Molex-type connector wired to unit thermostat terminals, and having tile ring on cabinet for drywall installation to accept thermostat mounting. Use part number A9155724, A9155728 or A9155729 thermostat assembly, which is thermostat model ATM11C01, ATM11C03 or ATA11C04, respectively with mating Molex-type connector.*

#### Fan and Motor Assembly:

The cabinet shall contain a removable motor/blower assembly. Units shall have a direct drive centrifugal fan. The fan motor shall be 2 speed, permanently lubricated, PSC type with thermal overload protection. The fan motor shall be isolated from the fan housing by a torsionally flexible motor mounting system with rubber type grommets to inhibit vibration induced high noise levels associated with "hard wire belly band" motor mounting. Airflow/External static pressure rating of the unit shall be based on a wet coil and clean filter.

*Option: High static motors.*

## Vertical Stack (VHS) Series

Rev.: 05/23/07D

**Chassis:**

The chassis, which incorporates the air coil, water coil, drain pan, and compressor, shall be easily installed for quick jobsite installation and future servicing purposes. The slide in chassis shall have an insulated panel separating the fan compartment from the compressor compartment. Compressors are not in the air stream. The chassis base shall be fabricated from heavy gauge galvanized steel formed to match the slide in rails of the cabinet. All electrical connections between the chassis and cabinet shall be made via locking quick-connects. Units shall have a factory installed 1 inch (25.4mm) thick filter bracket and throwaway type glass fiber filter. Furnish one spare set of filters.

Water connections between chassis and the cabinet shall be accomplished via a hose kit consisting of Kevlar-reinforced EPDM core hose surrounded by a stainless-steel braid. Hose kit shall have brass fittings with stainless-steel ferrules. Hose ends shall be solid External NPT which connects to mating fitting on cabinet shut off ball valve(s), and Internal NPSM (National Pipe Straight Mechanical) swivel end with fiber or EPDM washer which connects to mating threaded end connection on chassis. The hose kit shall be rated for 350 psi (2412 kPa) design working pressure.

**Refrigerant Circuit:**

Units shall have a sealed refrigerant circuit including a hermetic compressor, thermostatic expansion valve for refrigerant metering, an enhanced corrugated aluminum lanced fin and rifled copper tube refrigerant to air heat exchanger, a coaxial (tube in tube) refrigerant to water heat exchanger, and safety controls including a high pressure switch, low pressure switch (loss of charge), a high level condensate sensor, water coil low temperature sensor, and air coil low temperature sensor. Access fittings shall be factory installed on high and low pressure refrigerant lines to facilitate field service. Activation of any safety device shall prevent compressor operation via a microprocessor lockout circuit. The lockout shall be reset at the thermostat or disconnect switch. **Units that cannot be reset at the thermostat shall not be acceptable.**

Hermetic compressors shall be internally sprung and externally isolated (with computer selected spring isolation). Compressor shall have thermal overload protection. Compressor shall be located in an insulated compartment away from air stream to minimize sound transmission. All units (except units with rotary compressors) shall include a discharge muffler to further enhance sound attenuation.

Refrigerant to air heat exchangers shall utilize enhanced corrugated lanced aluminum fins and rifled copper tube construction rated to withstand 450 PSIG (3101 kPa) refrigerant working pressure. Refrigerant to water heat exchangers shall be of copper inner water tube and steel refrigerant outer tube design, rated to withstand 450 PSIG (3101 kPa) working refrigerant pressure and 450 PSIG (3101 kPa) working water pressure. The refrigerant to water heat exchanger shall be "electro-coated" with a low cure cathodic epoxy material a minimum of 0.4 mils thick (0.4 – 1.5 mils range) on all surfaces. The black colored coating shall provide a minimum of 1000 hours salt spray protection per ASTM B117-97 on all external steel and copper tubing. The material shall be formulated without the inclusion of any heavy metals and shall exhibit a pencil hardness of 2H (ASTM D3363-92A), crosshatch adhesion of 4B-5B (ASTM D3359-95), and impact resistance of 160 in-lbs (184 kg-cm) direct (ASTM D2794-93).

Refrigerant metering shall be accomplished by thermostatic expansion valve only. Expansion valves shall be dual port balanced types with external equalizer for optimum refrigerant metering. Reversing valve shall be four-way solenoid activated refrigerant valve, which shall default to heating mode should the solenoid fail to function. If the reversing valve solenoid defaults to cooling mode, an additional low temperature thermostat must be provided to prevent over-cooling an already cold room.

*Option: The refrigerant to air heat exchanger shall be "electro-coated" with a low cure cathodic epoxy material a minimum of 0.4 mils thick (0.4 – 1.5 mils range) on all surfaces. The black colored coating shall provide a minimum of 1000 hours salt spray protection per ASTM B117-97 on all galvanized end plates and copper tubing, and a minimum of 2000 hours of salt spray on all aluminum fins. The material shall be formulated without the inclusion of any heavy metals and shall exhibit a pencil hardness of 2H (ASTM D3363-92A), crosshatch adhesion of 4B-5B (ASTM D3359-95), and impact resistance of 160 in-lbs (184 kg-cm) direct (ASTM D2794-93).*

*Option: The unit will be supplied with cupro nickel coaxial water to refrigerant heat exchanger.*

*Option: The unit will be supplied with internally factory mounted two-way water valve for variable speed pumping requirements. A factory-mounted or field-installed high pressure switch shall be installed in the water piping to disable compressor operation in the event water pressures build due to water freezing in the piping system.*

*Option: The unit will be supplied with internally factory mounted automatic water flow regulators.*

*Option: The unit will be supplied with internally mounted secondary pump for primary/secondary applications.*

**Cabinet Drain Pan:**

The drain pan shall be constructed of galvanized steel and have a powder coat paint application to further inhibit corrosion. This corrosion protection system shall meet the stringent 1000 hour salt spray test per ASTM B117. If plastic type material is used, it



must be HDPE (High Density Polyethylene) to avoid thermal cycling shock stress failure over the lifetime of the unit. Stainless Steel materials are also acceptable. Drain pan shall be fully insulated. Drain pan shall have at a minimum a doubled sloped surface to allow positive drainage to the outlet opening, which shall be at the lowest level of the entire pan surface. Drain outlet shall be connected from pan outlet to condensate riser (if supplied) with factory installed trap inside of cabinet. The unit as standard will be supplied with solid-state electronic condensate overflow protection. **Mechanical float switches will NOT be accepted.**

#### Electrical:

A control box shall be located within the unit compressor compartment and shall contain a 50VA transformer, 24 volt activated, 2 or 3 pole compressor contactor, terminal block for thermostat wiring and solid-state controller for complete unit operation. Reversing valve and fan motor wiring shall be routed through this electronic controller. Units shall be name-plated for use with time delay fuses or HACR circuit breakers. Unit controls shall be 24 Volt and provide heating or cooling as required by the remote thermostat / sensor.

*Option: Disconnect Switch, Non-Fused*

*Option: Circuit Breaker*

#### Solid State Control System (CXM):

Units shall have a solid-state control system. **Units utilizing electro-mechanical control shall not be acceptable.** 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 interface with a heat pump type thermostat. The control system shall have the following features:

- a. Anti-short cycle time delay on compressor operation.
- b. Random start on power up mode.
- c. Low voltage protection.
- d. High voltage protection.
- e. Unit shutdown on high or low refrigerant pressures.
- f. Unit shutdown on low water temperature.
- g. Condensate overflow electronic protection.
- h. Option to reset unit at thermostat or disconnect.
- i. Automatic intelligent reset. Unit shall automatically reset the unit 5 minutes after trip if the fault has cleared. If a fault occurs 3 times sequentially without thermostat meeting temperature, then lockout requiring manual reset will occur.
- j. Ability to defeat time delays for servicing.
- k. Light emitting diode (LED) on circuit board to indicate high pressure, low pressure, low voltage, high voltage, low water/air temperature cut-out, condensate overflow, and control voltage status.
- l. The low-pressure switch shall not be monitored for the first 120 seconds after a compressor start command to prevent nuisance safety trips.
- m. 24V output to cycle a motorized water valve or other device with compressor contactor.
- n. Unit Performance Sentinel (UPS). The UPS warns when the heat pump is running inefficiently.
- o. Water coil low temperature sensing (selectable for water or anti-freeze).
- p. Air coil low temperature sensing.

**NOTE: Units not providing the 8 safety protections of anti-short cycle, low voltage, high voltage, high refrigerant pressure, low pressure (loss of charge), air coil low temperature cut-out, water coil low temperature cut-out, and condensate overflow protections will not be accepted.**

#### Option: Enhanced solid state control system (DXM)

This control system features two stage control of cooling and two stage control of heating modes for exacting temperature and dehumidification purposes.

This control system coupled with a multi-stage thermostat will better dehumidify room air by automatically running the heat pump's fan at lower speed on the first stage of cooling thereby implementing low sensible heat ratio cooling. On the need for higher cooling performance the system will activate the second stage of cooling and automatically switch the fan to the higher fan speed setting. This system may be further enhanced with a humidistat. **Units not having automatic low sensible heat ratio cooling will not be accepted;** as an alternate a hot gas reheat coil may be provided with control system for automatic activation. Control shall have all of the above mentioned features of the CXM control system along with the following expanded features:

- a. Removable thermostat connector.
- b. Night setback control.
- c. Random start on return from night setback.
- d. Minimized reversing valve operation (Unit control logic shall only switch the reversing valve when cooling is demanded for

## Vertical Stack (VHS) Series

Rev.: 05/23/07D

the first time. The reversing valve shall be held in this position until the first call for heating, ensuring quiet operation and increased valve life.).

- e. Override temperature control with 2-hour (adjustable) timer for room occupant to override setback temperature at the thermostat.
- f. Dry contact night setback output for digital night setback thermostats.
- g. Ability to work with heat pump or heat/cool (Y, W) type thermostats.
- h. Ability to work with heat pump thermostats using O or B reversing valve control.
- i. Emergency shutdown contacts.
- j. Boilerless system heat control at low loop water temperature.
- k. Ability to allow up to 3 units to be controlled by one thermostat.
- l. Relay to operate an external damper.
- m. Ability to automatically change fan speed from multistage thermostat.
- n. Relay to start system pump.
- o. 75 VA control transformer. Control transformer shall have load side short circuit and overload protection via a built in circuit breaker.

**Remote Service Sentinel (CXM/DXM):**

Solid state control system shall communicate with thermostat to display (at the thermostat) the unit status, fault status, and specific fault condition, as well as retrieve previously stored fault that caused unit shutdown. The Remote Service Sentinel allows building maintenance personnel or service personnel to diagnose unit from the wall thermostat. The control board shall provide a signal to the thermostat fault light, indicating a lockout. Upon cycling the G (fan) input 3 times within a 60 second time period, the fault light shall display the specific code as indicated by a sequence of flashes. A detailed flashing code shall be provided at the thermostat LED to display unit status and specific fault status such as over/under voltage fault, high pressure fault, low pressure fault, low water temperature fault, condensate overflow fault, etc. **Units that do not provide this remote service sentinel shall not be acceptable.**

**Option: Lonworks interface system**

Units shall have all the features listed above (either CXM or DXM) and the control board will be supplied with a LONWORKS interface board, which is LONMark certified. This will permit all units to be daisy chained via a 2-wire twisted pair shielded cable. The following points must be available at a central or remote computer location:

- a. Space temperature
- b. Leaving water temperature
- c. Discharge air temperature
- d. Command of space temperature setpoint
- e. Cooling status
- f. Heating status
- g. Low temperature sensor alarm
- h. Low pressure sensor alarm
- i. High pressure switch alarm
- j. Condensate sensor alarm
- k. Hi/low voltage alarm
- l. Fan "ON/AUTO" position of space thermostat as specified above
- m. Unoccupied / occupied command
- n. Cooling command
- o. Heating command
- p. Fan "ON / AUTO" command
- q. Fault reset command
- r. Itemized fault code revealing reason for specific shutdown fault (any one of 7)

This option also provides the upgraded 75VA control transformer with load side short circuit and overload protection via a built in circuit breaker.

**Option: MPC (Multiple Protocol Control) interface system**

Units shall have all the features listed above (either CXM or DXM) and the control board will be supplied with a Multiple Protocol interface board. Available protocols are BACnet MS/TP, Modbus, or Johnson Controls N2. The choice of protocol shall be field selectable/changeable via the use of a simple selector switch. Protocol selection shall not require any additional programming or special external hardware or software tools. This will permit all units to be daisy chain connected by a 2-wire twisted pair shielded cable. The following points must be available at a central or remote computer location:

- a. Space temperature
- b. Leaving water temperature
- c. Discharge air temperature
- d. Command of space temperature setpoint

- e. Cooling status
- f. Heating status
- g. Low temperature sensor alarm
- h. Low pressure sensor alarm
- i. High pressure switch alarm
- j. Condensate overflow alarm
- k. Hi/low voltage alarm
- l. Fan "ON/AUTO" position of space thermostat as specified above
- m. Unoccupied / occupied command
- n. Cooling command
- o. Heating command
- p. Fan "ON / AUTO" command
- q. Fault reset command
- r. Itemized fault code revealing reason for specific shutdown fault (any one of 7)

This option also provides the upgraded 75VA control transformer with load side short circuit and overload protection via a built in circuit breaker.

#### Return Panel / Supply Grilles:

The return panel shall be architecturally designed, acoustic type, flush mounted with hinged door for easy and quick access to filter and unit interior. Chassis shall be easily removed. The hinged return panel shall be made of heavy gauge die formed galvanized steel with a powder coat finish in "polar ice" color. **Return air panels that protrude from wall more than 5/8 inch (15.9mm) are not acceptable.** Supply grille(s) shall be architecturally designed "brushed" aluminum or powder coated steel (color: polar ice).

*Option: Supply grille with Double deflection damper style louvers.*

*Option: Style "H" Return air panel that allows outside air entry just behind panel on right or left side (Note: This option eliminates unit-mounted thermostat option).*

#### Warranty:

Climate Master shall warranty equipment for a period of 12 months from start up or 18 months from shipping (which ever occurs first).

*Option: Extended 4-year compressor warranty covers compressor for a total of 5 years.*

*Option: Extended 4-year refrigeration circuit warranty covers coils, reversing valve, expansion valve and compressor for a total of 5 years.*

*Option: Extended 4-year control board warranty covers the CXM/DXM control board for a total of 5 years.*

#### FIELD INSTALLED OPTIONS

##### Hose Kits - AHH Series (required for field water connections):

Water connections between chassis and the cabinet shall be accomplished via a hose kit consisting of Kevlar-reinforced EPDM core hose surrounded by a stainless-steel braid. Hose kit shall have brass fittings with stainless-steel ferrules. Hose ends shall be solid External NPT which connects to mating fitting on cabinet shut off ball valve(s), and Internal NPSM (National Pipe Straight Mechanical) swivel end with fiber or EPDM washer which connects to mating threaded end connection on chassis. The hose kit shall be rated for 350 psi (2412 kPa) design working pressure. This hose kit accessory is required for each cabinet.

##### Thermostats:

The thermostat shall be a ClimateMaster mechanical or electronic type thermostat as selected below with the described features:

- a. Single Stage Standard Manual Changeover (ATM11C01)  
Thermostat shall be a single-stage, vertical mount, manual changeover with HEAT-OFF-COOL system switch and fan ON-AUTO switch. Thermostat shall have a mechanical temperature indicator and set point indication. Thermostat shall only require 4 wires for connection. Mercury bulb thermostats are not acceptable.
- b. Single Stage Digital Manual Changeover with Two-Speed Fan Control (ATM11C03) – DXM and PSC Fan required  
Thermostat shall be a single-stage, digital, manual changeover with HEAT-OFF-COOL system switch, fan ON-AUTO switch, and fan LO-HI switch. Thermostat shall have an LCD display with temperature and set-point(s) in °F or °C. The Thermostat shall provide permanent memory of set-point(s) without batteries. A fault LED shall be provided to display specific fault condition. Thermostat shall come standard with remote temperature sensor, but may be operated with internal sensor if desired via installation of a jumper.

## Vertical Stack (VHS) Series

Rev.: 05/23/07D

- c. Single Stage Digital Auto or Manual Changeover (ATA11U01)  
Thermostat shall be a single-stage, digital, auto or manual changeover with HEAT-OFF-COOL-AUTO system switch and fan ON-AUTO switch. Thermostat shall have an LCD display with temperature and set-point(s) in °F or °C. The Thermostat shall provide permanent memory of set-point(s) without batteries. A fault LED shall be provided to display specific fault condition. Thermostat shall provide temperature display offset for custom applications.
- d. Single Stage Digital Automatic Changeover with Two-Speed Fan Control (ATA11C04) – DXM and PSC Fan required  
Thermostat shall be a single-stage, digital, auto or manual changeover with HEAT-OFF-COOL-AUTO system switch, fan ON-AUTO switch, and fan LO-HI switch. Thermostat shall have an LCD display with temperature and set-point(s) in °F or °C. The Thermostat shall provide permanent memory of set-point(s) without batteries. A fault LED shall be provided to display specific fault condition. Thermostat shall come standard with remote temperature sensor, but may be operated with internal sensor if desired via installation of a jumper.
- e. Multistage Digital Automatic Changeover (ATA22U01)  
Thermostat shall be multi-stage (2H/2C), manual or automatic changeover with HEAT-OFF-COOL-AUTO system settings and fan ON-AUTO settings. Thermostat shall have an LCD display with temperature, set-point(s), mode, and status indication. The temperature indication shall be selectable for °F or °C. The thermostat shall provide permanent memory of set-point(s) without batteries. A fault LED shall be provided to indicate specific fault condition(s). Thermostat shall provide temperature display offset for custom applications. Thermostat shall allow unit to provide better dehumidification with optional DXM controller by automatically using lower fan speed on stage 1 cooling (higher latent cooling) as main cooling mode, and automatically shifting to high speed fan on stage 2 cooling.
- f. Single Stage Manual Changeover Programmable 5/2 Day (ATP11N01)  
Thermostat shall be 5 day/2 day programmable (with up to 4 set points per day), single stage (1H/1C), manual changeover with HEAT-OFF-COOL system settings and fan ON-AUTO settings. Thermostat shall have an LCD display with temperature, set-point(s), mode, and status indication. The temperature indication shall be selectable for °F or °C. The thermostat shall provide permanent memory of set-point(s) without batteries. Thermostat shall provide convenient override feature to temporarily change set point.
- g. Multistage Automatic or Manual Changeover Programmable 5/2 Day (ATP21U01)  
Thermostat shall be 5 day/2 day programmable (with up to 4 set points per day), multi-stage (2H/1C), automatic or manual changeover with HEAT-OFF-COOL-AUTO system settings and fan ON-AUTO settings. Thermostat shall have an LCD display with temperature, set-point(s), mode, and status indication. The temperature indication shall be selectable for °F or °C. The thermostat shall provide permanent memory of set-point(s) without batteries. Thermostat shall provide convenient override feature to temporarily change set point.
- h. Multistage Automatic or Manual Changeover Programmable 7 Day (ATP32U01)  
Thermostat shall be 7 day programmable (with up to 4 set points per day), multi-stage (3H/2C), automatic or manual changeover with HEAT-OFF-COOL-AUTO system settings and fan ON-AUTO settings. Thermostat shall have a blue backlit dot matrix LCD display with temperature, set-points, mode, and status indication. The temperature indication shall be selectable for °F or °C. Time display shall be selectable for 12 or 24 hour clock. Fault identification shall be provided (when used with ClimateMaster CXM or DXM controls) to simplify troubleshooting by providing specific unit fault at the thermostat with red backlit LCD during unit lockout. The thermostat shall provide permanent memory of set-points without batteries. Thermostat shall provide heating set-point range limit, cooling set-point range limit, temperature display offset, keypad lockout, dead-band range setting, and inter-stage differential settings. Thermostat shall provide progressive recovery to anticipate time required to bring space temperature to the next programmed event. Thermostat shall provide an installer setup for configuring options and for setup of servicing contractor name and contact information. Thermostat shall allow the use of an accessory remote and/or outdoor temperature sensor (AST008). Thermostat navigation shall be accomplished via five buttons (up/down/right/left/select) with menu-driven selections for ease of use and programming.
- i. Multistage Automatic or Manual Changeover Programmable 7 Day with Humidity Control (ATP32U02)  
Thermostat shall be 7 day programmable (with up to 4 set points per day), multi-stage (3H/2C), automatic or manual changeover with HEAT-OFF-COOL-AUTO system settings and fan ON-AUTO settings. Separate dehumidification and humidification set points shall be configurable for discreet outputs to a dehumidification option and/or an external humidifier. Installer configuration mode shall allow thermostat dehumidification mode to operate with ClimaDry reheat or with ECM fan dehumidification mode via settings changes. Thermostat shall have a blue backlit dot matrix LCD display with temperature, relative humidity, set-points, mode, and status indication. The temperature indication shall be selectable for °F or °C. Time display shall be selectable for 12 or 24 hour clock. Fault identification shall be provided (when used with ClimateMaster CXM or DXM controls) to simplify troubleshooting by providing specific unit fault at the thermostat with red backlit LCD during unit lockout. The thermostat shall provide permanent memory of set-points without batteries. Thermostat shall provide heating set-point range limit, cooling set-point range limit, temperature display offset, keypad lockout, dead-band range setting, and inter-stage differential settings. Thermostat shall provide progressive recovery to anticipate time required to bring space temperature to the next programmed event. Thermostat shall provide an installer setup for configuring options and for setup of servicing contractor name and contact information. Thermostat shall allow the use of an accessory remote and/or outdoor temperature sensor (AST008). Thermostat navigation shall be accomplished via five buttons (up/down/right/left/select) with menu-driven selections for ease of use and programming.

**DDC Sensors:**

ClimateMaster wall mounted DDC sensor to monitor room temperature and interfaces with optional interface system described above. Several types as described below:

- a. Sensor only with no display (LON and MPC).
- b. Sensor with override (LON only).
- c. Sensor with setpoint and adjustment override (MPC only).
- d. Sensor with setpoint and adjustment override, LCD display, status/fault indication (LON and MPC).

## Vertical Stack (VHS) Series

Rev.: 05/23/07D

## Section Change Log

Date:	Item:	Action:
05/23/07	Specifications	Updated for new Safety Agency
05/23/07	Decoders	Updated Cabinet and Chassis decoders
01/01/07	Electrical	Updated Electrical Data
01/01/07	Specifications	Updated thermostat offering
01/01/07	Wiring Diagram	Added pressure switch for motorized water valve option
01/01/07	Motorized Valve	Updated Cv, MOPD, and WPD values
01/01/07	Performance Data	Added low temperature selection notes
01/01/06	First Published	

**Notes:**



Vertical Stack (VHS) Series

Rev.: 05/23/07D