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**Installation, Operation  
& Maintenance Manual**



**Large Belt Drive  
(HBH/V) Series**

HBH 072-120

HBV 072-300

60Hz - HFC-410A





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## Model Nomenclature

**Model Type**  
1 2  
**HB**  
HB = Heat Controller Compact

**Configuration**  
3  
**H**  
H = Horizontal  
V = Vertical

**Unit Size**  
4 5 6  
**096**  
072  
096  
120  
[1] 160  
192  
240  
300

**Revision Level**  
7  
**A**  
A = Current Revision

**Voltage**  
8  
**4**  
3 = 208-230/60/3  
4 = 460/60/3  
5 = 575/60/3

**Controls**  
9  
**C**  
C = CXM2  
D = DXM2.5  
N = CXM2 w/MPC  
P = DXM2.5 w/MPC

**Supply Air Flow Configuration**  
10  
**3**  
S = Straight Supply  
B = Back Supply  
F = Front Return  
T = Top Supply

**Return Air Flow Configuration**  
11  
**A**  
12  
**C**  
L = Left Return  
R = Right Return  
V = Left Return, S.S. Drain Pan  
W = Right Return, S.S. Drain Pan  
B = Back Return  
F = Front Return  
Y = Back Return, S.S. Drain Pan  
Z = Front Return, S.S. Drain Pan  
Horizontal Only  
Vertical Only

**Heat Exchanger Options**  
13  
**L**  
14  
**S**

OPTION	COPPER WATER COIL	CUPRO-NICKEL WATER COIL	NON-COATED AIR COIL	COATED COIL	WATER SIDE ECONOMIZER
A			NO	YES	
C	YES	NO	YES	NO	NO
J		YES	NO	YES	
N	NO		YES	NO	
1	YES	NO	NO	YES	
2			YES	NO	
3			NO	YES	LOW AIRSIDE PRESSURE
4	NO	YES	YES	NO	

**Blower Drive Package**  
A = Standard RPM & Standard Motor  
B = Low RPM & Standard Motor  
C = High RPM & Standard Motor  
D = Standard RPM & Large Motor  
E = High RPM & Large Motor

**Cabinet Insulation**

OPTION	RANGE	ULTRA QUIET	1" FILTER RAILS/FRAMES	2" FILTER RAILS/FRAMES	4" FILTER RAILS/FRAMES	
1	EXTENDED RANGE		YES		NO	
A		NO	NO	YES	NO	
B			NO	NO	YES	YES
C		YES	YES	NO	NO	NO
D			NO	NO	YES	
3	STANDARD RANGE		YES		NO	
E		NO	NO	YES	NO	
F			NO	NO	YES	YES
G		YES	YES	NO	NO	NO
H			NO	YES	NO	
			NO	NO	YES	

1. Sizes 160-300 are vertical only

2. When digit 12 is 1, 2, 3, or 4 digit 9 must be D, M, or P.

3. When digit 12 is 1, 2, 3, or 4 digit 10 must be 1, 2, A, B, C, or D.

4. Horizontal units not available with 4" filter frames.

## General Information

### Safety

Warnings, cautions and notices appear throughout this manual. Read these items carefully before attempting any installation, service or troubleshooting of the equipment.

**DANGER:** Indicates an immediate hazardous situation, which if not avoided will result in death or serious injury. DANGER labels on unit access panels must be observed.

**WARNING:** Indicates a potentially hazardous situation, which if not avoided could result in death or serious injury.

**CAUTION:** Indicates a potentially hazardous situation or an unsafe practice, which if not avoided could result in minor or moderate injury or product or property damage.

**NOTICE:** Notification of installation, operation or maintenance information, which is important, but which is not hazard-related.

<b>▲ WARNING! ▲</b>
<p><b>WARNING!</b> The EarthPure® Application and Service Manual should be read and understood before attempting to service refrigerant circuits with HFC-410A.</p>
<b>▲ WARNING! ▲</b>
<p><b>WARNING!</b> To avoid the release of refrigerant into the atmosphere, the refrigerant circuit of this unit must be serviced only by technicians who meet local, state, and federal proficiency requirements.</p>
<b>▲ CAUTION! ▲</b>
<p><b>CAUTION!</b> To avoid equipment damage, DO NOT use these units as a source of heating or cooling during the construction process. The mechanical components and filters will quickly become clogged with construction dirt and debris, which may cause system damage.</p>
<b>▲ WARNING! ▲</b>
<p><b>WARNING!</b> The installation of water-source heat pumps and all associated components, parts, and accessories which make up the installation shall be in accordance with the regulations of ALL authorities having jurisdiction and MUST conform to all applicable codes. It is the responsibility of the installing contractor to determine and comply with ALL applicable codes and regulations.</p>

<b>▲ WARNING! ▲</b>
<p><b>WARNING!</b> All refrigerant discharged from this unit must be recovered WITHOUT EXCEPTION. Technicians must follow industry accepted guidelines and all local, state, and federal statutes for the recovery and disposal of refrigerants. If a compressor is removed from this unit, refrigerant circuit oil will remain in the compressor. To avoid leakage of compressor oil, refrigerant lines of the compressor must be sealed after it is removed.</p>

**Inspection** - Upon receipt of the equipment, carefully check the shipment against the bill of lading. Make sure all units have been received. Inspect the packaging of each unit, and inspect each unit for damage. Ensure that the carrier makes proper notation of any shortages or damage on all copies of the freight bill and completes a common carrier inspection report. Concealed damage not discovered during unloading must be reported to the carrier within 15 days of receipt of shipment. If not filed within 15 days, the freight company can deny the claim without recourse. Note: It is the responsibility of the purchaser to file all necessary claims with the carrier. Notify your equipment supplier of all damage within fifteen (15) days of shipment.

**Storage** - Equipment should be stored in its original packaging in a clean, dry area. Store units in an upright position at all times.

**Unit Protection** - Cover units on the job site with either the original packaging or an equivalent protective covering. Cap the open ends of pipes stored on the job site. In areas where painting, plastering, and/or spraying has not been completed, all due precautions must be taken to avoid physical damage to the units and contamination by foreign material. Physical damage and contamination may prevent proper start-up and may result in costly equipment clean-up.

Examine all pipes, fittings, and valves before installing any of the system components. Remove any dirt or debris found in or on these components.

**Pre-Installation** - Installation, Operation, and Maintenance instructions are provided with each unit. Horizontal equipment is designed for installation above false ceiling or in a ceiling plenum. Other unit configurations are typically installed in a mechanical room. The installation site chosen should include adequate service clearance around the unit. Before unit start-up, read all manuals and become familiar with the unit and its operation. Thoroughly check the system before operation.



**Prepare units for installation as follows:**

1. Compare the electrical data on the unit nameplate with ordering and shipping information to verify that the correct unit has been shipped.
2. Keep the cabinet covered with the original packaging until installation is complete and all plastering, painting, etc. is finished.
3. Verify refrigerant tubing is free of kinks or dents and that it does not touch other unit components.
4. Inspect all electrical connections. Connections must be clean and tight at the terminals.
5. Some airflow patterns and some control box locations are field convertible. Locate the conversion section of this IOM.

**▲ CAUTION! ▲**

**CAUTION!** All three phase scroll compressors must have direction of rotation verified at start-up. Verification is achieved by checking compressor Amp draw. Amp draw will be substantially lower compared to nameplate values. Additionally, reverse rotation results in an elevated sound level compared to correct rotation. Reverse rotation will result in compressor internal overload trip within several minutes. Verify compressor type before proceeding.

**▲ CAUTION! ▲**

**CAUTION!** DO NOT store or install units in corrosive environments or in locations subject to temperature or humidity extremes (e.g., attics, garages, rooftops, etc.). Corrosive conditions and high temperature or humidity can significantly reduce performance, reliability, and service life. Always move and store units in an upright position. Tilting units on their sides may cause equipment damage.

**▲ CAUTION! ▲**

**CAUTION!** CUT HAZARD - Failure to follow this caution may result in personal injury. Sheet metal parts may have sharp edges or burrs. Use care and wear appropriate protective clothing, safety glasses and gloves when handling parts and servicing heat pumps.

## HBH Physical Data

Model	072	096	120
Compressor Quantity	Scroll		
Number of Circuits (Compressors)	2		
Factory Charge HFC-410a (oz) [kg] per circuit	60 [1.70]	76 [2.15]	80 [2.27]
<b>Blower Motor</b>			
Blower Motor Quantity	1		
Standard Motor (hp) [kW]	1 [0.75]	2 [1.49]	3 [2.24]
Large Motor (hp) [kW]	2 [1.49]	3 [2.24]	5 [3.73]
<b>Blower</b>			
No. of Blowers	1		
Blower Wheel Size D x W (in) [cm]	12 x 12 [30.48 x 30.48]		
<b>Water Connection Size</b>			
FPT (in) [mm]	1-1/4" [31.8]	1-1/2" [38.1]	
<b>Coax Volume</b>			
Volume (US Gallons) [liters]	1.62 [6.13]	1.81 [6.85]	2.40 [9.08]
<b>Condensate Connection Size</b>			
FPT (in) [mm]	3/4" [19.1]		
<b>Air Coil Data</b>			
Air Coil Dimensions H x W (in) [cm]	20 x 54 [50.8 x 137.2]	20 x 64 [50.8 x 162.6]	
Air Coil Total Face Area (ft <sup>2</sup> ) [m <sup>2</sup> ]	7.5 [0.70]	8.9 [0.83]	
<b>Miscellaneous Data</b>			
Filter Standard - 1" [25.4mm] Throwaway (qty) (in) [cm]	(QTY.3) 16 x 20 [40.6 x 50.8] (QTY.1) 20 x 20 [50.8 x 50.8]		
Weight - Operating (lbs) [kg]	586 [265.8]	644 [292.1]	698 [316.6]
Weight - Packaged (lbs) [kg]	626 [283.9]	684 [310.3]	738 [334.8]

All units have grommet compressor mountings, and 1/2" & 1-3/4" electrical knockouts.

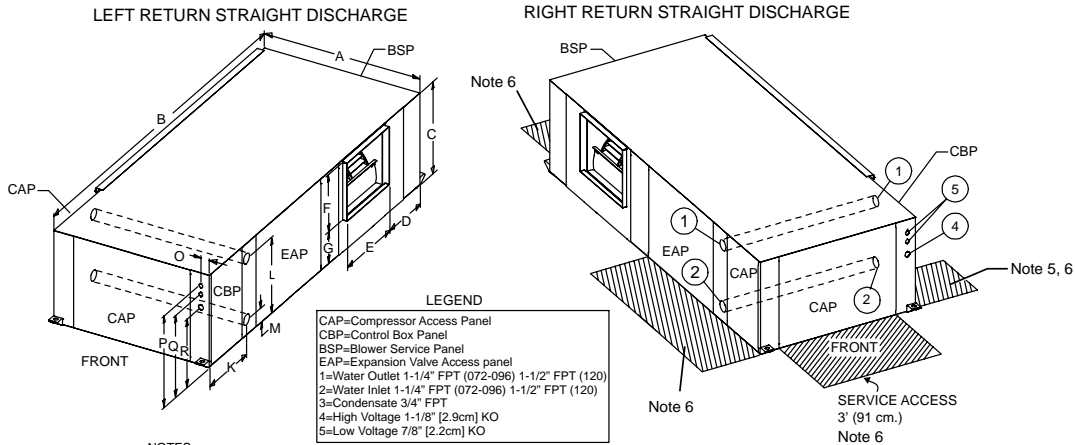
Unit Maximum Water Working Pressure	Max Pressure PSIG [kPa]
Base Unit	500 [3445]

### HBH072-120 Corner Weights

	HBH072	HBH096	HBH120
Weight - Operating (lbs) [kg]	586 [265.8]	644 [292.1]	698 [316.6]
Weight - Packaged (lbs) [kg]	626 [283.9]	684 [310.3]	738 [334.8]
Weight - Corner - Control box/Compressor side (lbs) [kg]	235 [106.6]	254 [115.2]	271 [122.9]
Weight - Corner - Compressor side (lbs) [kg]	101 [45.8]	120 [54.4]	137 [62.1]
Weight - Corner - Blower side (lbs) [kg]	180 [81.6]	190 [86.2]	200 [90.7]
Weight - Corner - Air Coil side (lbs) [kg]	70 [31.8]	80 [36.3]	90 [40.8]

ALL CONFIGURATIONS REQUIRE SERVICE ACCESS AREA DESCRIBED IN NOTES 5 AND 6.

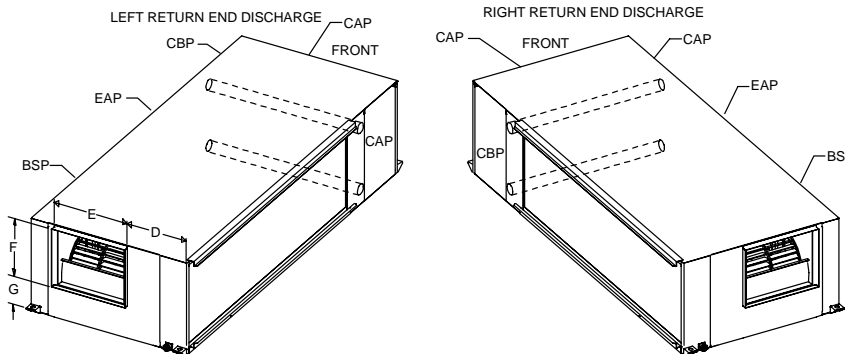
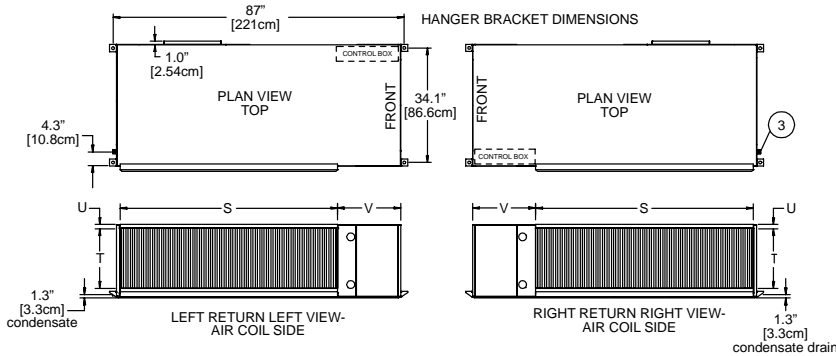
**HBH072-120 Dimensional Data**



NOTES:

- All dimensions in table are inches (cm).

1. Access is required for all removable panels and installer should take care to comply with all building codes and allow adequate clearance for future field service.
2. Water inlet and water outlet connections are available on either side (left or right) of the unit. Qty (2x) MPT Plugs are shipped loose in a plastic bag tied to the water leg in front of the unit. Installer must plug water inlet/outlet side not being connected to.
3. Condensate drain is available on end opposite compressor.
4. Electrical access is available on either side (left or right) of the front.
5. Electric box is on right side. It can be field converted to left side. Conversion should only be attempted by qualified service technician. If electric box relocated to opposite side, and water connected to opposite side, then this access is not required.
6. Units require 3" (9.1 cm) clearance for water connections, CAP, CSP, EAP and BSP service access.
7. Overall cabinet width dimensions does not include filter rail and duct flange.



**HBH072-120 Dimensional Data**

Model	Overall Cabinet							Discharge Connections Duct Flange			Water Connections			Electrical Knockouts				Return Air Connections Using Return Air Opening			
	A	B	C	D	E	F	G	K	L	M	O	P	Q	R	S	T	U	V			
	Depth	Width	Height	Supply Depth	Supply Width	Supply Height		1 Water Outlet	2 Water Inlet					Return Depth	Return Height						
072-120	in.	36.3	84.9	21.6	14.0	17.0	13.5	7.8	15.0	8.3	4.0	2.0	18.8	16.8	13.8	65.0	18.0	1.0	18.9		
	cm.	92.2	215.6	54.9	35.6	43.2	34.3	19.8	38.1	21.1	10.2	5.1	47.8	42.7	35.1	165.1	45.7	2.5	48.0		



## HBV Physical Data

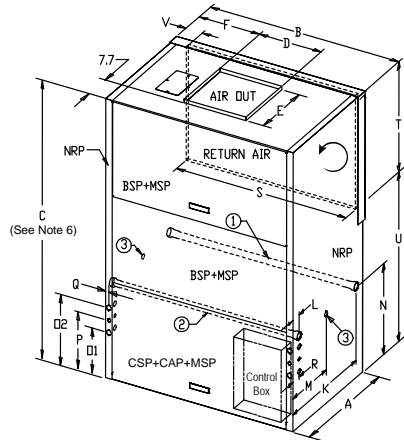
Model	072	096	120	160	192	240	300
Compressor	Scroll						
Number of Circuits (Compressors)	2						
Factory Charge HFC-410a - (oz) [kg] per circuit	60 [1.70]	76 [2.15]	80 [2.27]	112 [3.18]	136 [3.86]	196 [5.56]	224 [6.35]
<b>Blower Motor</b>							
Blower Motor Quantity	1						
Standard Motor (hp) [kw]	1 [.75]	2 [1.49]	3 [2.23]	3 [2.24]	3 [2.24]	5 [3.73]	7.5 [5.60]
Optional Large Motor (hp) [kw]	2 [1.49]	3 [2.24]	5 [3.73]	5 [3.73]	5 [3.73]	7.5 [5.59]	10 [7.46]
<b>Blower</b>							
No. of Blowers	1			2		3	
Blower Wheel Size D x W (in) [cm]	12 x 12 [30.48 x 30.48]						
<b>Water Connection Size</b>							
FPT (in) [mm]	1-1/4" [31.8]		1-1/2" [38.1]	2" [50.8]		2-1/2" [63.5]	
<b>Coax Volume</b>							
Volume (US Gallons) [liters]	1.62 [6.13]	1.81 [6.85]	2.40 [9.08]	3.62 [13.70]	4.83 [18.28]	4.90 [18.55]	7.39 [27.98]
<b>Condensate Connection Size</b>							
FPT (in) [mm]	3/4" [19.1]						
<b>Air Coil Data</b>							
Air Coil Dimensions H x W (in) [cm]	32 x 34 [81.28 x 86.36]		36 x 36 [91.44 x 91.44]		36 x 76 [91.44 x 193.04]		
Air Coil Total Face Area (ft <sup>2</sup> ) [m <sup>2</sup> ]	7.6 [0.71]		9.0 [0.84]		19 [1.77]		
Air Coil Tube Size (in) [cm]	3/8" [0.953]						
Air Coil Fin Spacing (fpi) [fins per cm]	14 [5.5]						12 [4.72]
Air Coil Number of Rows	3			2	3		4
<b>Miscellaneous Data</b>							
Filter Standard - 1" [25.4mm] Throwaway (qty) (in) [cm]	(QTY.4) 20 x 20 [50.8 x 50.8]			(QTY.4) 20 x 25 [50.80 x 63.5] (QTY.2) 20 x 30 [50.80 x 76.2]			
Weight - Operating (lbs) [kg]	586 [265.8]	644 [292.1]	698 [316.6]	1069 [484.9]	1164 [528.0]	1184 [537.1]	1297 [588.3]
Weight - Packaged (lbs) [kg]	626 [283.9]	684 [310.3]	738 [334.8]	1149 [521.2]	1244 [564.3]	1264 [573.3]	1377 [624.6]

All units have grommet compressor mountings, and 1/2" & 1-3/4" electrical knockouts.

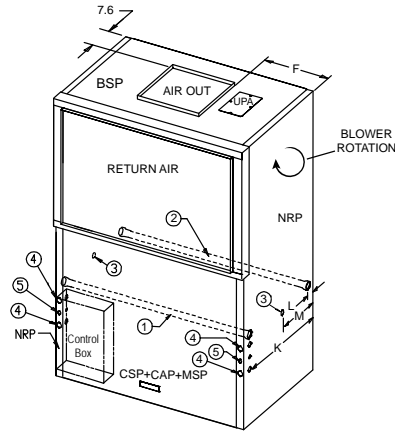
Unit Maximum Water Working Pressure	Max Pressure PSIG [kPa]
Base Unit	500 [3445]

## HBV072-120 Dimensional Data

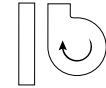
ALL CONFIGURATIONS REQUIRE SERVICE ACCESS AREA DESCRIBED IN NOTES 7, 8, 9, AND 10.



REAR RETURN TOP DISCHARGE (RR/TD)



FRONT RETURN TOP DISCHARGE (FR/TD)

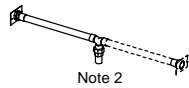


BLOWER TO AIR COIL RELATIONSHIP FOR TOP DISCHARGE 072-120

LEGEND	TCV072-096	TCV120
① Water Inlet (See Note 2)	1-1/4" FPT	1-1/2" FPT
② Water Outlet (See Note 2)	1-1/4" FPT	1-1/2" FPT
③ Condensate Drain (See Note 3)	1" FPT	
④ High Voltage Access (See Note 4)	1-3/8" [3.49 CM]	
⑤ Low Voltage Access (See Note 4)	7/8" [2.2 CM]	
BSP - Blower Service Panel CAP - Control Access Panel CSP - Compressor Access Panel MSP - Motor Service Panel NRP - Non Removable Panel UPA - Upper Pulley Access		

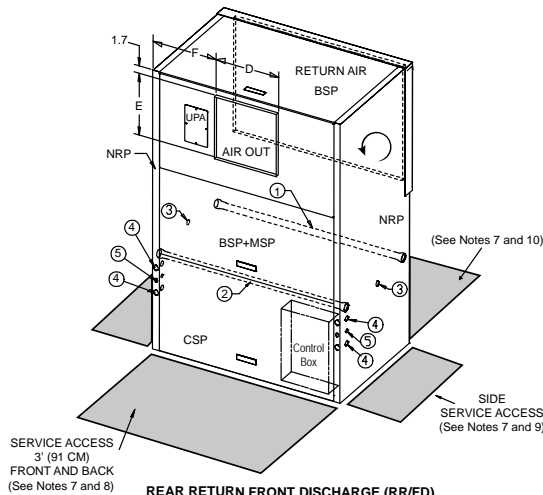
NOTES:

- All dimensions in table are inches (cm)
- While access to all removable panels may not be required, installer should take care to comply with all building codes and allow adequate clearance for future field service.
- Water inlet and water outlet connections are factory shipped on the left side. Union allows field conversion to right side.
- Condensate drain is available on either side (left or right) of unit. Drain hose and drain connection will be tied inside the unit. Installer will untie the drain hose, form trap, and connect to the condensate drain hole of installer's choice.
- Electrical access is available on either side (left or right) of unit and is also available in the front on the left or right side of the unit.
- Overall width - Add 3.12" (8cm) for 1" (2.5cm) or 2" (5cm) Filter Frame; or 5.12" (13cm) for 4" (10.2cm) and for front or rear supply add additional 1.06" (2.7cm) for supply duct collar.
- Overall cabinet height dimension does not include duct flange for top discharge configuration.
- While access to all removable panels may not be required, installer should take care to comply with all building codes and allow adequate clearance for future field service.
- Units require 3 feet (91 cm) clearance, CAP, CSP, MSP and BSP service access.
- Side service access must be 2 feet (9.4cm) on any side that connections are made.
- Filter removal is from bottom of frame, allow 2 feet (9.4cm) access for servicing.

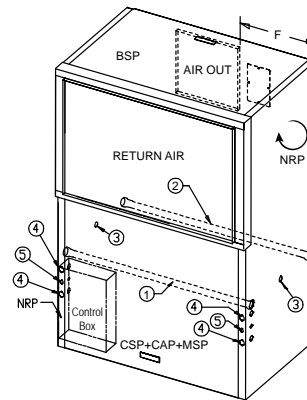


Note 2

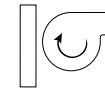
ALL CONFIGURATIONS



REAR RETURN FRONT DISCHARGE (RR/FD)



FRONT RETURN REAR DISCHARGE (FR/RD)



BLOWER TO AIR COIL RELATIONSHIP FOR REAR OR FRONT DISCHARGE 072-120

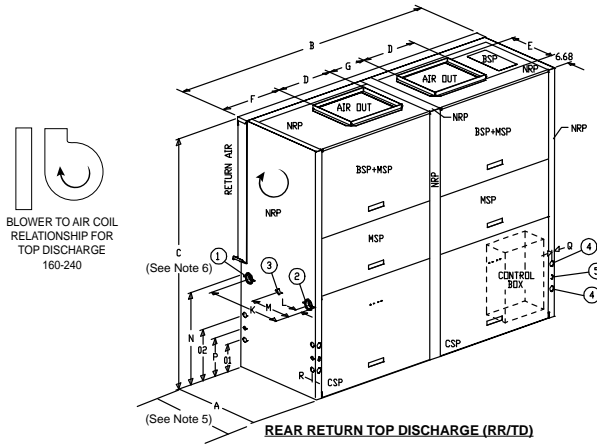
SERVICE ACCESS  
3" (91 CM)  
FRONT AND BACK  
(See Notes 7 and 8)

SIDE SERVICE ACCESS  
(See Notes 7 and 9)

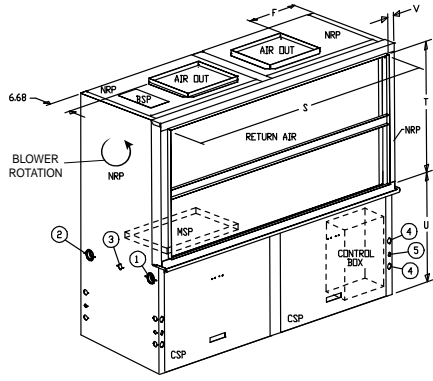
Model	Overall Cabinet			Discharge Connection Duct Flange			Water Connections				Electric Knockouts					Return Air Connections Using Return Air Opening				
	A	B	C	D	E	F	K	L	M	N	O1	O2	P	Q	R	S	T	U	V	
	Depth	Width	Height	Supply Width	Supply Depth		1 Water Inlet	2 Water Outlet	3 Condensate							Return Depth	Return Height			
072-120	in.	29.0	41.0	69.8	17.5	14.8	11.9	22.0	7.3	14.5	21.3	8.0	15.0	11.3	1.0	1.5	36.0	36.8	30.6	2.7
	cm.	73.7	104.1	177.2	44.5	37.5	30.2	55.9	18.4	36.8	54.0	20.3	38.1	28.6	2.5	3.8	91.4	93.3	77.8	6.9

## HBV160-240 Dimensional Data

ALL CONFIGURATIONS REQUIRE SERVICE ACCESS AREA DESCRIBED IN NOTES 7, 8, 9, AND 10.



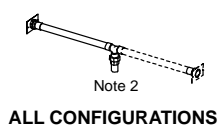
REAR RETURN TOP DISCHARGE (RR/TD)



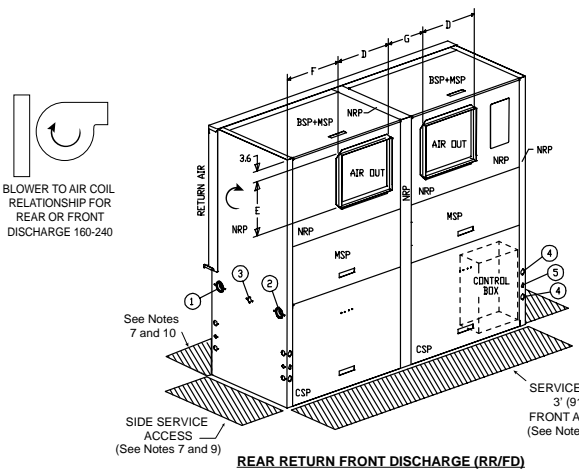
FRONT RETURN TOP DISCHARGE (FR/TD)

LEGEND	TCV160-240
① WATER INLET (SEE NOTE 2)	2" FPT
② WATER OUTLET (SEE NOTE 2)	2" FPT
③ CONDENSATE DRAIN (SEE NOTE 3)	1" FPT
④ HIGH VOLTAGE ACCESS (SEE NOTE 4)	1-3/8" [3.49 CM]
⑤ LOW VOLTAGE ACCESS (SEE NOTE 4)	7/8" [2.2 CM]
BSP - BLOWER SERVICE PANEL	
CAP - CONTROL ACCESS PANEL	
CSP - COMPRESSOR ACCESS PANEL	
MSP - MOTOR SERVICE PANEL	
NRP - NON REMOVABLE PANEL	

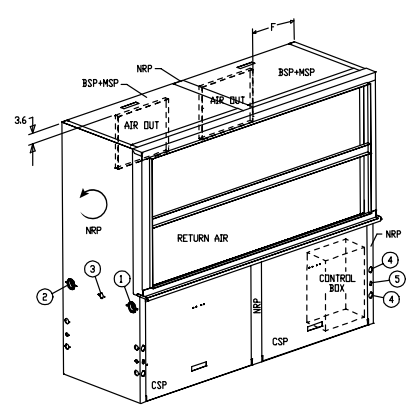
- NOTES:
- All dimensions in table are inches (cm)
  - While access to all removable panels may not be required, installer should take care to comply with all building codes and allow adequate clearance for future field service.
  - Water inlet and water outlet connections are factory shipped on the left side. Union allows field conversion to right side.
  - Condensate drain is available on either side (left or right) of unit. Drain hose and drain connection will be tied inside the unit. Installer will untie the drain hose, form trap, and connect to the condensate drain hole of installer's choice.
  - Electrical access is available on either side (left or right) of unit and is also available in the front on the left or right side of the unit.
  - Overall width - Add 3.12" (8cm) for 1" (2.5cm) or 2" (5cm) Filter Frame; or 5.12" (13cm) for 4" (10.2cm) and for front or rear supply add additional 1.06" (2.7cm) for supply duct collar.
  - Overall cabinet height dimension does not include duct flange for top discharge configuration.
  - While access to all removable panels may not be required, installer should take care to comply with all building codes and allow adequate clearance for future field service.
  - Units require 3 feet (91 cm) clearance, CAP, CSP, MSP and BSP service access.
  - Side service access must be 2 feet (9.4cm) on any side that connections are made.
  - Filter removal is from bottom of frame, allow 2 feet (9.4cm) access for servicing.



ALL CONFIGURATIONS



REAR RETURN FRONT DISCHARGE (RR/FD)

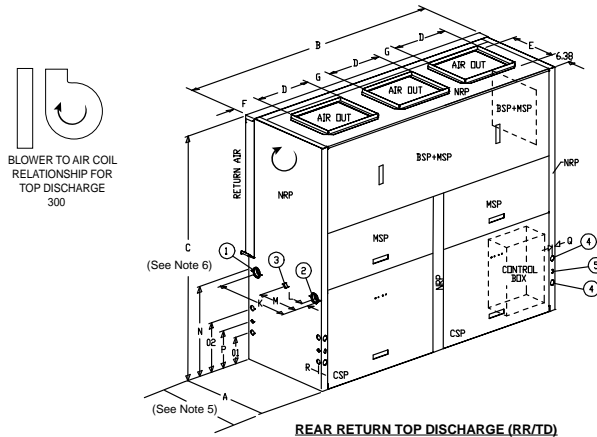


FRONT RETURN REAR DISCHARGE (FR/RD)

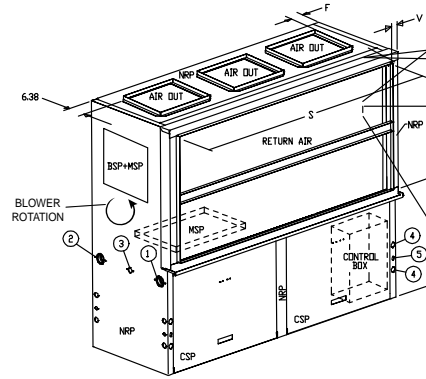
Model	Overall Cabinet			Discharge Connection Duct Flange				Water Connections			Electrical Knockouts					Return Air Connections Using Return Air Opening				
	A	B	C	D	E	F	G	K	L	M	O1	O2	P	Q	R	S	T	U	V	
	Width	Depth	Height	Supply Width	Supply Depth	Supply Width	Supply Depth	Water Inlet	Water Outlet	Condensate						Return Depth	Return Height			
160-240	in.	29.0	82.0	69.8	17.5	14.8	17.9	11.5	26.1	3.1	14.5	8.0	15.0	11.3	1.0	1.5	77.0	35.8	31.7	2.6
	cm.	73.7	208.3	177.2	44.5	37.5	45.4	29.3	66.3	7.9	36.8	20.3	38.1	28.6	2.5	3.8	195.6	90.8	80.5	6.7
300	in.	29.0	82.0	69.8	17.5	14.8	6.3	8.6	25.7	3.1	14.5	8.0	15.0	11.3	1.0	1.5	77.0	35.8	31.7	2.6
	cm.	73.7	208.3	177.2	44.5	37.5	16.0	21.8	26.1	7.9	36.8	20.3	38.1	28.6	2.5	3.8	195.6	90.9	80.5	6.7

## HBV300 Dimensional Data

ALL CONFIGURATIONS REQUIRE SERVICE ACCESS AREA DESCRIBED IN NOTES 7, 8, 9, AND 10.

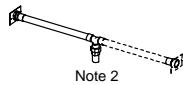


REAR RETURN TOP DISCHARGE (RR/TD)



FRONT RETURN TOP DISCHARGE (FR/TD)

LEGEND		TCV300
①	WATER INLET (SEE NOTE 2)	2-1/2" FPT
②	WATER OUTLET (SEE NOTE 2)	2-1/2" FPT
③	CONDENSATE DRAIN (SEE NOTE 3)	1" FPT
④	HIGH VOLTAGE ACCESS (SEE NOTE 4)	1-3/8" [3.49 CM]
⑤	LOW VOLTAGE ACCESS (SEE NOTE 4)	7/8" [2.2 CM]
BSP - BLOWER SERVICE PANEL		
CAP - CONTROL ACCESS PANEL		
CSP - COMPRESSOR ACCESS PANEL		
MSP - MOTOR SERVICE PANEL		
NRP - NON REMOVABLE PANEL		

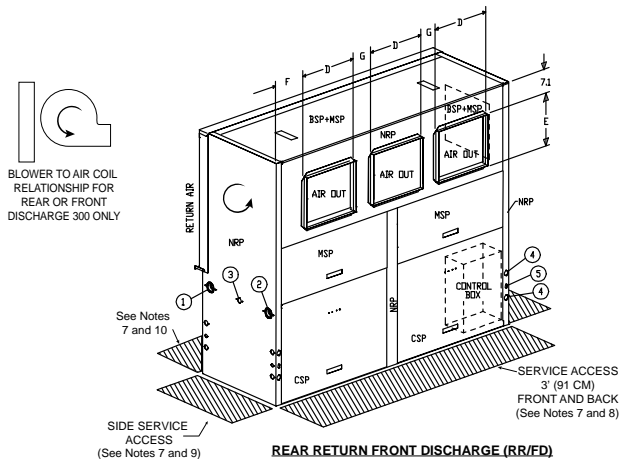


ALL CONFIGURATIONS

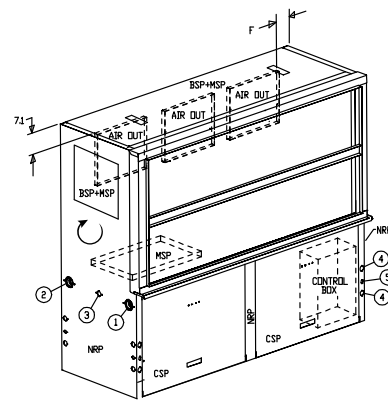
NOTES:

All dimensions in table are inches (cm)

- While access to all removable panels may not be required, installer should take care to comply with all building codes and allow adequate clearance for future field service.
- Water inlet and water outlet connections are factory shipped on the left side. Union allows field conversion to right side.
- Condensate drain is available on either side (left or right) of unit. Drain hose and drain connection will be tied inside the unit. Installer will untie the drain hose, form trap, and connect to the condensate drain hole of installer's choice.
- Electrical access is available on either side (left or right) of unit and is also available in the front on the left or right side of the unit.
- Overall width - Add 3.12" (8cm) for 1" (2.5cm) or 2" (5cm) Filter Frame; or 5.12" (13cm) for 4" (10.2cm) and for front or rear supply add additional 1.06" (2.7cm) for supply duct collar.
- Overall cabinet height dimension does not include duct flange for top discharge configuration.
- While access to all removable panels may not be required, installer should take care to comply with all building codes and allow adequate clearance for future field service.
- Units require 3 feet (91 cm) clearance, CAP, CSP, MSP and BSP service access.
- Side service access must be 2 feet (9.4cm) on any side that connections are made.
- Filter removal is from bottom of frame, allow 2 feet (9.4cm) access for servicing.



REAR RETURN FRONT DISCHARGE (RR/RD)



FRONT RETURN REAR DISCHARGE (FR/RD)

Model	Overall Cabinet			Discharge Connection Duct Flange				Water Connections			Electrical Knockouts					Return Air Connections Using Return Air Opening				
	A	B	C	D	E	F	G	K	L	M	O1	O2	P	Q	R	S	T	U	V	
	Width	Depth	Height	Supply Width	Supply Depth	Supply Width	Supply Depth	Water Inlet	Water Outlet	Condensate						Return Depth	Return Height			
160	in.	29.0	82.0	69.8	17.5	14.8	17.9	11.5	26.1	3.1	14.5	8.0	15.0	11.3	1.0	1.5	77.0	35.8	31.7	2.6
	cm.	73.7	208.3	177.2	44.5	37.5	45.4	29.3	66.3	7.9	36.8	20.3	38.1	28.6	2.5	3.8	195.6	90.8	80.5	6.7
240	in.	29.0	82.0	69.8	17.5	14.8	6.3	8.6	25.7	3.1	14.5	8.0	15.0	11.3	1.0	1.5	77.0	35.8	31.7	2.6
	cm.	73.7	208.3	177.2	44.5	37.5	16.0	21.8	26.1	7.9	36.8	20.3	38.1	28.6	2.5	3.8	195.6	90.9	80.5	6.7



## Horizontal Installation

**Horizontal Unit Location** - Units are not designed for outdoor installation. Locate the unit in an INDOOR area that allows enough space for service personnel to perform typical maintenance or repairs without removing unit from the ceiling. Horizontal units are typically installed above a false ceiling or in a ceiling plenum. Never install units in areas subject to freezing or where humidity levels could cause cabinet condensation (such as unconditioned spaces subject to 100% outside air). Consideration should be given to access for easy removal of the filter and access panels. Provide sufficient room to make water, electrical, and duct connection(s). Allow 3 feet (91 cm) clearance for servicing unit through all access panels.

If the unit is located in a confined space, such as a closet, provisions must be made for return air to freely enter the space by means of a louvered door, etc. Any access panel screws that would be difficult to remove after the unit is installed should be removed prior to setting the unit. Refer to Figure 3 for an illustration of a typical installation. Refer to unit submittal data or engineering design guide for dimensional data.

Conform to the following guidelines when selecting unit location:

1. Provide a hinged access door in concealed-spline or plaster ceilings. Provide removable ceiling tiles in T-bar or lay-in ceilings. Refer to horizontal unit dimensions for specific series and model in unit submittal data. Size the access opening to accommodate the service technician during the removal or replacement of the compressor and the removal or installation of the unit itself.
2. Provide access to hanger brackets, water valves and fittings. Provide screwdriver clearance to access panels, discharge collars and all electrical connections.
3. DO NOT obstruct the space beneath the unit with piping, electrical cables and other items that prohibit future removal of components or the unit itself.
4. Use a manual portable jack/lift to lift and support the weight of the unit during installation and servicing.

The installation of water source heat pump units and all associated components, parts and accessories which make up the installation shall be in accordance with the regulations of ALL authorities having jurisdiction and MUST conform to all applicable codes. It is the responsibility of the installing contractor to determine and comply with ALL applicable codes and regulations.

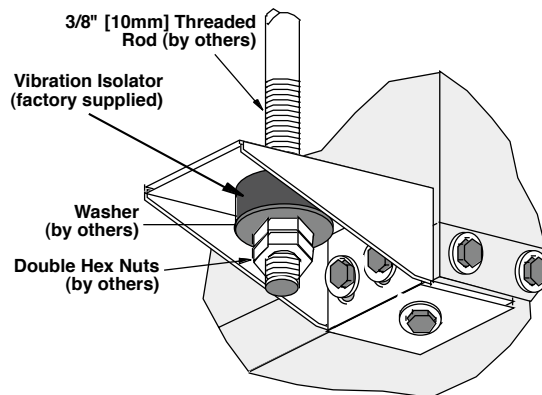
**Mounting Horizontal Units** - Horizontal units have hanger kits pre-installed from the factory as shown in Figure 1. Figure 3 shows a typical horizontal unit installation.

Horizontal heat pumps are typically suspended above a ceiling or within a soffit using field supplied, threaded rods sized to support the weight of the unit.

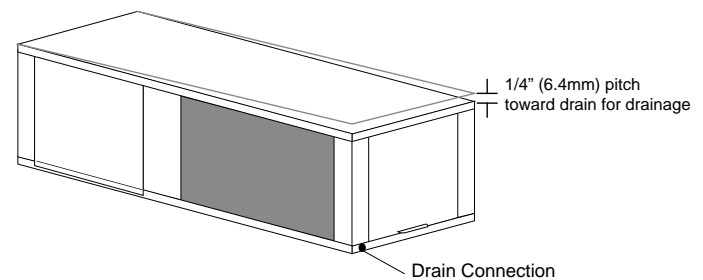
Use four (4) field supplied threaded rods and factory provided vibration isolators to suspend the unit. Hang the unit clear of the floor slab above and support the unit by the mounting bracket assemblies only. DO NOT attach the unit flush with the floor slab above.

Pitch the unit toward the drain as shown in Figure 2 to improve the condensate drainage.

**Figure 1: Hanger Bracket**

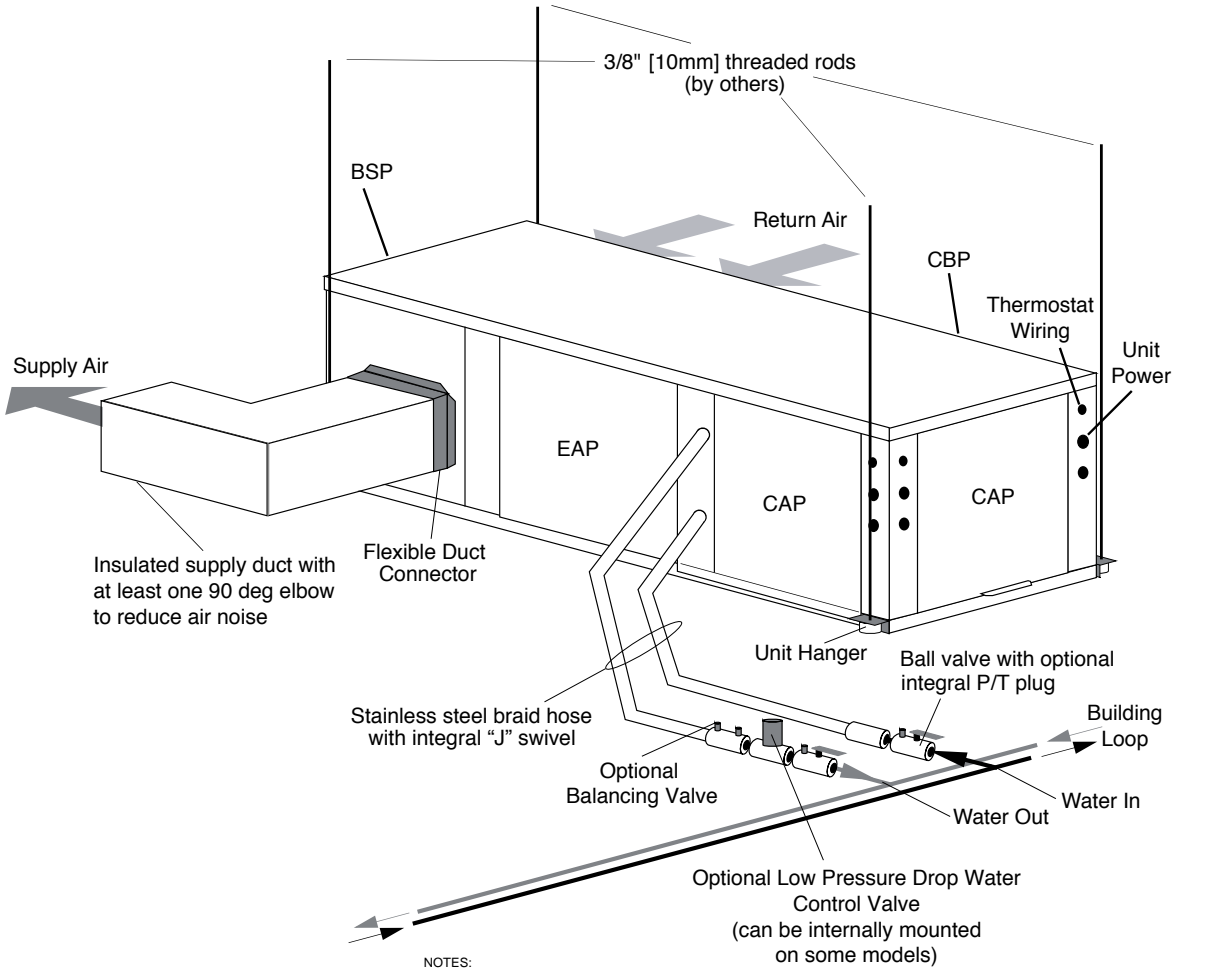


**Figure 2: Horizontal Unit Pitch**





**Figure 3: Typical Horizontal Unit Installation**



- NOTES:**  
 - All dimensions in table are inches (cm).
1. Access is required for all removable panels and installer should take care to comply with all building codes and allow adequate clearance for future field service.
  2. Water inlet and water outlet connections are available on either side (left or right) of the unit. Qty (2x) MPT Plugs are shipped loose in a plastic bag tied to the water leg in front of the unit. Installer must plug water inlet/outlet side not being connected to.
  3. Condensate drain is available on end opposite compressor.
  4. Electrical access is available on either side (left or right) of the front.
  5. Electric box is on right side. It can be field converted to left side. Conversion should only be attempted by qualified service technician. If electric box relocated to opposite side, and water connected to opposite side, then this access is not required.
  6. Units require 3' (9.1 cm) clearance for water connections, CAP, CSP, EAP and BSP service access.
  7. Overall cabinet width dimensions does not include filter rail and duct flange.

**LEGEND**

CAP=Compressor Access Panel
CBP=Control Box Panel
BSP=Blower Service Panel
EAP=Expansion Valve Access panel
1=Water Outlet 1-1/4" FPT (072-096) 1-1/2" FPT (120)
2=Water Inlet 1-1/4" FPT (072-096) 1-1/2" FPT (120)
3=Condensate 3/4" FPT
4=High Voltage 1-1/8" [2.9cm] KO
5=Low Voltage 7/8" [2.2cm] KO

**Air Coil** - To obtain maximum performance, the air coil should be cleaned before start-up. A 10% solution of dishwasher detergent and water is recommended for both sides of the coil. A thorough water rinse should follow. UV based anti-bacterial systems may damage coated air coils.

**Notice! Installation Note - Ducted Return:** Many horizontal WSHPs are installed in a return air ceiling plenum application (above ceiling). Vertical WSHPs are commonly installed in a mechanical room with free return (e.g. louvered door). Therefore, filter rails are the industry standard and are included on MARS commercial heat pumps for the purposes of holding the filter only. For ducted return applications, the filter rail must be removed and replaced with a duct flange or filter frame. Canvas or flexible connectors should also be used to minimize vibration between the unit and ductwork.

## HBH Field Conversion of Air Discharge

### ⚠ WARNING! ⚠

**WARNING!** To avoid possible injury or death due to electrical shock, open the power supply disconnect switch and secure it in an open position during installation or conversion.

**Overview** - Horizontal units can be field converted between straight (side) and back (end) discharge using the instructions below.

**Note:** It is not possible to field convert return air between left or right return models due to the necessity of refrigeration copper piping changes.

**Preparation** - Field conversion must be completed on the ground. If the unit is already hung it should be taken down for the field conversion. Place in a well-lighted area. Conversion should only be attempted by a qualified service technician.

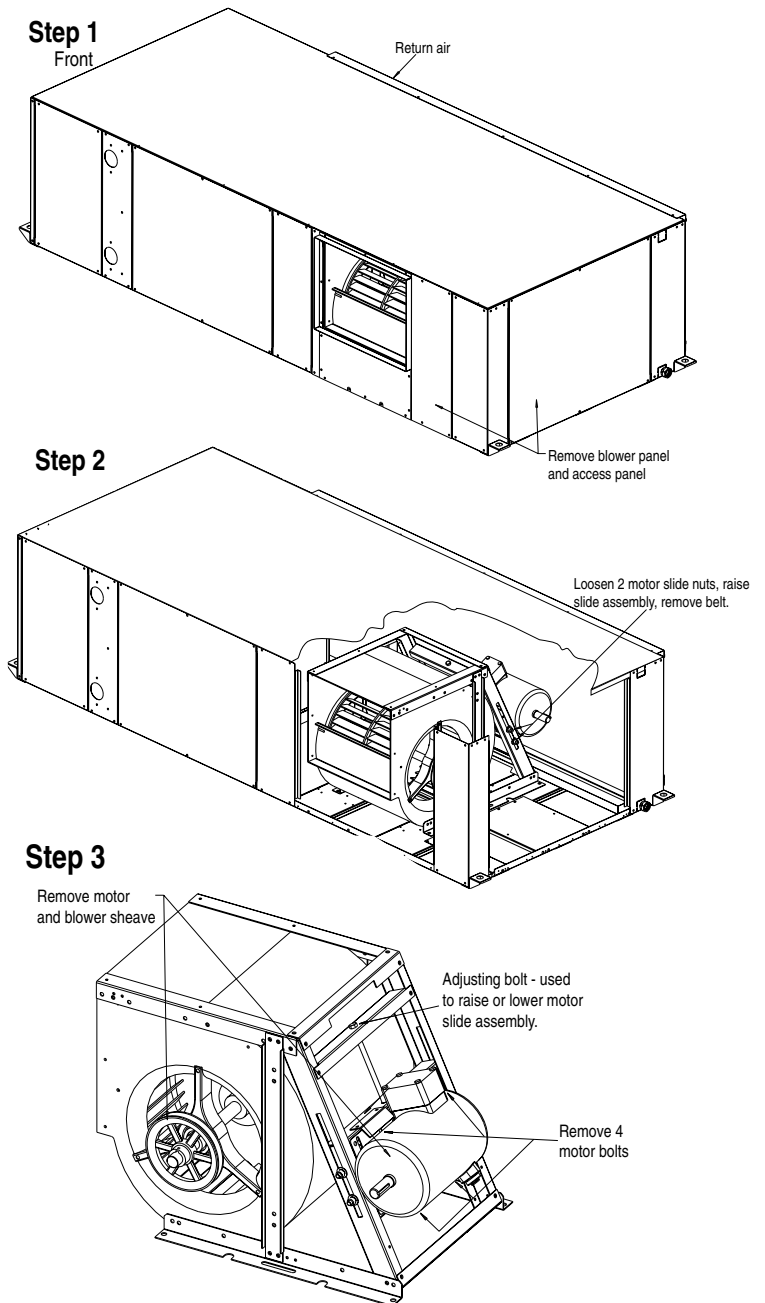
### Side to Back Discharge Conversion

1. Remove back panel and side access panel
2. Loosen 2 motor slide nuts, raise motor slide assembly and remove belt and motor sheave.
3. Remove blower sheave. Remove motor bolts and carefully remove motor.
4. Remove 2 motor clips and reattach to opposite side.
5. Unbolt (3 per side) complete housing assembly.
6. Rotate complete assembly into new position. Locate over mounting holes in base, reattach using 3 bolts per side.
7. Mount motor, motor sheave, blower sheave and belt. Make sure wires are not pinched and not over sharp edges. Adjust motor downward to tighten belt. Raise or lower motor slide assembly with adjusting bolt and retighten 2 slide nuts. Check for correct tension (See Tensioning V-Belt Drives page). Rewire motor (at contactor) for correct rotation. Spin blower wheel to ensure wheel is not obstructed.
8. Replace 2 panels.

**Back to Side Discharge Conversion** - If the discharge is changed from back to side, use above instruction noting that illustrations will be reversed.

**Left vs. Right Return** - It is not possible to field convert return air between left or right return models due to the necessity of refrigeration copper piping changes. However, the conversion process of side to back or back to side discharge for either right or left return configuration is the same. In some cases, it may be possible to rotate the entire unit 180 degrees if the return air connection needs to be on the opposite side. Note that rotating the unit will move the piping to the other end of the unit.

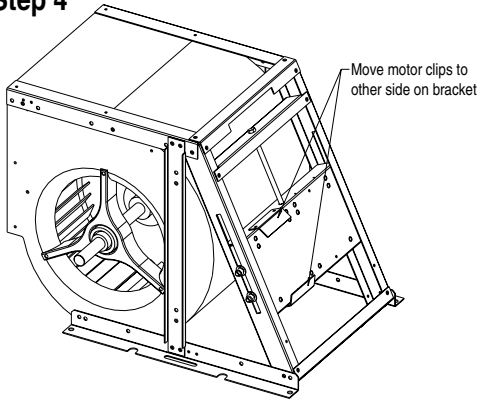
**Figure 4: Left Return Side Discharge to Back**



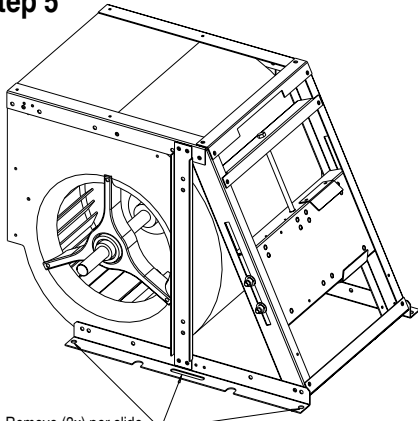
**Figure 4 Continued on Following Page**

**Figure 4 Continued: Left Return Side Discharge to Back**

**Step 4**

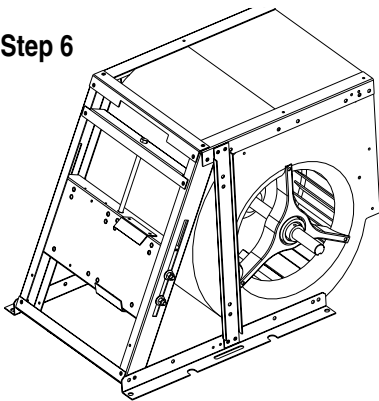


**Step 5**



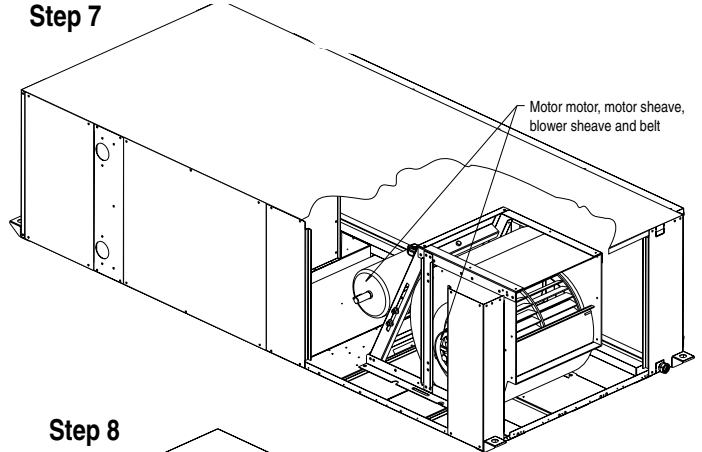
Remove (3x) per slide  
1/4-20 UNC bolts

**Step 6**

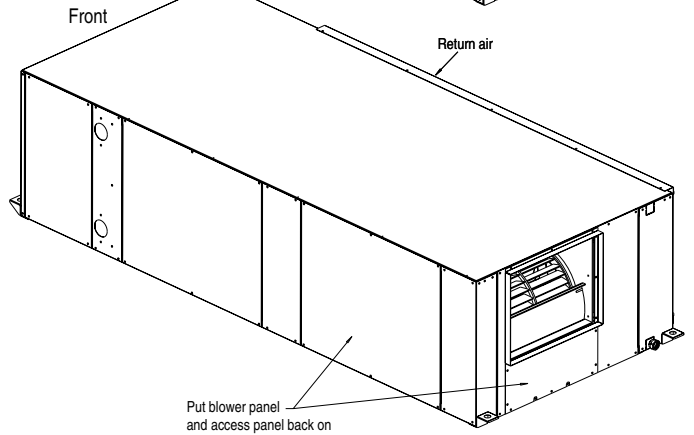


Rotate entire blower housing ASM to rest at back end of the unit. Locate housing holes and bolt down using previous 1/4-20 UNC bolts (3x) ea. side.

**Step 7**

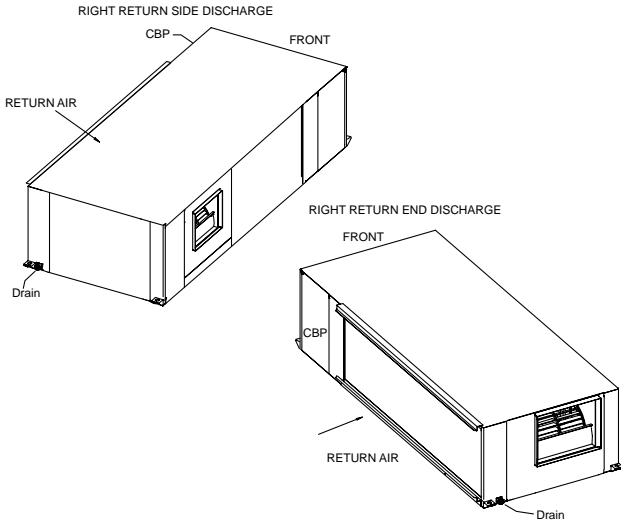


**Step 8**



## Horizontal Installation

**Figure 5: Right Return Side Discharge to Back**



**Horizontal Units Condensate Piping** - Pitch the unit toward the drain as shown in Figure 2 to improve the condensate drainage. Ensure that unit pitch does not cause condensate leaks inside the cabinet.

Install condensate trap at each unit with the top of the trap positioned below the unit condensate drain connection as shown in Figure 6. Design the depth of the trap (water-seal) based upon the amount of ESP capability of the blower (where 2 inches [51mm] of ESP capability requires 2 inches [51mm] of trap depth). As a general rule, 1-1/2 inch [38mm] trap depth is the minimum.

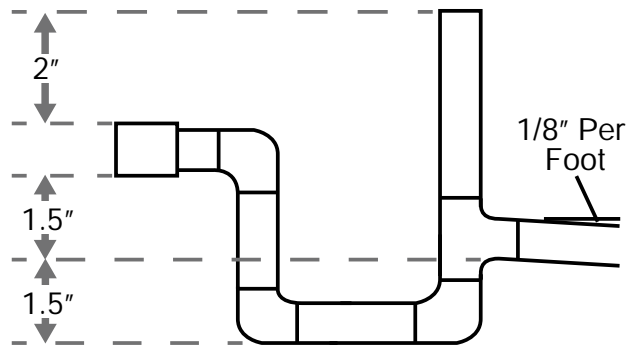
Each unit must be installed with its own individual trap and connection to the condensate line (main) or riser. Provide a means to flush or blow out the condensate line. DO NOT install units with a common trap and/or vent.

### DUCT SYSTEM INSTALLATION

Duct System Installation - Proper duct sizing and design is critical to the performance of the unit. The duct system should be designed to allow adequate and even airflow through the unit during operation. Air flow through the unit **MUST** be at or above the minimum stated airflow for the unit to avoid equipment damage. Duct systems should be designed for quiet operation. Refer to Figure 3 for horizontal duct system details or Figure 8 for vertical duct system details. A flexible connector is recommended for both discharge and return air duct connections on metal duct systems to eliminate the transfer of vibration to the duct system. To maximize sound attenuation of the unit blower, the supply and return plenums should include internal fiberglass duct liner or be constructed from ductboard for the first few feet. Application of the unit to uninsulated ductwork in an unconditioned space is not recommended, as the unit's performance may be adversely affected.

Always vent the condensate line when dirt or air can collect in the line or a long horizontal drain line is required. Also vent when large units are working against higher external static pressure than other units connected to the same condensate main since this may cause poor drainage for all units on the line. **WHEN A VENT IS INSTALLED IN THE DRAIN LINE, IT MUST BE LOCATED AFTER THE TRAP IN THE DIRECTION OF THE CONDENSATE FLOW.**

**Figure 6: Horizontal Condensate Connection**



\* Some units include a painted drain connection. Using a threaded pipe or similar device to clear any excess paint accumulated inside this fitting may ease final drain line installation.

**⚠ CAUTION! ⚠**

**CAUTION!** Ensure condensate line is pitched toward drain 1/8 inch per ft [11mm per m] of run.

## Vertical Installation

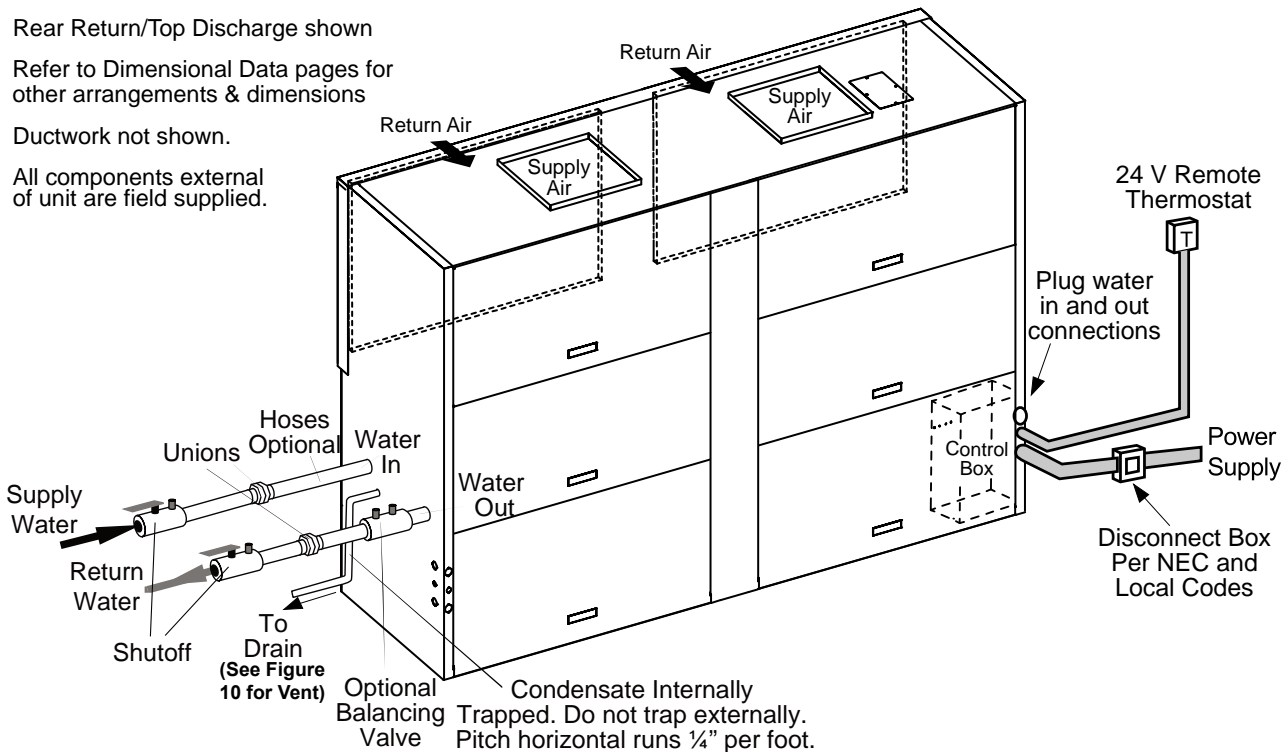
**Figure 7: Typical Vertical Installation**

Rear Return/Top Discharge shown

Refer to Dimensional Data pages for other arrangements & dimensions

Ductwork not shown.

All components external of unit are field supplied.



### Vertical Location and Access

HB units are not designed for outdoor installation. Locate the unit in an indoor area that allows enough space for installation and for service personnel to perform typical maintenance or repairs. HB units are typically installed in a floor level closet or in a small mechanical room. Refer to Figure 7 for an illustration of a typical installation. Install units with adequate clearance to allow maintenance and servicing. Conform to the following guidelines when selecting unit location:

- Provide adequate clearance for filter replacement and drain pan cleaning. DO NOT block filter access with piping, conduit or other materials. Refer to submittal drawing for Vertical Unit Dimensions.
- Provide access for fan and fan motor maintenance and for servicing of the compressor and coils without removal of the unit.
- Provide an unobstructed path to the unit within the closet or mechanical room to enable removal of the unit if necessary.
- Provide access to water valves and fittings, and screwdriver access to the unit side panels, discharge collar and all electrical connections

### Duct System Design & Installation Guidelines

The following application guidelines must be used when installing HB units. Failure to follow these guidelines could result in unsatisfactory unit performance and/or premature failure of some unit components. MARS will not warrant, or accept responsibility for products which fail, have defects, damage or insufficient performance as a result of improper application.

- The duct system must be sized to handle the airflow quietly and must not exceed the maximum allowable External Static Pressure. To maximize sound attenuation metal supply and return ducts should include internal insulation or be of duct board construction for the first 10 feet or end of first full-sized elbow.
- Install a flexible connector in all supply and return air ducts close to the unit to inhibit sound transfer to the ducts.
- Do not install uninsulated duct in an unconditioned space. The unit performance will be adversely affected and damage from condensate can occur.

## HBV Field Conversion of Air Discharge

### **⚠ WARNING! ⚠**

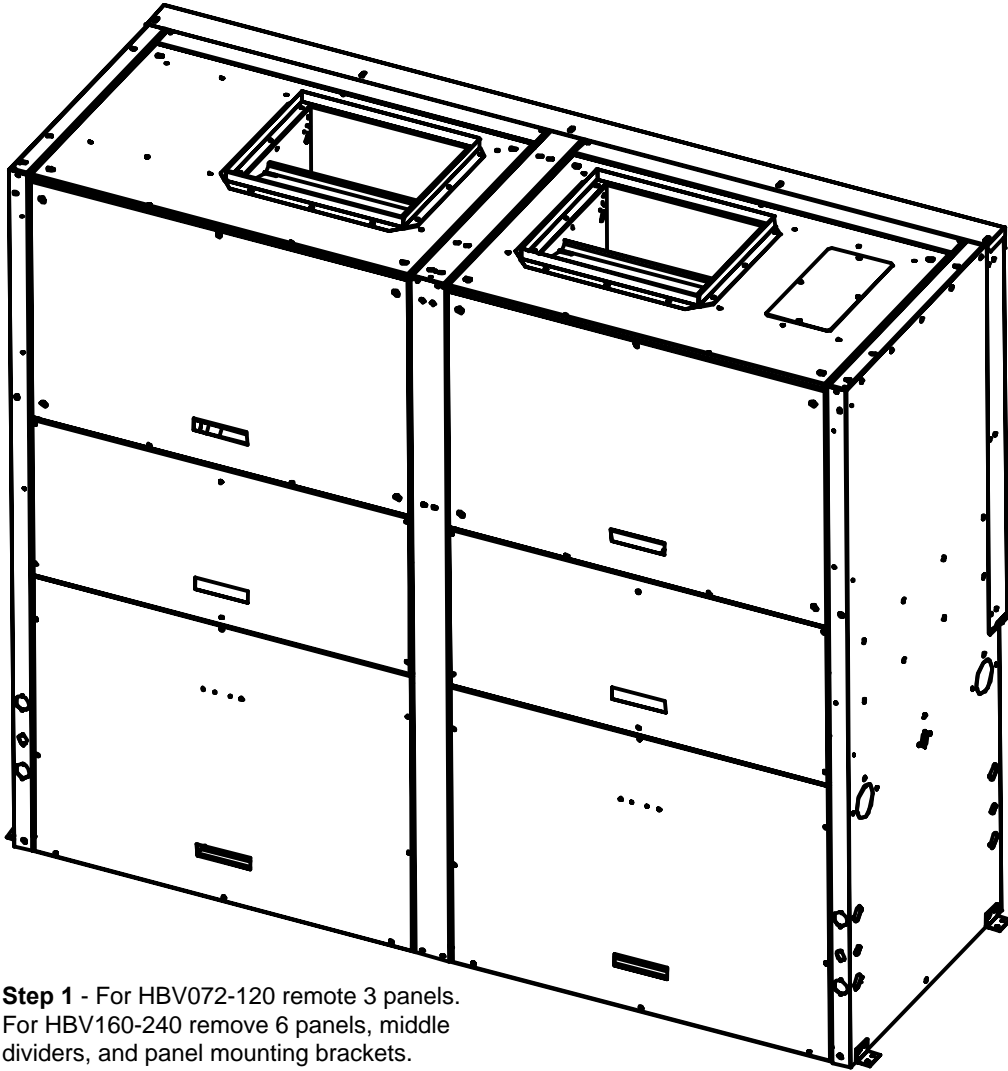
**WARNING!** To avoid possible injury or death due to electrical shock, open the power supply disconnect switch and secure it in an open position during installation or conversion.

Overview - Vertical units can be field converted between top and straight (side) and back (end) discharge using the instructions below.

Preparation - Place in a well-lighted area. Conversion should only be attempted by qualified service technicians.

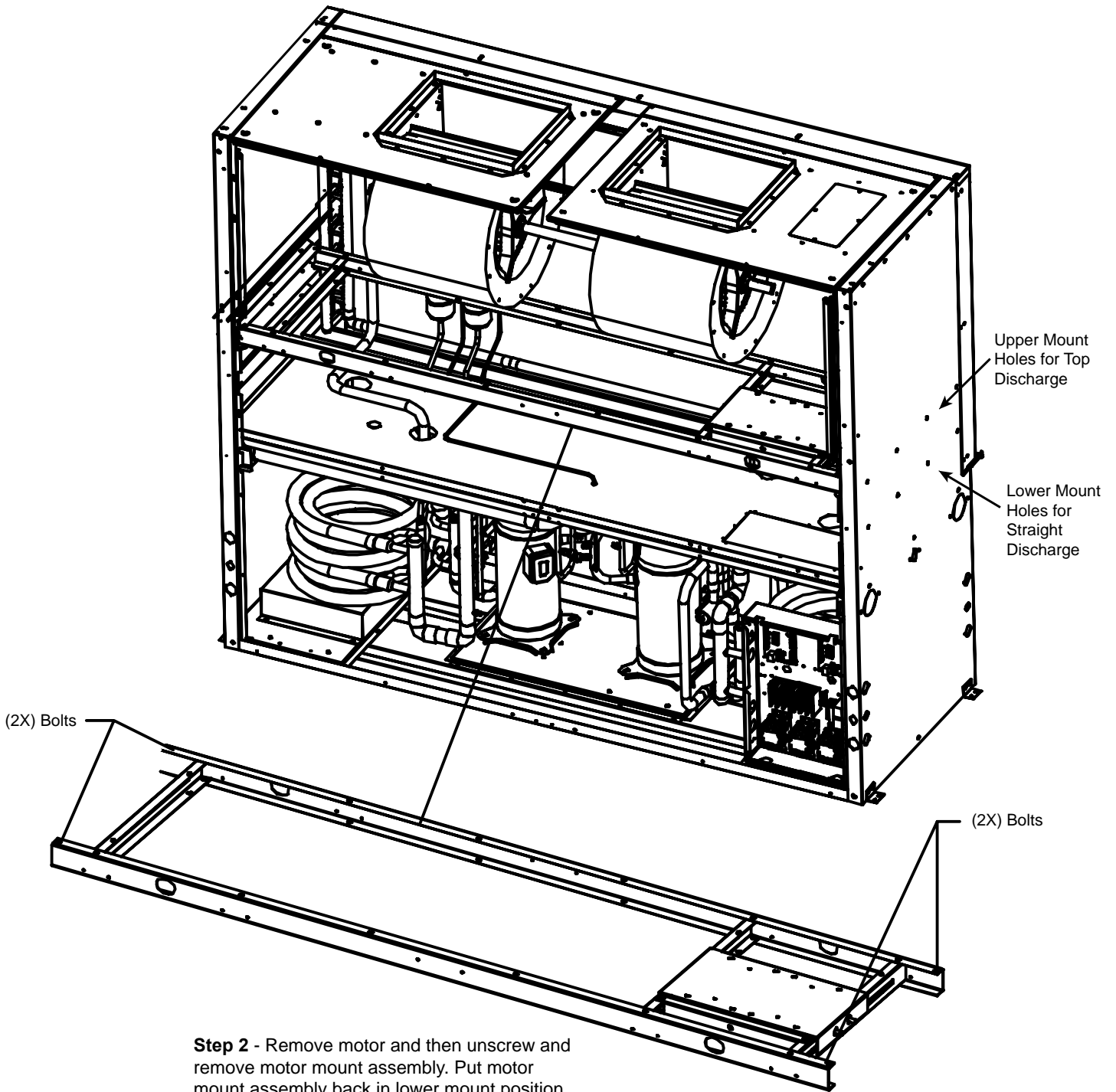
## HBV072-240 Field Conversion of Air Discharge

**Figure 8: HBV072 - 120 and HBV160-240 Pictorially Shown Top Discharge Steps to Convert to Straight Discharge**



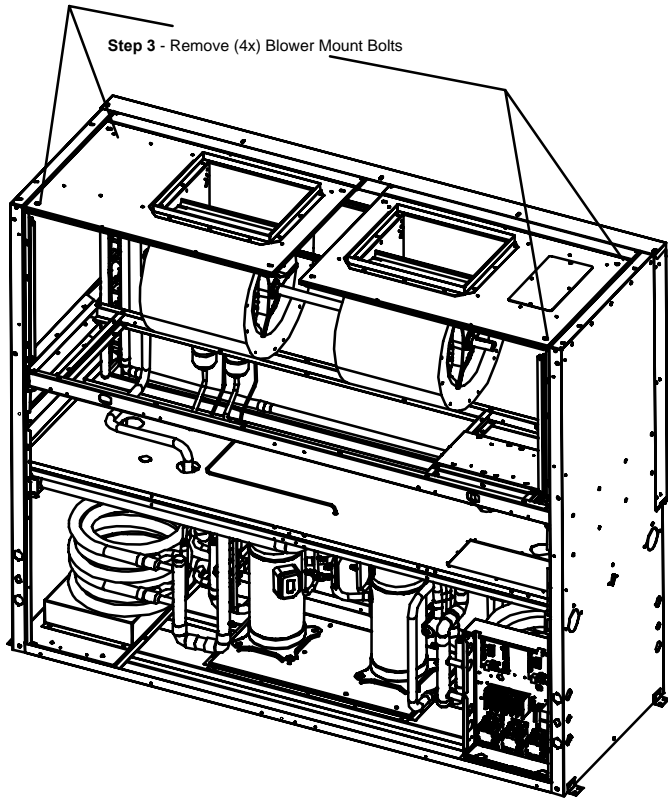
**Step 1** - For HBV072-120 remove 3 panels.  
For HBV160-240 remove 6 panels, middle  
dividers, and panel mounting brackets.

### HBV072-240 Field Conversion of Air Discharge

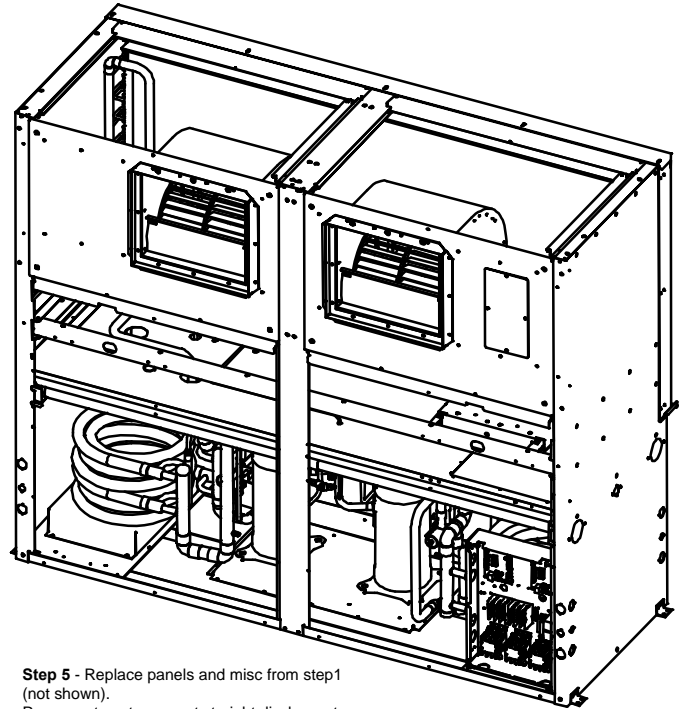




## HBV072-240 Field Conversion of Air Discharge

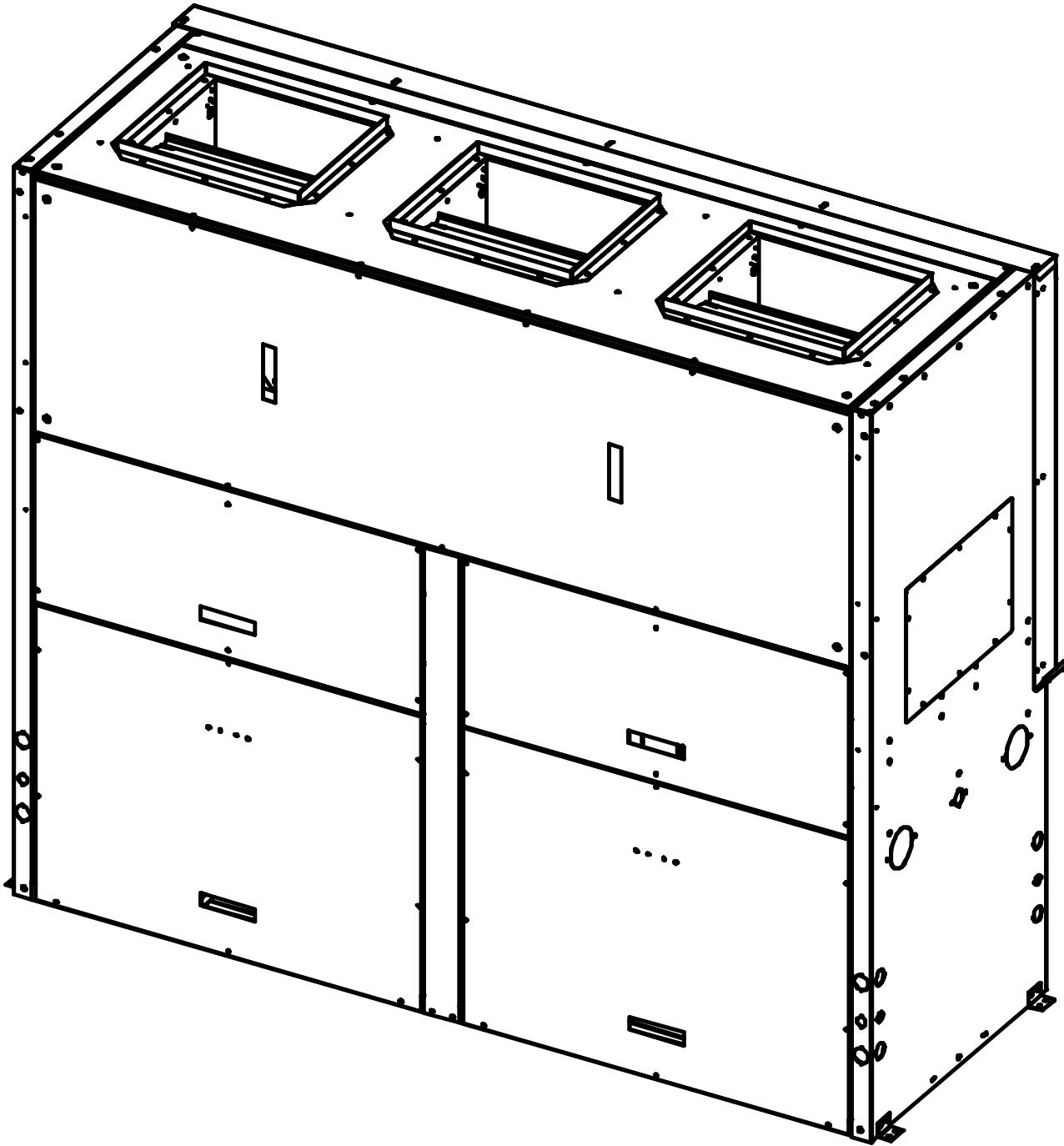


**Step 4** - Rotate blower assembly 90 degrees. Reattach blower assembly to front of unit as shown. Put belt on and retighten.



## HBV300 Field Conversion of Air Discharge

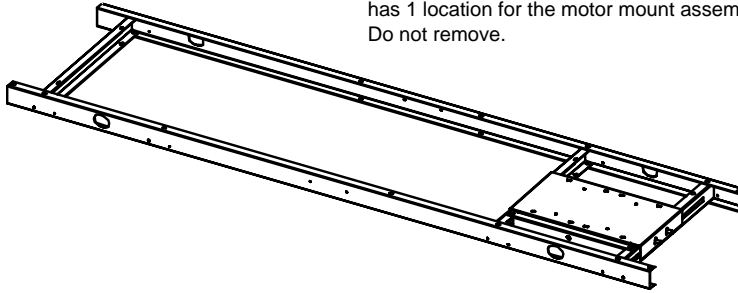
**Figure 8: HBV300 Top Discharge Steps to Convert to Straight Discharge**



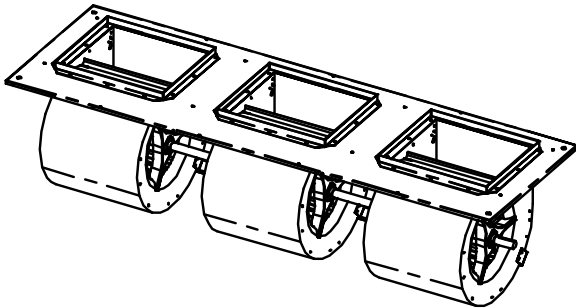
**Step 1** - Remove 5 panels, dividers, and panel mount brackets.

## HBV300 Field Conversion of Air Discharge

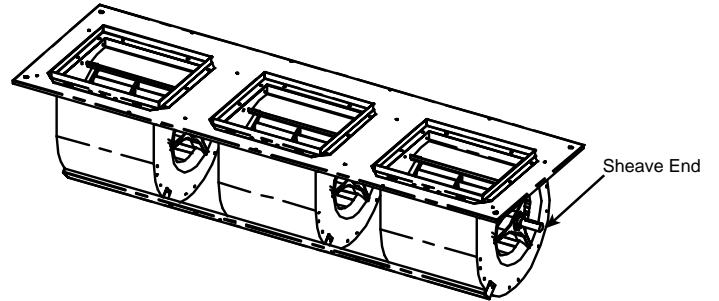
**Note:** Unlike the 160-240, the TCV300 only has 1 location for the motor mount assembly. Do not remove.



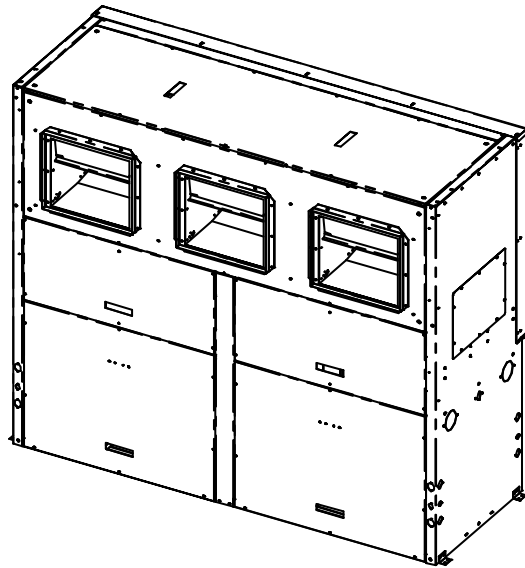
**Step 2** - Unattach and lift entire 3 blower sub assembly out of the unit.



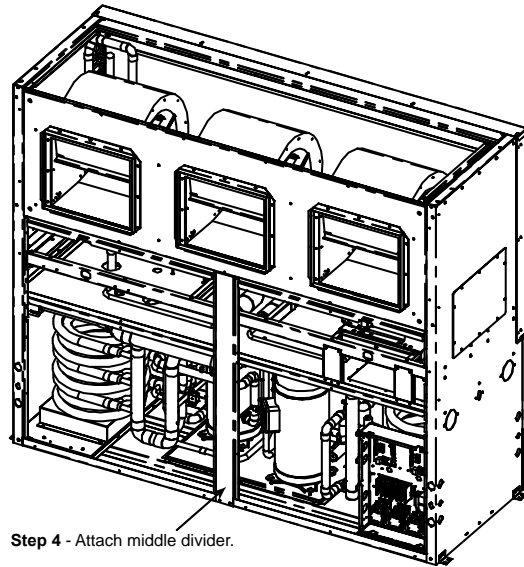
**Step 3** - Rotate blower assembly 180 degrees. Remove blower sheave and put on opposite side.



## HBV300 Field Conversion of Air Discharge



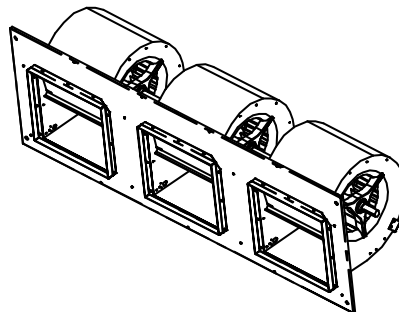
**Step 7** - Replace brackets and 5 panels.  
Reverse steps to convert straight discharge to top discharge.



**Step 4** - Attach middle divider.

**Step 6** - Reattach blower assembly to the front of the unit. Put belt on and retighten.

**Step 5** - Rotate the blower assembly 90 degrees counter clockwise. The belly of the blowers should be facing upward.



**⚠ WARNING! ⚠**

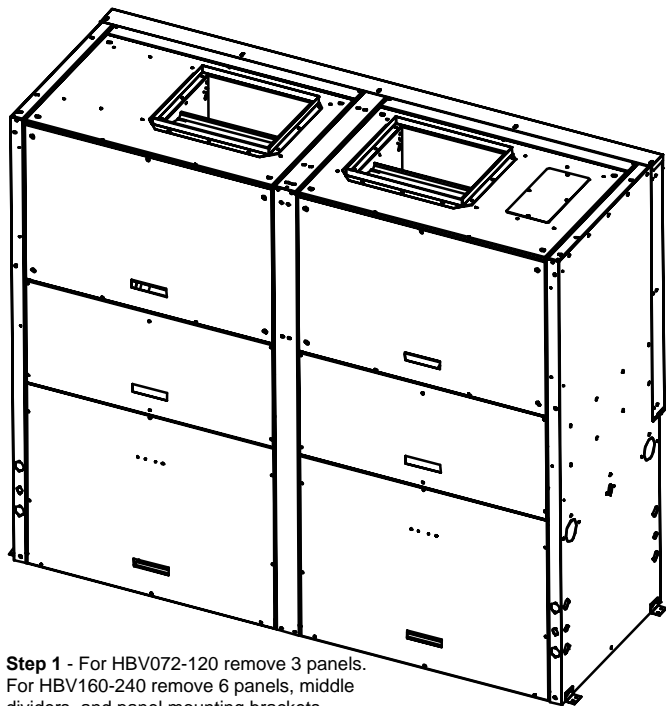
**WARNING!** To avoid possible injury or death due to electrical shock, open the power supply disconnect switch and secure it in an open position during installation or conversion.

**Overview** - Vertical unit control box can be field converted from front to any other corner for 160-300 or opposite corner (water coil side) for 072-120.

**Preparation** - Place in a well-lighted area. Conversion should only be attempted by a qualified service technician.

**Figure 9: HBV160-240 Shown, Typical All HBV Models**

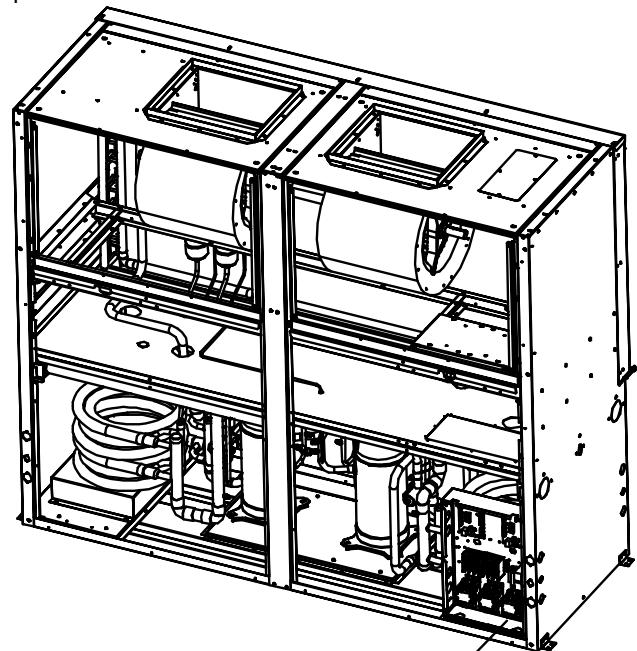
**Note: Must provide 3 feet (or code requirement) service access for new control box location.**



**Step 1** - For HBV072-120 remove 3 panels. For HBV160-240 remove 6 panels, middle dividers, and panel mounting brackets.

**HBV Field Conversion of Control Box**

**Step 1** - Remove control box access panel and panel box will be relocated to.



Original Control Box Location for Back Return Top Discharge

**Step 2:** Unattach all wires from components, remove the control box, tag wires. Pull wires out of box.

**Step 3:** Attach box to new location.

**Step 4:** Reroute wires. (Note: Keep wires away from hot lines and sharp edges).

**Step 5:** Reattach wires. (Note: Models with 2 compressors, rewire circuit 1 to same compressor. (I.E., compressor configuration does not change. Only location of control box changes.

**Step 6:** Check wiring is per wire diagram.

**Step 7:** Replace panels.

## HBV Field Conversion of Water Connections

### ⚠ WARNING! ⚠

**WARNING!** To avoid possible injury or death due to electrical shock, open the power supply disconnect switch and secure it in an open position during installation or conversion.

**Overview** - All models the water connection can be field converted to opposite side. Connections can be both left, right, or 1 each side.

**Preparation** - Field conversion must be completed on the ground. If the unit is already hung it should be taken down for the field conversion. Place in a well-lighted area. Conversion should only be attempted by a qualified service technician.

### Side to Back Discharge Conversion

**Step 1:** Remove panels needed for access to water connections.

**Step 2:** Remove screws from side panels. Loosen (4x) screws in slots but do not remove.

**Step 3:** Both water in and out have a union centered in the middle of the unit. Undo both unions, rotate the water legs for opposite configuration retighten unions, reattach connection flanges to wrappers. Use slots to adjust and retighten screws in slots.

**Step 4:** Replace panels.

**Step 5:** Check wiring is per wire diagram.

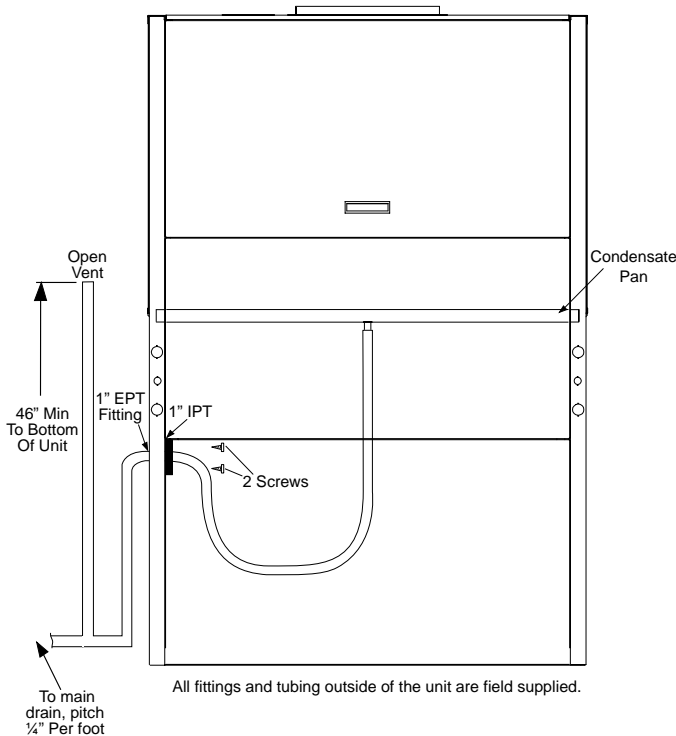
**Step 6:** Replace panels

## Vertical Condensate Installation

**Condensate Piping** - HBV - Remove KO on side that drain will be connected. Remove access panels. Inside of unit, untie and uncoil drain hose. Form trap in hose, make sure hose is not kinked or deformed. Connect plate assembly to side frame with 2 screws.

Outside of unit, connect 1" MPT fitting to plate assembly. Run line to building drain. Horizontal runs must be pitched 1/4" per foot (10 mm per 46 cm) toward drain. Do not trap externally.

Figure 10 illustrates a typical trap and vent used with HBV series equipment  
Each unit must be installed with its own individual line to  
**Figure 10: HBV**



the building main condensate drain line or riser. Provide a means to flush or blow out the condensate line. DO NOT install units with a common trap and or vent. Always vent the condensate line when dirt or air can collect in the line or a long horizontal drain line is required. Also vent when large units are working against higher external static pressure than other units connected to the same condensate main since this may cause poor drainage for all units on the line. WHEN A VENT IS INSTALLED IN THE DRAIN LINE, IT MUST BE LOCATED AFTER THE TRAP IN THE DIRECTION OF THE CONDENSATE FLOW and opening 46" (117 cm) minimum from bottom of unit. (Vent per code)

**⚠ WARNING! ⚠**

**WARNING!** Ensure condensate line is pitched toward drain 1/4" per foot [10mm per 46cm] of run.

**Horizontal and Vertical Installations** - Drain main or riser must be sized for all units connected to it.

Pipe Size	Connected Tons	Connected kW
3/4" [19mm]	<4	<14
1" [25mm]	<6	<21
1-1/4" [32mm]	<30	<105
1-1/2" [38mm]	<50	<175
2" [51mm]	<150	<527
3" [76mm]	<300	<1055
4" [102mm]	<500	<1758

\* Make sure all connections are secure and water tight.

After drain is connected to main and all drain connections are secure and water tight, pour 1 gallon of water into condensate pan. Water should drain out freely. Repair any leaks.

- On units with multiple fan outlets a "pair of pants" duct connection must be used for proper air balance and distribution and to prevent fan oscillation.
- Include at least one 90-degree turn in supply air ducts to reduce noise transmission.
- Existing ducts must be checked to ensure proper size and configuration prior to installation of any replacement unit. Also inspect for and repair all air leaks in existing ducts.
- Units may only be connected to a dedicated duct system. Consult the factory BEFORE connecting multiple units to a common duct system.
- Never connect a unit to a duct system with automatic or modulating dampers, VAV boxes, etc. in the supply air system. Never allow a situation where the total CFM can drop below the minimum required for proper unit operation.
- Never connect a bypass damper from the supply air duct to the return air duct. Never allow the return air temperature to drop below the minimum allowable normal temperature for proper unit operation.
- Do not use HB units for 100% outdoor air treatment. Do not add hot-gas-bypass to "convert" a unit for outdoor air treatment. Always use a dedicated outdoor air unit for outdoor air treatment.
- Do not exceed 10% of the total unit CFM with untreated outdoor air.

## Piping Installation

### Installation of Supply and Return Piping

Follow these piping guidelines:

1. Install a drain valve at the base of each supply and return riser to facilitate system flushing.
2. Install shut-off / balancing valves and unions at each unit to permit unit removal for servicing.
3. Place strainers at the inlet of each system circulating pump.
4. Select the proper hose length to allow slack between connection points. Hoses may vary in length by +2% to -4% under pressure.
5. Refer to Table 1. Do not exceed the minimum bend radius for the hose selected. Exceeding the minimum bend radius may cause the hose to collapse, which reduces water flow rate. Install an angle adapter to avoid sharp bends in the hose when the radius falls below the required minimum.

Insulation is not required on loop water piping except where the piping runs through unheated areas, outside the building or when the loop water temperature is below the minimum expected dew point of the pipe ambient conditions. Insulation is required if loop water temperature drops below the dew point (insulation is required for ground loop applications in most climates).

Pipe joint compound is not necessary when Teflon® thread tape is pre-applied to hose assemblies or when flared-end connections are used. If pipe joint compound is preferred, use compound only in small amounts on the external pipe threads of the fitting adapters. Prevent sealant from reaching the flared surfaces of the joint.

Note: When antifreeze is used in the loop, ensure that it is compatible with the Teflon® tape or pipe joint compound that is applied.

Maximum allowable torque for brass fittings is 30 ft-lbs [41 N-m]. If a torque wrench is not available, tighten finger-tight plus one quarter turn. Tighten steel fittings as necessary.

Optional pressure-rated hose assemblies designed specifically for use with MARS units are available. Similar hoses can be obtained from alternate suppliers. Supply and return hoses are fitted with swivel-joint fittings at one end to prevent kinking during installation.

Refer to Figure 11 for an illustration of a typical supply/return hose kit. Adapters secure hose assemblies to the unit and risers. Install hose assemblies properly and check regularly to avoid system failure and reduced service life.

**⚠ WARNING! ⚠**

**WARNING!** Polyolester Oil, commonly known as POE oil, is a synthetic oil used in many refrigeration systems including those with HFC-410A refrigerant. POE oil, if it ever comes in contact with PVC or CPVC piping, may cause failure of the PVC/CPVC. PVC/CPVC piping should never be used as supply or return water piping with water source heat pump products containing HFC-410A as system failures and property damage may result.

**⚠ CAUTION! ⚠**

**CAUTION!** Corrosive system water requires corrosion resistant fittings and hoses, and may require water treatment.

**⚠ CAUTION! ⚠**

**CAUTION!** Do not bend or kink supply lines or hoses.

**⚠ CAUTION! ⚠**

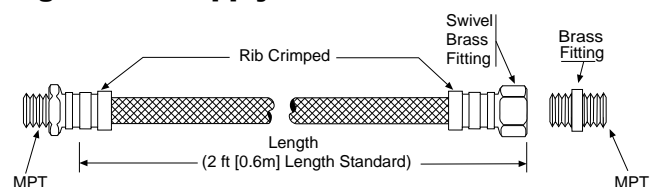
**CAUTION!** Piping must comply with all applicable codes.

**Table 1: Metal Hose Minimum Bend Radii**

Hose Diameter	Minimum Bend Radii
1/2" [12.7mm]	2-1/2" [6.4cm]
3/4" [19.1mm]	4" [10.2cm]
1" [25.4mm]	5-1/2" [14cm]
1-1/4" [31.8mm]	6-3/4" [17.1cm]
1-1/2" [38.1mm]	8.5" [21.6cm]

**NOTICE!** Do not allow hoses to rest against structural building components. Compressor vibration may be transmitted through the hoses to the structure, causing unnecessary noise complaints.

**Figure 11 : Supply/Return Hose Kit**





## Water-Loop Heat Pump Applications

Commercial Water Loop Applications - Commercial systems typically include a number of units connected to a common piping system. Any unit plumbing maintenance work can introduce air into the piping system; therefore air elimination equipment is a major portion of the mechanical room plumbing. In piping systems expected to utilize water temperatures below 50°F [10°C], 1/2" (13mm) closed cell insulation is required on all piping surfaces to eliminate condensation (extended range units required). Metal to plastic threaded joints should never be used due to their tendency to leak over time.

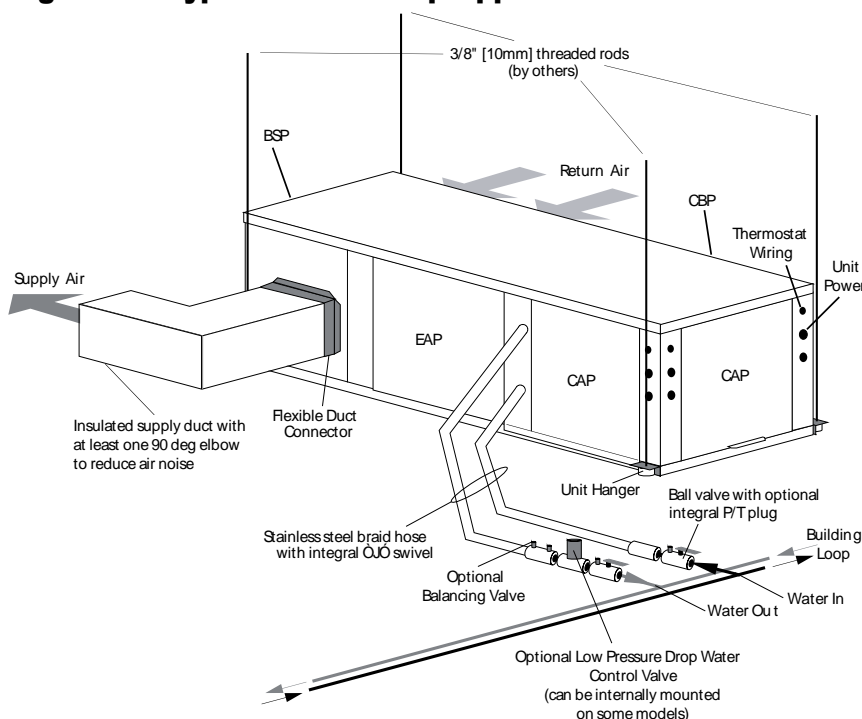
Teflon tape thread sealant is recommended to minimize internal fouling of the heat exchanger. Do not over tighten connections and route piping so as not to interfere with service or maintenance access. Hose kits are available from ClimateMaster in different configurations as shown in Figure 12 for connection between the unit and the piping system. Depending upon selection, hose kits may include shut off valves, P/T plugs for performance measurement, high pressure stainless steel braided hose, "Y" type strainer with blow down valve, and/or "J" type swivel connection. Balancing valves and an external low pressure drop solenoid valve for use in variable speed pumping systems may also be included in the hose kit.

The piping system should be flushed to remove dirt, piping chips, and other foreign material prior to operation (see "Piping System Cleaning and Flushing Procedures" in this manual). The flow rate is usually set between 2.25 and 3.5 gpm per ton [2.9 and 4.5 l/m per kW] of cooling capacity. ClimateMaster recommends 3 gpm per ton [3.9 l/m per kW] for most applications of water loop heat pumps. To ensure proper maintenance and servicing, P/T ports are imperative for temperature and flow verification, as well as performance checks.

Water loop heat pump (cooling tower/boiler) systems typically utilize a common loop, maintained between 60 - 90°F [16 - 32°C]. The use of a closed circuit evaporative cooling tower with a secondary heat exchanger between the tower and the water loop is recommended. If an open type cooling tower is used continuously, chemical treatment and filtering will be necessary.

Low Water Temperature Cutout Setting - CXM2 Control When antifreeze is selected, the LT1 jumper (JW3) should be clipped to select the low temperature (antifreeze 10.0°F [-12.2°C]) setpoint and avoid nuisance faults (see "Low Water Temperature Cutout Selection" in this manual). Note: Low water temperature operation requires extended range equipment.

**Figure 12: Typical Water-Loop Application**



## Ground-Loop Heat Pump Applications

### ~ CAUTION! ~

**CAUTION!** The following instructions represent industry accepted installation practices for closed loop earth coupled heat pump systems. Instructions are provided to assist the contractor in installing trouble free ground loops. These instructions are recommendations only. State/provincial and local codes **MUST** be followed and installation **MUST** conform to ALL applicable codes. It is the responsibility of the installing contractor to determine and comply with ALL applicable codes and regulations.

### ~ CAUTION! ~

**CAUTION!** Ground loop applications require extended range equipment and optional refrigerant/water circuit insulation.

**Pre-Installation** - Prior to installation, locate and mark all existing underground utilities, piping, etc. Install loops for new construction before sidewalks, patios, driveways, and other construction has begun. During construction, accurately mark all ground loop piping on the plot plan as an aid in avoiding potential future damage to the installation.

**Piping Installation** - The typical closed loop ground source system is shown in Figure 13. All earth loop piping materials should be limited to polyethylene fusion only for in-ground sections of the loop. Galvanized or steel fittings should not be used at any time due to their tendency to corrode. All plastic to metal threaded fittings should be avoided due to their potential to leak in earth coupled applications. A flanged fitting should be substituted. P/T plugs should be used so that flow can be measured using the pressure drop of the unit heat exchanger.

Earth loop temperatures can range between 25 and 110°F [-4 to 43°C]. Flow rates between 2.25 and 3 gpm per ton [2.41 to 3.23 l/m per kW] of cooling capacity is recommended in these applications. Test individual horizontal loop circuits before backfilling.

Test vertical U-bends and pond loop assemblies prior to installation. Pressures of at least 100 psi [689 kPa] should be used when testing. Do not exceed the pipe pressure rating. Test entire system when all loops are assembled.

**Flushing the Earth Loop** - Upon completion of system installation and testing, flush the system to remove all foreign objects and purge to remove all air.

**Antifreeze** - In areas where minimum entering loop temperatures drop below 40°F [5°C] or where piping will be routed through areas subject to freezing, antifreeze is required. Alcohols and glycols are commonly used as antifreeze; however your local sales manager should be consulted for the antifreeze best suited to your area. Low temperature protection should be maintained to 15°F [9°C] below the lowest expected entering loop temperature. For example, if 30°F [-1°C] is the minimum expected entering loop temperature, the leaving loop temperature would be 25 to 22°F [-4 to -6°C] and low temperature protection should be at 15°F [-10°C]. Calculation is as follows:

$$30^{\circ}\text{F} - 15^{\circ}\text{F} = 15^{\circ}\text{F} \quad [-1^{\circ}\text{C} - 9^{\circ}\text{C} = -10^{\circ}\text{C}]$$

All alcohols should be premixed and pumped from a reservoir outside of the building when possible or introduced under the water level to prevent fumes. Calculate the total volume of fluid in the piping system. Then use the percentage by volume shown in table 2 for the amount of antifreeze needed. Antifreeze concentration should be checked from a well mixed sample using a hydrometer to measure specific gravity.

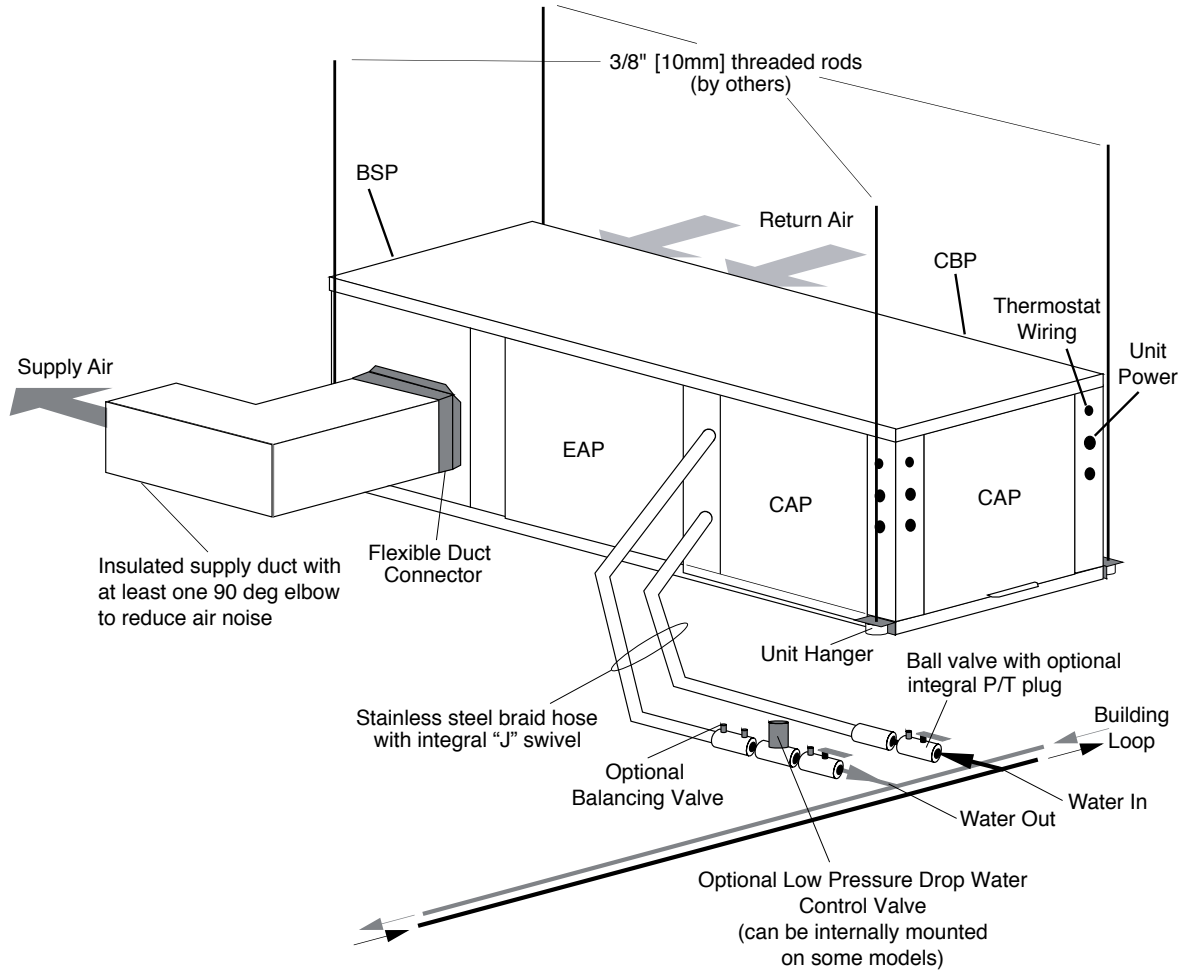
**Low Water Temperature Cutout Setting - CXM2 Control**  
When antifreeze is selected, the LT1 jumper (JW3) should be clipped to select the low temperature (antifreeze 10.0°F [-12.2°C]) setpoint and avoid nuisance faults (see "Low Water Temperature Cutout Selection" in this manual). Note: Low water temperature operation requires extended range equipment.

**Table 2: Antifreeze Percentages by Volume**

Type	Minimum Temperature for Low Temperature Protection			
	10°F [-12.2°C]	15°F [-9.4°C]	20°F [-6.7°C]	25°F [-3.9°C]
Methanol	25%	21%	16%	10%
100% USP food grade Propylene Glycol	38%	25%	22%	15%
Ethanol*	29%	25%	20%	14%

\* Must not be denatured with any petroleum based product

**Figure 13: Typical Ground-Loop Application**



## Ground-Water Heat Pump Applications

**Open Loop - Ground Water Systems** - Typical open loop piping is shown in Figure 14. Shut off valves should be included for ease of servicing. Boiler drains or other valves should be “tee’d” into the lines to allow acid flushing of the heat exchanger. Shut off valves should be positioned to allow flow through the coax via the boiler drains without allowing flow into the piping system. P/T plugs should be used so that pressure drop and temperature can be measured. Supply and return water piping materials should be limited to copper, PE, or similar material. PVC or CPVC should never be used as they are incompatible with the POE oils used in HFC-410A products and piping system failure and property damage may result.

### ▲ WARNING! ▲

**WARNING!** Polyolester Oil, commonly known as POE oil, is a synthetic oil used in many refrigeration systems including those with HFC-410A refrigerant. POE oil, if it ever comes in contact with PVC or CPVC piping, may cause failure of the PVC/CPVC. PVC/CPVC piping should never be used as supply or return water piping with water source heat pump products containing HFC-410A as system failures and property damage may result.

Water quantity should be plentiful and of good quality. Consult table 3 for water quality guidelines. The unit can be ordered with either a copper or cupro-nickel water heat exchanger. Consult Table 3 for recommendations. Copper is recommended for closed loop systems and open loop ground water systems that are not high in mineral content or corrosiveness. In conditions anticipating heavy scale formation or in brackish water, a cupro-nickel heat exchanger is recommended. In ground water situations where scaling could be heavy or where biological growth such as iron bacteria will be present, an open loop system is not recommended. Heat exchanger coils may over time lose heat exchange capabilities due to build up of mineral deposits. Heat exchangers must only be serviced by a qualified technician, as acid and special pumping equipment is required. Desuperheater coils can likewise become scaled and possibly plugged. In areas with extremely hard water, the owner should be informed that the heat exchanger may require occasional acid flushing. In some cases, the desuperheater option should not be recommended due to hard water conditions and additional maintenance required.

**Water Quality Standards** - Table 3 should be consulted for water quality requirements. Scaling potential should be assessed using the pH/Calcium hardness method. If the pH <7.5 and the calcium hardness is less than 100 ppm, scaling potential is low. If this method yields numbers out of range of those listed, the Ryznar Stability and Langelier Saturation indices should be calculated. Use the appropriate scaling surface temperature for the application, 150°F [66°C] for direct use (well water/open loop) and DHW (desuperheater); 90°F [32°F] for indirect use. A monitoring plan should be implemented in these probable scaling situations. Other water quality issues such as iron fouling, corrosion prevention and erosion and clogging should be referenced in Table 3.

**Expansion Tank and Pump** - Use a closed, bladder-type expansion tank to minimize mineral formation due to air exposure. The expansion tank should be sized to provide at least one minute continuous run time of the pump using its drawdown capacity rating to prevent pump short cycling. Discharge water from the unit is not contaminated in any manner and can be disposed of in various ways, depending on local building codes (e.g. recharge well, storm sewer, drain field, adjacent stream or pond, etc.). Most local codes forbid the use of sanitary sewer for disposal. Consult your local building and zoning department to assure compliance in your area.

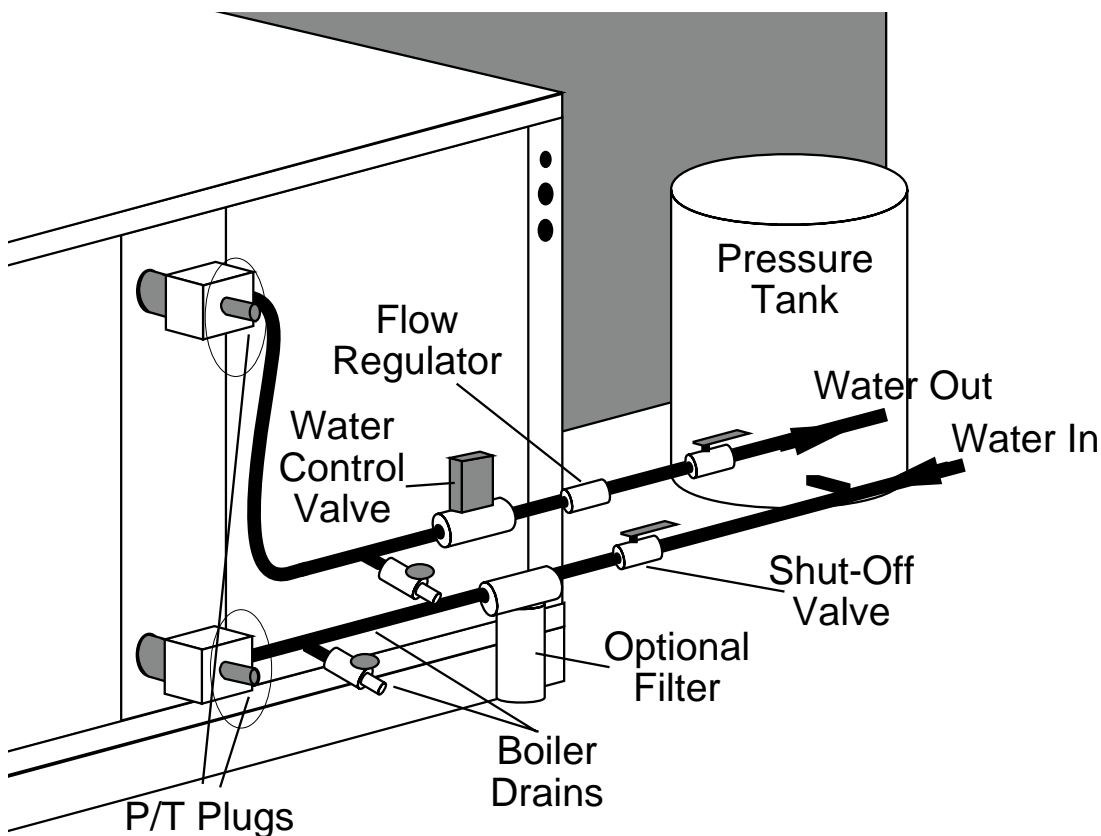
**Water Control Valve** - Note the placement of the water control valve in Figure 14. Always maintain water pressure in the heat exchanger by placing the water control valve(s) on the discharge line to prevent mineral precipitation during the off-cycle. Pilot operated slow closing valves are recommended to reduce water hammer. If water hammer persists, a mini-expansion tank can be mounted on the piping to help absorb the excess hammer shock. Ensure that the total ‘VA’ draw of the valve can be supplied by the unit transformer. For instance, a slow closing valve can draw up to 35VA. This can overload smaller 40 or 50 VA transformers depending on the other controls in the circuit. A typical pilot operated solenoid valve draws approximately 15VA (see Figure 18). Note the special wiring diagrams for slow closing valves (Figures 19 & 20).

**Flow Regulation** - Flow regulation can be accomplished by two methods. One method of flow regulation involves simply adjusting the ball valve or water control valve on the discharge line. Measure the pressure drop through the unit heat exchanger, and determine flow rate from Tables 8a through 8e. Since the pressure is constantly varying, two pressure gauges may be needed. Adjust the valve until the desired flow of 1.5 to 2 gpm per ton [2.0 to 2.6 l/m per kW] is achieved. A second method of flow control requires a flow control device mounted on the outlet of the water control valve. The device is typically a brass fitting with an orifice of

rubber or plastic material that is designed to allow a specified flow rate. On occasion, flow control devices may produce velocity noise that can be reduced by applying some back pressure from the ball valve located on the discharge line. Slightly closing the valve will spread the pressure drop over both devices, lessening the velocity noise. **NOTE: When EWT is below 50°F [10°C], 2 gpm per ton (2.6 l/m per kW) is required.**

**Water Coil Low Temperature Limit Setting** - For all open loop systems the 30°F [-1.1°C] FP1 setting (factory setting-water) should be used to avoid freeze damage to the unit. See “Low Water Temperature Cutout Selection” in this manual for details on the low limit setting.

**Figure 14: Typical Open Loop/Well Application**



## Water Quality Standards

**Table 3: Water Quality Standards**

Water Quality Parameter	HX Material	Closed Recirculating	Open Loop and Recirculating Well		
<b>Scaling Potential - Primary Measurement</b>					
Above the given limits, scaling is likely to occur. Scaling indexes should be calculated using the limits below					
pH/Calcium Hardness Method	All	-	<b>pH &lt; 7.5 and Ca Hardness &lt;100ppm</b>		
<b>Index Limits for Probable Scaling Situations - (Operation outside these limits is not recommended)</b>					
Scaling indexes should be calculated at 66°C for direct use and HWG applications, and at 32°C for indirect HX use. A monitoring plan should be implemented.					
Ryznar Stability Index	All	-	<b>6.0 - 7.5</b> If >7.5 minimize steel pipe use.		
Langelier Saturation Index	All	-	<b>-0.5 to +0.5</b> If <-0.5 minimize steel pipe use. Based upon 66°C HWG and Direct well, 29°C Indirect Well HX		
<b>Iron Fouling</b>					
Iron Fe <sup>2+</sup> (Ferrous) (Bacterial Iron potential)	All	-	<b>&lt;0.2 ppm (Ferrous)</b> If Fe <sup>2+</sup> (ferrous)>0.2 ppm with pH 6 - 8, O <sub>2</sub> <5 ppm check for iron bacteria.		
Iron Fouling	All	-	<b>&lt;0.5 ppm of Oxygen</b> Above this level deposition will occur.		
<b>Corrosion Prevention</b>					
pH	All	<b>6 - 8.5</b> Monitor/treat as needed	<b>6 - 8.5</b> Minimize steel pipe below 7 and no open tanks with pH <8		
Hydrogen Sulfide (H <sub>2</sub> S)	All	-	<b>&lt;0.5 ppm</b> At H <sub>2</sub> S>0.2 ppm, avoid use of copper and copper nickel piping or HX's. Rotten egg smell appears at 0.5 ppm level. Copper alloy (bronze or brass) cast components are OK to <0.5 ppm.		
Ammonia ion as hydroxide, chloride, nitrate and sulfate compounds	All	-	<b>&lt;0.5 ppm</b>		
Maximum Chloride Levels	Copper Cupronickel 304 SS 316 SS Titanium	- - - - -	Maximum Allowable at maximum water temperature.		
			10°C	24°C	38°C
			<20ppm	NR	NR
			<150 ppm	NR	NR
			<400 ppm	<250 ppm	<150 ppm
<1000 ppm	<550 ppm	< 375 ppm			
>1000 ppm	>550 ppm	>375 ppm			
<b>Erosion and Clogging</b>					
Particulate Size and Erosion	All	<10 ppm of particles and a maximum velocity of 1.8 m/s Filtered for maximum 841 micron [0.84 mm, 20 mesh] size.	<10 ppm (<1 ppm "sandfree" for reinjection) of particles and a maximum velocity of 1.8 m/s. Filtered for maximum 841 micron 0.84 mm, 20 mesh] size. Any particulate that is not removed can potentially clog components.		

The MARS Water Quality Table provides water quality requirements for MARS coaxial heat exchangers. The water should be evaluated by an independent testing facility/Rev.: 5/6/2014 S comparing to this Table and when properties are outside of these requirements, an external secondary heat exchanger must be used to isolate the heat pump heat exchanger from the unsuitable water. Failure to do so will void the warranty for the coaxial heat exchanger and any other components damaged by a leak.

Notes:

- Closed Recirculating system is identified by a closed pressurized piping system.
- Recirculating open wells should observe the open recirculating design considerations.
- NR - Application not recommended.
- "-" No design Maximum.

## Electrical - Line Voltage

Electrical - Line Voltage - All field installed wiring, including electrical ground, must comply with the National Electrical Code as well as all applicable local codes. Refer to the unit electrical data for fuse sizes. Consult wiring diagram for field connections that must be made by the installing (or electrical) contractor. All final electrical connections must be made with a length of flexible conduit to minimize vibration and sound transmission to the building.

General Line Voltage Wiring - Be sure the available power is the same voltage and phase shown on the unit serial plate. Line and low voltage wiring must be done in accordance with local codes or the National Electric Code, whichever is applicable.

**Transformer** - All 208/230 voltage units are factory wired for 208 volt. If supply voltage is 230 volt, installer must rewire transformer. See wire diagram for connections.

**⚠ WARNING! ⚠**

**WARNING!** To avoid possible injury or death due to electrical shock, open the power supply disconnect switch and secure it in an open position during installation.

**⚠ CAUTION! ⚠**

**CAUTION!** Use only copper conductors for field installed electrical wiring. Unit terminals are not designed to accept other types of conductors.

**Table 4a: ® Compact (HBH/V) Series Electrical Data - (Standard 60Hz Units)**

Model #	Voltage Code	Voltage	Min/Max Voltage	Blower Option	Compressor			Fan Motor FLA	Total FLA/ Rated Current	Min Circuit Amp	SCCR ka rms symmetrical	SCCR Volts Maximum	Max Fuse/ HACR
					QTY	RLA	LRA						
HBH/V072	H	208/230/60/3	197/254	A, B, C	2	10.4	73.0	3.2	24.0	26.6	N/A	N/A	35
	H	208/230/60/3	197/254	D, E	2	10.4	73.0	6.0	26.8	29.4	N/A	N/A	35
	F	460/60/3	414/506	A, B, C	2	5.8	38.0	1.6	13.2	14.7	N/A	N/A	20
	F	460/60/3	414/506	D, E	2	5.8	38.0	2.9	14.5	16.0	N/A	N/A	20
	N	575/60/3	518/633	A, B, C	2	3.8	36.5	1.2	8.8	9.8	N/A	N/A	15
	N	575/60/3	518/633	D, E	2	3.8	36.5	2.4	10.0	11.0	N/A	N/A	15
HBH/V096	H	208/230/60/3	197/254	A, B, C	2	13.7	83.1	6.0	33.4	36.8	N/A	N/A	50
	H	208/230/60/3	197/254	D, E	2	13.7	83.1	8.5	35.9	39.3	N/A	N/A	50
	F	460/60/3	414/506	A, B, C	2	6.2	41.0	2.9	15.3	16.9	N/A	N/A	20
	F	460/60/3	414/506	D, E	2	6.2	41.0	4.1	16.5	18.1	N/A	N/A	20
	N	575/60/3	518/633	A, B, C	2	4.8	33.0	2.4	12.0	13.2	N/A	N/A	15
	N	575/60/3	518/633	D, E	2	4.8	33.0	3.2	12.8	14.0	N/A	N/A	15
HBH/V120	H	208/230/60/3	197/254	A, B, C	2	15.6	110.0	8.5	39.7	43.6	N/A	N/A	50
	H	208/230/60/3	197/254	D, E	2	15.6	110.0	13.8	45.0	48.9	N/A	N/A	60
	F	460/60/3	414/506	A, B, C	2	7.8	52.0	4.1	19.7	21.7	N/A	N/A	25
	F	460/60/3	414/506	D, E	2	7.8	52.0	6.5	22.1	24.1	N/A	N/A	30
	N	575/60/3	518/633	A, B, C	2	5.8	38.9	3.2	14.8	16.3	N/A	N/A	20
	N	575/60/3	518/633	D, E	2	5.8	38.9	5.2	16.8	18.3	N/A	N/A	20
HBV160	H	208/230/60/3	197/254	A, B, C	2	23.2	164.0	8.5	54.9	60.7	5	600	80
	H	208/230/60/3	197/254	D, E	2	23.2	164.0	13.8	60.2	66.0	5	600	80
	F	460/60/3	414/506	A, B, C	2	11.2	75.0	4.1	26.5	29.3	N/A	N/A	40
	F	460/60/3	414/506	D, E	2	11.2	75.0	6.5	28.9	31.7	N/A	N/A	40
	N	575/60/3	518/633	A, B, C	2	7.9	54.0	3.2	19.0	21.0	N/A	N/A	25
	N	575/60/3	518/633	D, E	2	7.9	54.0	5.2	21.0	23.0	N/A	N/A	30
HBV192	H	208/230/60/3	197/254	A, B, C	2	25.0	164.0	8.5	58.5	64.8	5	600	80
	H	208/230/60/3	197/254	D, E	2	25.0	164.0	13.8	63.8	70.1	5	600	90
	F	460/60/3	414/506	A, B, C	2	12.2	100.0	4.1	28.5	31.6	N/A	N/A	40
	F	460/60/3	414/506	D, E	2	12.2	100.0	6.5	30.9	34.0	N/A	N/A	45
	N	575/60/3	518/633	A, B, C	2	9.0	78.0	3.2	21.2	23.5	N/A	N/A	30
	N	575/60/3	518/633	D, E	2	9.0	78.0	5.2	23.2	25.5	N/A	N/A	30
HBV240	H	208/230/60/3	197/254	A, B, C	2	30.1	225.0	13.8	74.0	81.5	5	600	110
	H	208/230/60/3	197/254	D, E	2	30.1	225.0	21.0	81.2	88.7	5	600	110
	F	460/60/3	414/506	A, B, C	2	16.7	114.0	6.5	39.9	44.1	N/A	N/A	60
	F	460/60/3	414/506	D, E	2	16.7	114.0	9.9	43.3	47.5	N/A	N/A	60
	N	575/60/3	518/633	A, B, C	2	12.2	80.0	5.2	29.6	32.7	N/A	N/A	40
	N	575/60/3	518/633	D, E	2	12.2	80.0	8.0	32.4	35.5	N/A	N/A	45
HBV300	H	208/230/60/3	197/254	A, B, C	2	48.1	245.0	21.0	117.2	129.2	5	600	150
	H	208/230/60/3	197/254	E	2	48.1	245.0	26.0	122.2	134.2	5	600	150
	F	460/60/3	414/506	A, B, C	2	18.6	125.0	9.9	47.1	51.8	5	600	70
	F	460/60/3	414/506	E	2	18.6	125.0	12.5	49.7	54.4	5	600	70
	N	575/60/3	518/633	A, B, C	2	14.7	100.0	8.0	37.4	41.1	N/A	N/A	50
	N	575/60/3	518/633	E	2	14.7	100.0	10.2	39.6	43.3	N/A	N/A	50

All fuses Class RK-5

## Electrical - Line Voltage

**Table 4b: ® Compact (HBH/V) Series Electrical Data - (Dual Point Power 60Hz Units)**

Model #	Voltage Code	Voltage	Min/Max Voltage	Blower Option	Compressor Power Supply							Emergency Power Supply					
					QTY	RLA	LRA	Comp FLA/ Rated Current	Comp MCA	SCCR kA rmas symmetrical	SCCR Volts Maximum	Comp Max Fuse/ HACR	Fan FLA/ Rated Current	Fan MCA	SCCR kA rmas symmetrical	SCCR Volts Maximum	Fan Max Fuse/ HACR
HBH/V072	H	208/230/60/3	197/254	A, B, C	2	10.4	73.0	20.8	23.4	N/A	N/A	30	3.2	4.0	N/A	N/A	15
	H	208/230/60/3	197/254	D, E	2	10.4	73.0	20.8	23.4	N/A	N/A	30	6.0	7.5	N/A	N/A	15
	F	460/60/3	414/506	A, B, C	2	5.8	38.0	11.6	13.1	N/A	N/A	15	1.6	2.0	N/A	N/A	15
	F	460/60/3	414/506	D, E	2	5.8	38.0	11.6	13.1	N/A	N/A	15	2.9	3.6	N/A	N/A	15
	N	575/60/3	518/633	A, B, C	2	3.8	36.5	7.6	8.6	N/A	N/A	15	1.2	1.5	N/A	N/A	15
	N	575/60/3	518/633	D, E	2	3.8	36.5	7.6	8.6	N/A	N/A	15	2.4	3.0	N/A	N/A	15
HBH/V096	H	208/230/60/3	197/254	A, B, C	2	13.7	83.1	27.4	30.8	N/A	N/A	40	6.0	7.5	N/A	N/A	15
	H	208/230/60/3	197/254	D, E	2	13.7	83.1	27.4	30.8	N/A	N/A	40	8.5	10.6	N/A	N/A	15
	F	460/60/3	414/506	A, B, C	2	6.2	41.0	12.4	14.0	N/A	N/A	20	2.9	3.6	N/A	N/A	15
	F	460/60/3	414/506	D, E	2	6.2	41.0	12.4	14.0	N/A	N/A	20	4.1	5.1	N/A	N/A	15
	N	575/60/3	518/633	A, B, C	2	4.8	33.0	9.6	10.8	N/A	N/A	15	2.4	3.0	N/A	N/A	15
	N	575/60/3	518/633	D, E	2	4.8	33.0	9.6	10.8	N/A	N/A	15	3.2	4.0	N/A	N/A	15
HBH/V120	H	208/230/60/3	197/254	A, B, C	2	15.6	110.0	31.2	35.1	N/A	N/A	50	8.5	10.6	N/A	N/A	15
	H	208/230/60/3	197/254	D, E	2	15.6	110.0	31.2	35.1	N/A	N/A	50	13.8	17.3	N/A	N/A	30
	F	460/60/3	414/506	A, B, C	2	7.8	52.0	15.6	17.6	N/A	N/A	25	4.1	5.1	N/A	N/A	15
	F	460/60/3	414/506	D, E	2	7.8	52.0	15.6	17.6	N/A	N/A	25	6.5	8.1	N/A	N/A	15
	N	575/60/3	518/633	A, B, C	2	5.8	38.9	11.6	13.1	N/A	N/A	15	3.2	4.0	N/A	N/A	15
	N	575/60/3	518/633	D, E	2	5.8	38.9	11.6	13.1	N/A	N/A	15	5.2	6.5	N/A	N/A	15
HBV160	H	208/230/60/3	197/254	A, B, C	2	23.2	164.0	46.4	52.2	5	600	70	8.5	10.6	N/A	N/A	15
	H	208/230/60/3	197/254	D, E	2	23.2	164.0	46.4	52.2	5	600	70	13.8	17.3	N/A	N/A	30
	F	460/60/3	414/506	A, B, C	2	11.2	75.0	22.4	25.2	N/A	N/A	35	4.1	5.1	N/A	N/A	15
	F	460/60/3	414/506	D, E	2	11.2	75.0	22.4	25.2	N/A	N/A	35	6.5	8.1	N/A	N/A	15
	N	575/60/3	518/633	A, B, C	2	7.9	54.0	15.8	17.8	N/A	N/A	25	3.2	4.0	N/A	N/A	15
	N	575/60/3	518/633	D, E	2	7.9	54.0	15.8	17.8	N/A	N/A	25	5.2	6.5	N/A	N/A	15
HBV192	H	208/230/60/3	197/254	A, B, C	2	25.0	164.0	50.0	56.3	5	600	80	8.5	10.6	N/A	N/A	15
	H	208/230/60/3	197/254	D, E	2	25.0	164.0	50.0	56.3	5	600	80	13.8	17.3	N/A	N/A	30
	F	460/60/3	414/506	A, B, C	2	12.2	100.0	24.4	27.5	N/A	N/A	35	4.1	5.1	N/A	N/A	15
	F	460/60/3	414/506	D, E	2	12.2	100.0	24.4	27.5	N/A	N/A	35	6.5	8.1	N/A	N/A	15
	N	575/60/3	518/633	A, B, C	2	9.0	78.0	18.0	20.3	N/A	N/A	25	3.2	4.0	N/A	N/A	15
	N	575/60/3	518/633	D, E	2	9.0	78.0	18.0	20.3	N/A	N/A	25	5.2	6.5	N/A	N/A	15
HBV240	H	208/230/60/3	197/254	A, B, C	2	30.1	225.0	60.2	67.7	5	600	90	13.8	17.3	N/A	N/A	30
	H	208/230/60/3	197/254	D, E	2	30.1	225.0	60.2	67.7	5	600	90	21.0	26.3	N/A	N/A	45
	F	460/60/3	414/506	A, B, C	2	16.7	114.0	33.4	37.6	N/A	N/A	50	6.5	8.1	N/A	N/A	15
	F	460/60/3	414/506	D, E	2	16.7	114.0	33.4	37.6	N/A	N/A	50	9.9	12.4	N/A	N/A	20
	N	575/60/3	518/633	A, B, C	2	12.2	80.0	24.4	27.5	N/A	N/A	35	5.2	6.5	N/A	N/A	15
	N	575/60/3	518/633	D, E	2	12.2	80.0	24.4	27.5	N/A	N/A	35	8.0	10.0	N/A	N/A	15
HBV300	H	208/230/60/3	197/254	A, B, C	2	48.1	245.0	96.2	108.2	5	600	150	21.0	26.3	N/A	N/A	45
	H	208/230/60/3	197/254	E	2	48.1	245.0	96.2	108.2	5	600	150	26.0	32.5	N/A	N/A	50
	F	460/60/3	414/506	A, B, C	2	18.6	125.0	37.2	41.9	N/A	N/A	60	9.9	12.4	N/A	N/A	20
	F	460/60/3	414/506	E	2	18.6	125.0	37.2	41.9	N/A	N/A	60	12.5	15.6	N/A	N/A	25
	N	575/60/3	518/633	A, B, C	2	14.7	100.0	29.4	33.1	N/A	N/A	45	8.0	10.0	N/A	N/A	15
	N	575/60/3	518/633	E	2	14.7	100.0	29.4	33.1	N/A	N/A	45	10.2	12.8	N/A	N/A	20

All fuses Class RK-5



## Electrical - Power Wiring

### ⚠ WARNING! ⚠

**WARNING!** Disconnect electrical power source to prevent injury or death from electrical shock.

### ⚠ CAUTION! ⚠

**CAUTION!** Use only copper conductors for field installed electrical wiring. Unit terminals are not designed to accept other types of conductors.

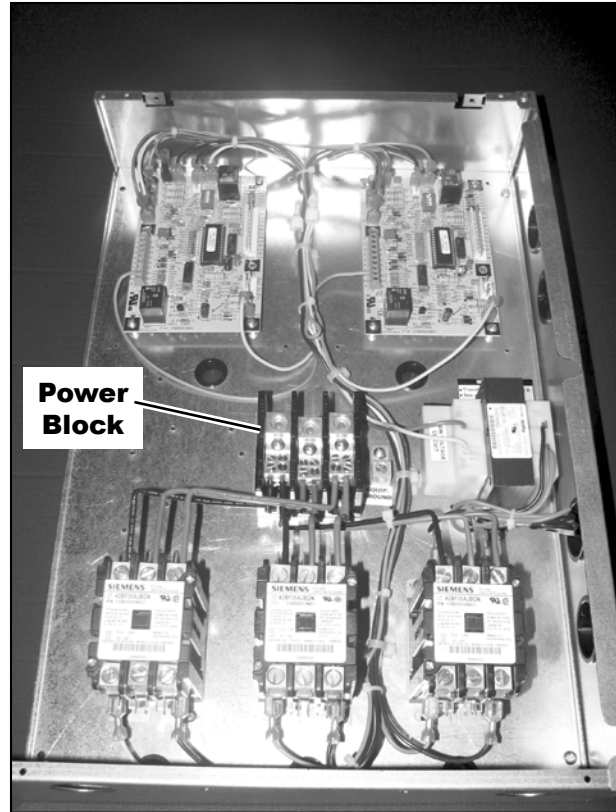
Electrical - Line Voltage - All field installed wiring, including electrical ground, must comply with the National Electrical Code as well as all applicable local codes. Refer to the unit electrical data for fuse sizes. Consult wiring diagram for field connections that must be made by the installing (or electrical) contractor. All final electrical connections must be made with a length of flexible conduit to minimize vibration and sound transmission to the building.

General Line Voltage Wiring - Be sure the available power is the same voltage and phase shown on the unit serial plate. Line and low voltage wiring must be done in accordance with local codes or the National Electric Code, whichever is applicable.

Auxiliary Line Voltage Wiring - A dedicated 115 VAC, 15 Amp **Power Connection** - Line voltage connection is made by connecting the incoming line voltage wires to the “L” side of the power block as shown in Figure 15. Consult electrical data tables for correct fuse size.

**Transformer** - All 208/230 voltage units are factory wired for 208 volt. If supply voltage is 230 volt, installer must rewire transformer. See wire diagram for connections.

Figure 15 : TCH 072-120 Line Voltage Wiring



## Electrical - Power & Low Voltage Wiring

### ELECTRICAL - LOW VOLTAGE WIRING

**Thermostat Connections** - The thermostat should be wired directly to the CXM2 or DXM2.5 board. Figure 16 shows wiring for TC units. See “Electrical – Thermostat” (Figure 20) for specific terminal connections. Review the appropriate AOM (Application, Operation and Maintenance) manual for units with DDC controls.

**Low Water Temperature Cutout Selection** - The CXM2/DXM2.5 control allows the field selection of low water (or water-antifreeze solution) temperature limit by clipping jumper JW3, which changes the sensing temperature associated with thermistor LT1. Note that the LT1 thermistor is located on the refrigerant line between the coaxial heat exchanger and expansion device (TXV or cap tube). Therefore, LT1 is sensing refrigerant temperature, not water temperature, which is a better indication of how water flow rate/temperature is affecting the refrigeration circuit.

The factory setting for LT1 is for systems using water (30°F [-1.1°C] refrigerant temperature). In low water temperature (extended range) applications with antifreeze (most ground loops), jumper JW3 should be clipped as shown in Figure 17 to change the setting to 10°F [-12.2°C] refrigerant temperature, a more suitable temperature when using an antifreeze solution. All MARS units operating with entering water temperatures below 59°F [15°C] must include the optional water/refrigerant circuit insulation package to prevent internal condensation.

Figure 16: HBH 072-120 Low Voltage Field Wiring (CXM2 Shown) NOTE: For DXM2.5, Y2 wiring at DXM2.5 Board #1

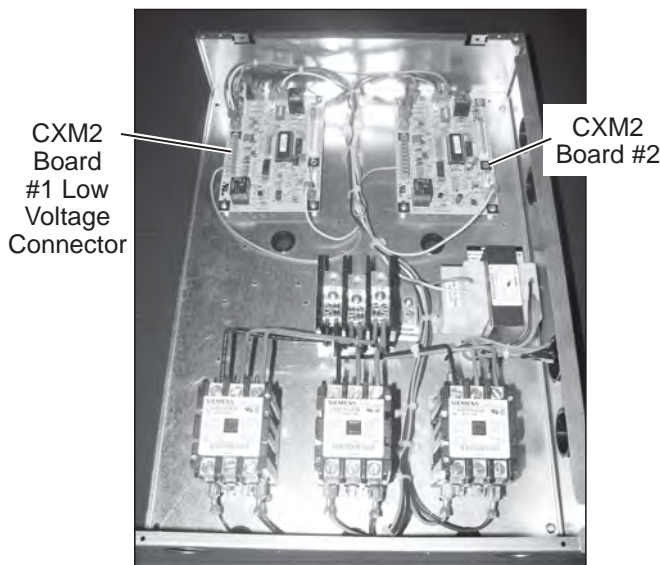
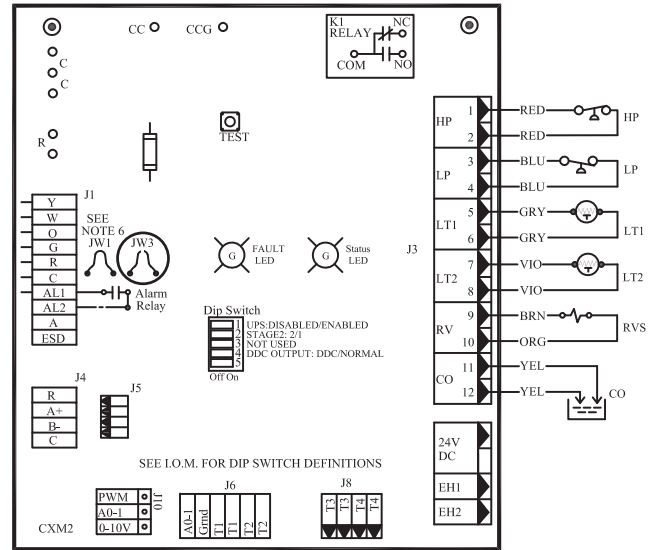


Figure 17: LT1 Limit Setting



**Accessory Connections** - A terminal paralleling the compressor contactor coil has been provided on the CXM2/DXM2.5 control. Terminal “A” is designed to control accessory devices, such as water valves. Note: This terminal should be used only with 24 Volt signals and not line voltage. Terminal “A” is energized with the compressor contactor. See the specific unit wiring diagram for details.

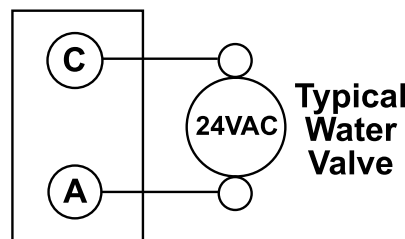
### Low Voltage VA Ratings

Components In Unit	VA
Typical Blower Contactor	6 - 9
Typical Reversing Valve Solenoid (2)	8 - 12
30A Compressor Contactor (2)	12 - 18
CXM2 board (2)	10 - 18
DXM2.5 board (2)	16 - 24
Units with CXM2 Remaining VA for Accessories	39 - 18
Units with DXM2.5 Remaining VA for Accessories	33 - 12

Standard transformer is 75VA.

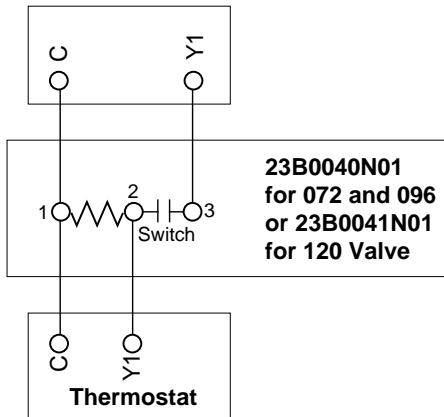
Figure 18 : Accessory Wiring

### Terminal Strip



## Electrical - Low Voltage Wiring

**Figure 19: Optional Motorized Water Valve**



### ⚠ CAUTION! ⚠

**CAUTION!** Many units are installed with a factory or field supplied manual or electric shut-off valve. **DAMAGE WILL OCCUR** if shut-off valve is closed during unit operation. A high pressure switch must be installed on the heat pump side of any field provided shut-off valves and connected to the heat pump controls in series with the built-in refrigerant circuit high pressure switch to disable compressor operation if water pressure exceeds pressure switch setting. The field installed high pressure switch shall have a cut-out pressure of 300 psig and a cut-in pressure of 250 psig. This pressure switch can be ordered from MARS with a 1/4" internal flare connection as part number 39B0005N02.

Water Solenoid Valves - An external solenoid valve(s) should be used on ground water installations to shut off flow to the unit when the compressor is not operating. A slow closing valve may be required to help reduce water hammer. Figure 18 shows typical wiring for a 24VAC external solenoid valve. This wiring should only be used if valve fully opens in 15 second. Figure 19 illustrates a typical slow closing water control valve wiring for Belimo valves. Slow closing valves take approximately 60 seconds to open (very little water will flow before 45 seconds). Once fully open, an end switch allows the compressor to be energized. Only relay or triac based electronic thermostats should be used with slow closing valves. When wired as shown, the slow closing valve will operate properly with the following notations:

1. The valve will remain open during a unit lockout.
2. The valve will draw approximately 25-35 VA through the "Y" signal of the thermostat.

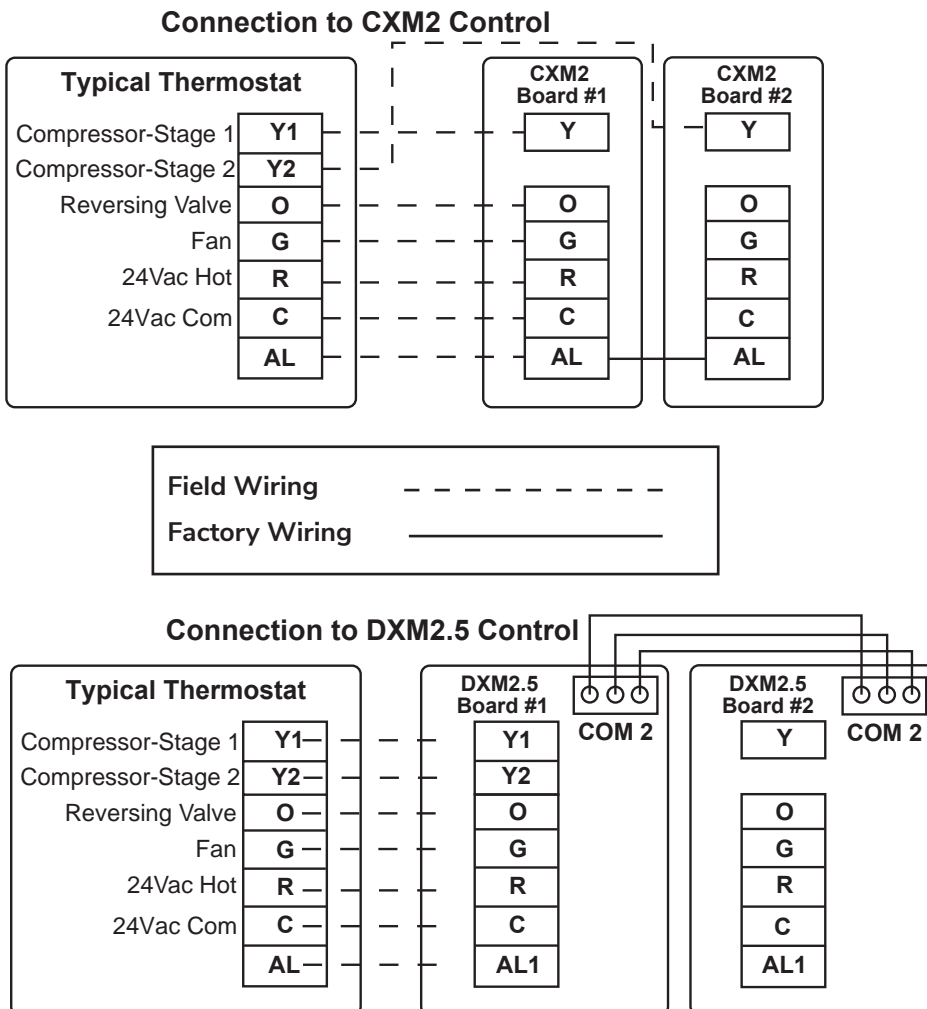
Note: This valve can overheat the anticipator of an electromechanical thermostat. Therefore, only relay or triac based thermostats should be used.

## Electrical - Thermostat Wiring

**Thermostat Installation** - The thermostat should be located on an interior wall in a larger room, away from supply duct drafts. DO NOT locate the thermostat in areas subject to sunlight, drafts or on external walls. The wire access hole behind the thermostat may in certain cases need to be sealed to prevent erroneous temperature measurement. Position the thermostat back plate against the wall so that it appears level and so the thermostat wires protrude through

the middle of the back plate. Mark the position of the back plate mounting holes and drill holes with a 3/16" (5mm) bit. Install supplied anchors and secure plate to the wall. Thermostat wire must be 18 AWG wire. Wire the appropriate thermostat as shown in Figure 20 to the low voltage terminal strip on the CXM2 or DXM2.5 control board. Practically any heat pump thermostat will work with MARS units, provided it has the correct number of heating and cooling stages.

**Figure 20: Thermostat Connection**



## Controls – CXM2 and DXM2.5



### CXM2 Controls

For detailed controller information, see the CXM2 Application, Operation, and Maintenance (AOM) manual (part # 97B0137N01). To confirm the controller type of your particular unit, refer to digit 9 on the unit model number and the unit nomenclature diagram found on page 3 of this manual.

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### DXM2.5 Controls

For detailed controller information, see the DXM2.5 Application, Operation, and Maintenance (AOM) manual (part # 97B0142N01). To confirm the controller type of your particular unit, refer to digit 9 on the unit model number and the unit nomenclature diagram found on page 3 of this manual.

## Blower Adjustment

### ▲ CAUTION! ▲

**CAUTION!** Always disconnect all power supply(s) to unit prior to making belt or sheave adjustments. Inadvertently starting of the motor can cause damage to the equipment and personal injury.

#### Airflow and External Static Pressure

**Selection Adjustment** - The HBH/V Series is available with standard, low, and high static options. These options will substitute a different blower drive sheave for each static range. In addition certain static ranges (bold print in Tables 5a through 5k) may require the optional large fan motor. Please specify static range and motor horsepower when ordering. See model nomenclature.

**Sheave Adjustment** - The HBH/V Series is supplied with variable sheave drive on the fan motor to adjust for differing airflows at various ESP conditions. Select an airflow requirement on the left side of the table, then move horizontally to right under the required ESP. Note the sheave turns open, rpm and horsepower for that condition. Fully closed the sheave will produce the highest static capability (higher rpm). To adjust sheave position: loosen belt tension and remove belt, loosen set screw on variable sheave (on fan motor) and open sheave to desired position. Retighten set screw and replace belt and set belt tension as below.

**Sheave and Pulley Alignment** - Verify belt is straight; misalignment will cause premature belt failure. Adjust sheave if needed.

**Belt Tensioning** - An overly loose belt will, upon motor start, produce a slippage 'squeel' and cause premature belt failure and or intermittent airflow. An overly tight belt can cause premature motor or blower bearing failure.

#### Belt Tensioning Procedure - HBH/V

1. Remove belt from motor sheave
2. Lift motor assembly
3. Loosen the 5/16" hex nuts on the grommet motor adjustment bolts (2 per bolt). To increase the belt tension loosen the top hex nut. To decrease the belt tension loosen the bottom hex nut.
4. Turn the bolts by hand to the desired position then tighten the 5/16" hex nuts ( 2 per bolt).
5. Lower the motor assembly
6. Install the belt
7. The belt should be tensioned tensioning gauge method such as the Browning Belt Tensioner to set proper belt tension (See next page).

#### Notes:

- **Motor position should not need adjustment.**
- **Motor sheave position is at mid position of each sheave. Thus the motor sheave is typically 2.5 turns open on a 5 turn sheave.**

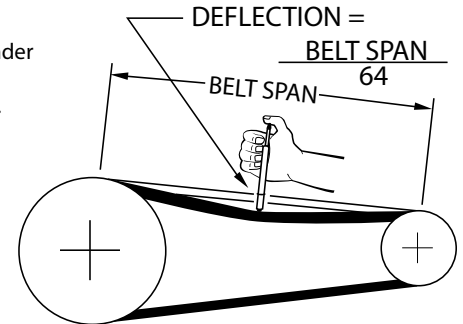
#### Special Note for AHRI Testing

The Units should be adjusted as follows for rated airflow:  
 HBH/V072 - 2400cfm/2.5 turns and 0.57 in wg ESP  
 HBH/V096 - 3200cfm/3.0 turns and 0.62 in wg ESP  
 HBH/V120 - 4000cfm/3.0 turns and 0.59 in wg ESP

## Tensioning V-Belt Drives

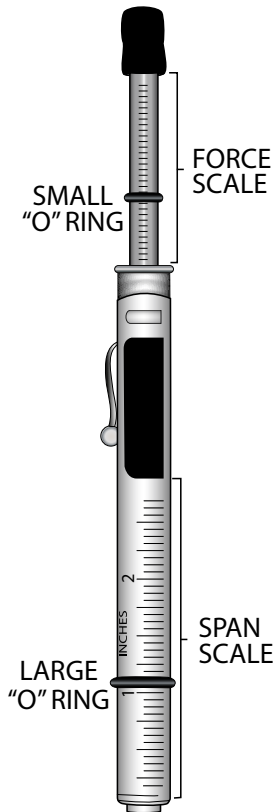
### General Rules of Tensioning

1. Ideal tension is the lowest tension at which the belt will not slip under peak load conditions.
2. Check tension frequently during the first 24-48 hours of operation.
3. Over tensioning shortens belt and bearing life.
4. Keep belts free from foreign material which may cause slip.
5. Make V-drive inspection on periodic basis. Tension when slipping. Never apply belt dressing as this will damage the belt and cause early failure.



### Tension Measurement Procedure

1. Measure the belt span (see sketch).
2. Position bottom of the large "O" ring on the span scale at the measured belt span.
3. Set the small "O" ring on the deflection force scale to zero.
4. Place the tension checker squarely on one belt at the center of the belt span. Apply a force on the plunger and perpendicular to the belt span until the bottom of the large "O" ring is even with the top of the next belt or with the bottom of a straight edge laid across the sheaves.
5. Remove the tension checker and read the force applied from the bottom of the small "O" ring on the deflection force scale.
6. Compare the force you have applied with the values given in the table below. The force should be between the minimum and maximum shown. The maximum value is shown for "New Belt" and new belts should be tensioned at this value to allow for expected tension loss. Used belts should be maintained at the minimum value as indicated in the table below.



NOTE: The ratio of deflection to belt span is 1:64.

			Belt Deflection Force			
			Super Gripbelts and Unnotched Gripbands		Gripnotch Belts and Notched Gripbands	
Cross Section	Smallest Sheave Diameter Range	RPM Range	Used Belt	New Belt	Used Belt	New Belt
A, AX	7.6 - 9.1	1000 - 2500 2501 - 4000	16.458 12.454	24.464 18.682	18.237 15.123	27.133 22.240
	9.6 - 12.2	1000 - 2500 2501 - 4000	20.016 16.902	30.246 25.354	22.240 19.126	32.915 28.467
	12.7 - 17.8	1000 - 2500 2501 - 4000	24.019 20.906	35.584 31.136	25.354 22.685	41.811 33.805
B, BX	8.6 - 10.7	860 - 2500 2501 - 4000	- -	- -	21.795 18.682	32.026 27.578
	11.2 - 14.2	860 - 2500 2501 - 4000	23.574 20.016	35.139 29.802	36.029 31.581	46.704 40.477
	14.7 - 21.8	860 - 2500 2501 - 4000	28.022 26.688	41.811 39.587	37.808 32.470	56.045 48.483

## Blower Sheave Information

**Table 4a: HBH/V Blower Sheave and Belt Information**

Model	Configuration Return/Supply	Component	Drive Package				
			A	B	C	D	E
72	Front or Back/ Top	Blower Sheave	BK67 X 1"	BK85 X 1"	BK67 X 1"	BK67 X 1"	BK67 X 1"
		Motor Sheave	1VP34 X 7/8"	1VP34 X 7/8"	1VP44 X 7/8"	1VP34 X 7/8"	1VP44 X 7/8"
		Motor	1HP	1HP	1HP	2HP	2HP
		Belt (Qty. 1)	BX46	BX48	BX48	BX46	BX47
96		Blower Sheave	BK67 X 1"	BK77 X 1"	BK62 X 1"	BK67 X 1"	BK62 X 1"
		Motor Sheave	1VP40 X 7/8"	1VP34 X 7/8"	1VP44 X 7/8"	1VP40 X 7/8"	1VP44 X 7/8"
		Motor	2HP	2HP	2HP	3HP	3HP
		Belt (Qty. 1)	BX46	BX47	BX46	BX46	BX46
120		Blower Sheave	BK67 X 1"	BK67 X 1"	BK67 X 1"	BK67 X 1"	BK67 X 1"
		Motor Sheave	1VP44 X 7/8"	1VP34 X 7/8"	1VP50 X 7/8"	1VP44 X 1-1/8"	1VP50 X 1-1/8"
		Motor	3HP	3HP	3HP	5HP	5HP
		Belt (Qty. 1)	BX46	BX46	BX46	BX46	BX47
160		Blower Sheave	BK80H	BK80H	BK80H	BK80H	BK80H
		Motor Sheave	1VP44 X 7/8"	1VP40 X 7/8"	1VP50 X 7/8"	1VP44 X 1-1/8"	1VP50 X 1-1/8"
		Motor	3HP	3HP	3HP	5HP	5HP
		Belt (Qty. 1)	BX42	B41	BX42	BX42	BX42
192	Blower Sheave	BK77H	BK95H	BK70H	BK77H	BK70H	
	Motor Sheave	1VP44 X 7/8"	1VP44 X 7/8"	1VP50 X 7/8"	1VP44 X 1-1/8"	1VP50 X 1-1/8"	
	Motor	3HP	3HP	3HP	5HP	5HP	
	Belt (Qty. 1)	B41	B45	B41	B41	B41	
240	Blower Sheave	BK90H	BK90H	BK80H	BK90H	2BK80H	
	Motor Sheave	1VP60 X 1-1/8"	1VP50 X 1-1/8"	1VP60 X 1-1/8"	1VP60 X 1-3/8"	2VP60 X 1-3/8"	
	Motor	5HP	5HP	5HP	7.5HP	7.5HP	
	Belt (Qty. 1)	B45	B44	B44	B44	BX42	
300	Blower Sheave	2BK80H	BK95H	2BK80H	N/A	2BK80H	
	Motor Sheave	2VP60 X 1-3/8"	1VP60 X 1-3/8"	2VP62 X 1-3/8"		2VP62 X 1-3/8"	
	Motor	7.5HP	7.5HP	7.5HP		10HP	
	Belt (Qty. 2)	BX55	BX57	BX55		BX55	





## HBH/V 072 Blower Performance

All Data is Wet Coil

SCFM	ESP	0.00	0.10	0.20	0.30	0.40	0.50	0.60	0.70	0.80	0.90	1.00	1.10	1.20	1.30	1.40	1.50
1800	BHP			0.28	0.32	0.35	0.39	0.42	0.45	0.48	0.52	0.56	0.60	0.64	0.69	0.72	0.76
	Sheave/Mtr			B	B	B	A	A	A	A	A	A	C	C	C	C	C
	RPM			599	645	690	735	775	815	850	885	910	940	965	995	1015	1040
	Turns Open			3	2	1	4	3.5	2.5	2	1.5	1	5	4.5	4	3.5	3
1900	BHP			0.31	0.36	0.40	0.44	0.49	0.53	2.50	0.62	0.65	0.69	0.73	0.76	0.80	0.84
	Sheave/Mtr			B	B	A	A	A	A	A	A	C	C	C	C	C	C
	RPM			604	655	695	740	780	820	855	890	920	950	980	1005	1030	1055
	Turns Open			3	2	5	4	3	2.5	2	1.5	5.5	4.5	4	3.5	3	3
2000	BHP		0.31	0.34	0.39	0.45	0.50	0.54	0.59	0.63	0.67	0.72	0.75	0.79	0.82	0.86	0.90
	Sheave/Mtr		B	B	B	A	A	A	A	A	A	C	C	C	C	C	C
	RPM		568	615	660	705	750	785	825	860	895	930	960	990	1015	1040	1065
	Turns Open		4.5	2.5	1.5	4.5	3.5	3	2.5	1.5	1	5	4.5	4	3.5	3	2.5
2100	BHP	0.33	0.38	0.42	0.46	0.50	0.54	0.59	0.65	0.70	0.74	0.78	0.81	0.85	0.89	0.94	0.98
	Sheave/Mtr	B	B	B	A	A	A	A	A	A	A	C	C	C	C	C	C
	RPM	531	583	630	670	715	755	795	835	875	905	940	970	1000	1025	1055	1080
	Turns Open	4.5	3.5	2	5	4.5	3.5	2.5	2	1.5	1	5	4	4	3	2.5	2.5
2200	BHP	0.37	0.40	0.45	0.49	0.55	0.60	0.65	0.70	0.75	0.79	0.83	0.87	0.92	0.96	1.00	1.04
	Sheave/Mtr	B	B	B	A	A	A	A	A	A	C	C	C	C	C	E	E
	RPM	552	599	645	685	730	770	810	850	885	915	950	980	1010	1040	1065	1090
	Turns Open	4	3	2	5	4	3	2.5	2	1.5	5.5	4.5	4	3.5	3	2.5	2
2300	BHP	0.42	0.47	0.51	0.56	0.60	0.65	0.70	0.75	0.80	0.84	0.89	0.94	1.00	1.05	1.10	1.16
	Sheave/Mtr	B	B	B	A	A	A	A	A	A	C	C	C	E	E	E	E
	RPM	573	620	660	705	745	785	820	860	895	925	960	990	1020	1050	1075	1105
	Turns Open	3.5	2.5	1.5	4.5	4	3	2.5	1.5	1	5	4.5	4	3.5	3	2.5	2
2400	BHP	0.48	0.52	0.57	0.61	0.66	0.72	0.78	0.83	0.87	0.92	0.97	1.02	1.07	1.13	1.19	1.25
	Sheave/Mtr	B	B	A	A	A	A	A	A	A	C	C	E	E	E	E	E
	RPM	604	645	690	730	765	805	845	880	910	945	975	1010	1035	1065	1095	1125
	Turns Open	3	2	5	4	3.5	2.5	2	1.5	1	5	4	3.5	3	2.5	2	1.5
2500	BHP	0.52	0.57	0.61	0.66	0.72	0.78	0.83	0.89	0.94	1.00	1.03	1.08	1.14	1.20	1.25	1.31
	Sheave/Mtr	B	B	A	A	A	A	A	A	C	E	E	E	E	E	E	E
	RPM	620	660	700	740	780	815	850	885	920	950	985	1015	1045	1075	1100	1130
	Turns Open	2.5	1.5	4.5	4	3	2.5	2	1.5	5.5	4.5	4	3.5	3	2.5	2	1.5
2600	BHP	0.56	0.61	0.66	0.70	0.76	0.82	0.88	0.93	0.98	1.04	1.08	1.14	1.20	1.26	1.32	1.37
	Sheave/Mtr	B	A	A	A	A	A	A	A	C	E	E	E	E	E	E	E
	RPM	635	675	715	750	790	825	860	895	925	960	990	1020	1050	1080	1110	1135
	Turns Open	2.5	5	4.5	3.5	3	2	1.5	1	5	4.5	4	3.5	3	2.5	1.5	1.5
2700	BHP	0.61	0.66	0.71	0.76	0.82	0.87	0.93	0.98	1.04	1.10	1.15	1.21	1.27	1.33	1.39	1.45
	Sheave/Mtr	B	A	A	A	A	A	A	A	E	E	E	E	E	E	E	E
	RPM	655	695	730	770	805	840	875	905	940	970	1000	1030	1060	1090	1120	1145
	Turns Open	2	4.5	4	3.5	2.5	2	1.5	1	5	4.5	3.5	3	2.5	2	1.5	1
2800	BHP	0.66	0.72	0.77	0.83	0.88	0.93	0.99	1.05	1.11	1.16	1.22	1.30	1.37	1.44	1.51	1.57
	Sheave/Mtr	B	A	A	A	A	A	A	D	E	E	E	E	E	E	E	E
	RPM	670	710	750	785	815	850	885	915	950	980	1010	1040	1070	1100	1130	1155
	Turns Open	1.5	4.5	3.5	3	2.5	1.5	1.5	1	4.5	4	3.5	3	2.5	2	1.5	1
2900	BHP	0.71	0.77	0.82	0.87	0.93	0.98	1.04	1.10	1.16	1.22	1.30	1.36	1.43	1.50	1.57	1.63
	Sheave/Mtr	A	A	A	A	A	A	D	E	E	E	E	E	E	E	E	E
	RPM	685	725	765	795	830	860	895	925	955	985	1020	1045	1075	1105	1135	1160
	Turns Open	5	4	3.5	3	2	1.5	1	5	4.5	4	3.5	3	2.5	1.5	1	1
3000	BHP	0.79	0.84	0.90	0.95	1.01	1.07	1.13	1.19	1.25	1.31	1.38	1.46	1.52	1.59	1.66	
	Sheave/Mtr	A	A	A	A	A	D	D	E	E	E	E	E	E	E	E	
	RPM	710	745	780	815	850	885	915	945	975	1005	1035	1065	1090	1120	1150	
	Turns Open	4.5	4	3	2.5	2	1	1	5	4	3.5	3	2.5	2	1.5	1	

A = Standard Static/Standard Motor, B = Low Static/Standard Motor, C = High Static/Standard Motor, D = Standard Static/Large Motor, E = High Static/Large Motor  
 Unit factory shipped with standard static sheave and drive at 2.5 turns open. Other speed require field selection.  
 For applications requiring higher static pressures, contact your local representative. Performance data does not include drive losses and is based on sea level conditions.  
 Do not operate in black regions. All airflow is rated at lowest Voltage if unit is dual Voltage rated, i.e. 208V for 208-230V units.



## HBH/V 096 Blower Performance

All Data is Wet Coil

SCFM	ESP	0.00	0.10	0.20	0.30	0.40	0.50	0.60	0.70	0.80	0.90	1.00	1.10	1.20	1.30	1.40	1.50
2400	BHP	0.45	0.50	0.54	0.59	0.63	0.69	0.74	0.80	0.85	0.90	0.94	0.99	1.04	1.10	1.16	1.22
	Sheave/Mtr	B	B	B	B	B	A	A	A	A	A	A	A	A	A	C	C
	RPM	578	625	665	705	745	785	820	860	895	925	960	990	1020	1050	1080	1110
	Turns Open	5	4	3	2.5	1.5	5.5	5	4	3.5	3	2.5	2	1.5	1	4	3.5
2500	BHP	0.50	0.55	0.59	0.64	0.69	0.75	0.81	0.88	0.92	0.97	1.01	1.06	1.12	1.17	1.23	1.29
	Sheave/Mtr	B	B	B	B	A	A	A	A	A	A	A	A	A	C	C	C
	RPM	599	645	685	725	765	800	835	875	905	940	970	1005	1035	1060	1090	1120
	Turns Open	4.5	3.5	2.5	2	6	5	4.5	4	3.5	3	2.5	2	1	4.5	3.5	3
2600	BHP	0.55	0.60	0.65	0.69	0.75	0.80	0.86	0.92	0.97	1.02	1.08	1.13	1.19	1.25	1.30	1.36
	Sheave/Mtr	B	B	B	B	A	A	A	A	A	A	A	A	A	C	C	C
	RPM	625	665	705	740	780	815	850	885	920	950	985	1015	1045	1075	1100	1130
	Turns Open	4	3	2.5	1.5	5.5	5	4.5	3.5	3	2.5	2	1.5	1	4	3.5	3
2700	BHP	0.60	0.65	0.70	0.75	0.80	0.86	0.91	0.97	1.02	1.08	1.14	1.20	1.26	1.32	1.38	1.44
	Sheave/Mtr	B	B	B	A	A	A	A	A	A	A	A	A	C	C	C	C
	RPM	645	685	725	760	795	830	865	900	930	960	995	1025	1055	1085	1115	1140
	Turns Open	3.5	2.5	2	6	5.5	4.5	4	3.5	3	2.5	2	1.5	4.5	4	3.5	3
2800	BHP	0.65	0.71	0.76	0.82	0.87	0.93	0.98	1.04	1.10	1.16	1.21	1.28	1.36	1.43	1.50	1.56
	Sheave/Mtr	B	B	B	A	A	A	A	A	A	A	A	A	C	C	C	C
	RPM	665	705	745	780	810	845	880	910	945	975	1005	1035	1065	1095	1125	1150
	Turns Open	3	2.5	1.5	5.5	5	4.5	4	3	2.5	2	1.5	1	4	3.5	3	2.5
2900	BHP	0.71	0.76	0.82	0.87	0.92	0.98	1.03	1.09	1.16	1.22	1.29	1.36	1.43	1.50	1.57	1.63
	Sheave/Mtr	B	B	A	A	A	A	A	A	A	A	A	A	C	C	C	C
	RPM	685	720	760	795	825	860	890	920	955	985	1015	1045	1075	1105	1135	1160
	Turns Open	2.5	2	6	5.5	5	4	3.5	3	2.5	2	1.5	1	4	3.5	3	2.5
3000	BHP	0.78	0.84	0.89	0.95	1.00	1.06	1.12	1.18	1.24	1.30	1.37	1.43	1.50	1.58	1.64	1.71
	Sheave/Mtr	B	B	A	A	A	A	A	A	A	A	A	C	C	C	C	C
	RPM	700	740	775	810	845	880	910	940	970	1000	1030	1055	1085	1115	1140	1170
	Turns Open	2.5	1.5	5.5	5	4.5	4	3.5	2.5	2	1.5	1	4.5	3.5	3.5	3	2.5
3100	BHP	0.85	0.91	0.96	1.02	1.08	1.14	1.22	1.29	1.36	1.44	1.50	1.57	1.63	1.70	1.76	1.82
	Sheave/Mtr	B	B	A	A	A	A	A	A	A	A	A	C	C	C	C	C
	RPM	720	755	790	825	860	890	925	955	985	1015	1040	1070	1095	1125	1150	1175
	Turns Open	2	1	5.5	4.5	4	3.5	3	2.5	2	1.5	1	4	3.5	3	2.5	2
3200	BHP	0.93	1.00	1.07	1.14	1.20	1.26	1.32	1.38	1.44	1.51	1.57	1.64	1.70	1.78	1.85	1.92
	Sheave/Mtr	B	A	A	A	A	A	A	A	A	A	C	C	C	C	C	C
	RPM	740	775	810	845	875	905	935	965	995	1025	1050	1080	1105	1135	1160	1185
	Turns Open	1.5	5.5	5	4.5	4	3.5	3	2	1.5	1	4.5	4	3.5	3	2.5	2

A = Standard Static/Standard Motor, B = Low Static/Standard Motor, C = High Static/Standard Motor, D = Standard Static/Large Motor, E = High Static/Large Motor  
Unit factory shipped with standard static sheave and drive at 2.5 turns open. Other speed require field selection.

For applications requiring higher static pressures, contact your local representative. Performance data does not include drive losses and is based on sea level conditions.  
Do not operate in black regions. All airflow in rated at lowest Voltage if unit is dual Voltage rated, i.e. 208V for 208-230V units.

**Table Continued on Next Page**



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All Data is Wet Coil

SCFM	ESP	0.00	0.10	0.20	0.30	0.40	0.50	0.60	0.70	0.80	0.90	1.00	1.10	1.20	1.30	1.40	1.50
3300	BHP	1.01	1.08	1.14	1.21	1.28	1.33	1.39	1.45	1.51	1.58	1.64	1.72	1.78	1.84	1.93	2.00
	Sheave/Mtr	B	A	A	A	A	A	A	A	A	A	C	C	C	C	C	E
	RPM	755	790	820	855	890	915	945	975	1005	1035	1060	1090	1115	1140	1170	1195
	Turns Open	1	5.5	5	4	3.5	3	2.5	2	1.5	1	4	3.5	3	3	2.5	2
3400	BHP	1.08	1.15	1.22	1.29	1.35	1.41	1.47	1.53	1.59	1.68	1.75	1.83	1.90	1.96	2.02	2.08
	Sheave/Mtr	A	A	A	A	A	A	A	A	A	A	C	C	C	C	E	E
	RPM	765	800	835	870	900	930	960	990	1015	1045	1070	1100	1125	1150	1175	1200
	Turns Open	6	5	4.5	4	3.5	3	2.5	2	1.5	1	4	3.5	3	2.5	2	2
3500	BHP	1.16	1.23	1.29	1.36	1.42	1.48	1.54	1.60	1.66	1.73	1.79	1.85	1.92	2.01	2.09	2.17
	Sheave/Mtr	A	A	A	A	A	A	A	A	A	C	C	C	C	E	E	E
	RPM	780	815	845	880	910	940	970	1000	1025	1055	1080	1105	1130	1160	1185	1210
	Turns Open	5.5	5	4.5	3.5	3	2.5	2	1.5	1	4.5	4	3.5	3	2.5	2	1.5
3600	BHP	1.24	1.30	1.37	1.44	1.51	1.58	1.65	1.72	1.78	1.86	1.92	1.98	2.06	2.13	2.21	2.29
	Sheave/Mtr	A	A	A	A	A	A	A	A	A	C	C	C	E	E	E	E
	RPM	795	825	860	890	920	950	980	1010	1035	1065	1090	1115	1145	1165	1190	1215
	Turns Open	5.5	4.5	4	3.5	3	2.5	2	1.5	1	4	3.5	3	2.5	2.5	2	1.5
3700	BHP	1.34	1.40	1.46	1.53	1.61	1.68	1.75	1.82	1.90	1.97	2.06	2.13	2.21	2.28	2.36	2.44
	Sheave/Mtr	A	A	A	A	A	A	A	A	C	C	E	E	E	E	E	E
	RPM	820	850	880	910	940	970	1000	1025	1055	1080	1110	1135	1160	1180	1205	1230
	Turns Open	5	4.5	3.5	3	2.5	2	1.5	1	4.5	4	3.5	3	2.5	2	1.5	1.5
3800	BHP	1.43	1.49	1.56	1.63	1.70	1.78	1.86	1.94	2.02	2.12	2.20	2.28	2.34	2.42	2.50	2.58
	Sheave/Mtr	A	A	A	A	A	A	A	A	E	E	E	E	E	E	E	E
	RPM	840	870	900	930	960	990	1020	1045	1070	1100	1125	1150	1170	1195	1220	1245
	Turns Open	4.5	4	3.5	3	2.5	2	1.5	1	4	3.5	3	2.5	2.5	2	1.5	1
3900	BHP	1.58	1.64	1.71	1.78	1.85	1.93	2.01	2.09	2.19	2.27	2.35	2.41	2.49	2.57	2.65	
	Sheave/Mtr	A	A	A	A	A	A	D	D	E	E	E	E	E	E	E	
	RPM	865	890	920	950	980	1010	1035	1060	1090	1115	1140	1160	1185	1210	1235	
	Turns Open	4	4	3	2.5	2	1.5	1	1	4	3.5	3	2.5	2	1.5	1.5	
4000	BHP	1.68	1.75	1.83	1.92	2.00	2.08	2.16	2.26	2.34	2.42	2.50	2.56	2.64	2.72	2.80	
	Sheave/Mtr	A	A	A	A	D	D	D	E	E	E	E	E	E	E	E	
	RPM	885	910	940	970	1000	1025	1050	1080	1105	1130	1155	1175	1200	1225	1250	
	Turns Open	4	3.5	2.5	2.5	2	1	1	4	3.5	3	2.5	2	2	1.5	1	

A = Standard Static/Standard Motor, B = Low Static/Standard Motor, C = High Static/Standard Motor, D = Standard Static/Large Motor, E = High Static/Large Motor  
 Unit factory shipped with standard static sheave and drive at 2.5 turns open. Other speed require field selection.  
 For applications requiring higher static pressures, contact your local representative. Performance data does not include drive losses and is based on sea level conditions.  
 Do not operate in black regions. All airflow in rated at lowest Voltage if unit is dual Voltage rated, i.e. 208V for 208-230V units.



## HBH/V 120 Blower Performance

All Data is Wet Coil

SCFM	ESP	0.00	0.10	0.20	0.30	0.40	0.50	0.60	0.70	0.80	0.90	1.00	1.10	1.20	1.30	1.40	1.50
3000	BHP	0.75	0.81	0.86	0.91	0.97	1.03	1.09	1.15	1.21	1.27	1.34	1.41	1.47	1.54	1.61	1.67
	Sheave/Mtr	B	B	B	B	B	B	A	A	A	A	A	A	A	A	A	A
	RPM	680	720	755	790	825	860	895	925	955	985	1015	1045	1070	1100	1130	1155
	Turns Open	5	4	3.5	3	2.5	1.5	5.5	5	4.5	4	3.5	3	2.5	2	1.5	1
3100	BHP	0.82	0.88	0.94	0.99	1.04	1.10	1.17	1.26	1.33	1.40	1.46	1.53	1.59	1.66	1.72	1.80
	Sheave/Mtr	B	B	B	B	B	A	A	A	A	A	A	A	A	A	A	C
	RPM	700	735	775	805	840	875	905	940	970	1000	1025	1055	1080	1110	1135	1165
	Turns Open	4.5	4	3	2.5	2	6	5.5	4.5	4.5	3.5	3	3	2.5	2	1.5	4
3200	BHP	0.90	0.96	1.03	1.10	1.17	1.23	1.29	1.35	1.41	1.47	1.55	1.61	1.68	1.74	1.81	1.89
	Sheave/Mtr	B	B	B	B	B	A	A	A	A	A	A	A	A	A	A	C
	RPM	720	755	790	825	860	890	920	950	980	1010	1040	1065	1095	1120	1145	1175
	Turns Open	4	3.5	3	2	1.5	5.5	5	4.5	4	3.5	3	2.5	2	1.5	1	3.5
3300	BHP	0.98	1.04	1.11	1.18	1.25	1.31	1.37	1.43	1.49	1.55	1.62	1.68	1.75	1.81	1.88	1.95
	Sheave/Mtr	B	B	B	B	A	A	A	A	A	A	A	A	A	A	A	C
	RPM	740	770	805	840	875	905	935	965	995	1020	1050	1075	1105	1130	1155	1180
	Turns Open	4	3	2.5	2	6	5.5	5	4	4	3	2.5	2.5	2	1.5	1	3.5
3400	BHP	1.06	1.13	1.19	1.26	1.33	1.38	1.44	1.50	1.56	1.65	1.72	1.80	1.87	1.94	2.00	2.06
	Sheave/Mtr	B	B	B	B	A	A	A	A	A	A	A	A	A	A	C	C
	RPM	755	790	820	855	890	915	945	975	1005	1035	1060	1090	1115	1140	1165	1190
	Turns Open	3.5	3	2.5	1.5	6	5	4.5	4	3.5	3	2.5	2	1.5	1	4	3
3500	BHP	1.14	1.21	1.27	1.34	1.40	1.46	1.52	1.58	1.65	1.71	1.77	1.84	1.90	1.98	2.06	2.14
	Sheave/Mtr	B	B	B	A	A	A	A	A	A	A	A	A	A	A	C	C
	RPM	770	805	835	870	900	930	960	990	1020	1045	1070	1100	1125	1150	1175	1200
	Turns Open	3	2.5	2	6	5.5	5	4.5	3.5	3.5	3	2.5	2	1.5	1	3.5	3
3600	BHP	1.23	1.29	1.36	1.42	1.50	1.57	1.64	1.71	1.77	1.84	1.90	1.96	2.05	2.13	2.21	2.27
	Sheave/Mtr	B	B	B	A	A	A	A	A	A	A	A	A	A	C	C	C
	RPM	790	820	855	885	915	945	975	1005	1030	1060	1085	1110	1140	1165	1190	1210
	Turns Open	3	2.5	1.5	6	5.5	4.5	4	3.5	3	2.5	2	1.5	1.5	4	3.5	3
3700	BHP	1.32	1.38	1.44	1.51	1.58	1.65	1.73	1.81	1.88	1.96	2.03	2.10	2.18	2.26	2.34	2.42
	Sheave/Mtr	B	B	A	A	A	A	A	A	A	A	A	A	A	C	C	C
	RPM	810	840	870	900	930	960	990	1020	1045	1075	1100	1125	1150	1175	1200	1225
	Turns Open	2.5	2	6	5.5	5	4.5	4	3	3	2.5	2	1.5	1	3.5	3	2.5
3800	BHP	1.41	1.47	1.54	1.61	1.68	1.75	1.82	1.91	1.99	2.07	2.17	2.25	2.31	2.39	2.47	2.55
	Sheave/Mtr	B	B	A	A	A	A	A	A	A	A	A	A	A	C	C	C
	RPM	830	860	890	920	950	980	1005	1035	1060	1085	1115	1140	1160	1185	1210	1235
	Turns Open	2	1.5	5.5	5	4.5	4	3.5	3	2.5	2	1.5	1	1	3.5	3	2.5
3900	BHP	1.54	1.60	1.67	1.74	1.82	1.89	1.96	2.04	2.14	2.22	2.30	2.38	2.46	2.52	2.60	2.68
	Sheave/Mtr	B	A	A	A	A	A	A	A	A	A	A	A	C	C	C	C
	RPM	850	875	905	935	965	995	1020	1045	1075	1100	1125	1150	1175	1195	1220	1245
	Turns Open	2	6	5.5	5	4.5	3.5	3	2.5	2.5	2	1.5	1	3.5	3	2.5	2
4000	BHP	1.63	1.71	1.78	1.86	1.94	2.03	2.11	2.19	2.27	2.37	2.45	2.51	2.59	2.67	2.75	2.85
	Sheave/Mtr	A	A	A	A	A	A	A	A	A	A	A	A	C	C	C	C
	RPM	865	895	920	950	980	1010	1035	1060	1085	1115	1140	1160	1185	1210	1235	1260
	Turns Open	6	5.5	5	4.5	4	3.5	3	2.5	2	1.5	1	1	3.5	3	2.5	2

A = Standard Static/Standard Motor, B = Low Static/Standard Motor, C = High Static/Standard Motor, D = Standard Static/Large Motor, E = High Static/Large Motor  
 Unit factory shipped with standard static sheave and drive at 2.5 turns open. Other speed require field selection.  
 For applications requiring higher static pressures, contact your local representative. Performance data does not include drive losses and is based on sea level conditions.  
 Do not operate in black regions. All airflow in rated at lowest Voltage if unit is dual Voltage rated, i.e. 208V for 208-230V units.

**Table Continued on Next Page**



**Table Continued from Previous Page**

All Data is Wet Coil

SCFM	ESP	0.00	0.10	0.20	0.30	0.40	0.50	0.60	0.70	0.80	0.90	1.00	1.10	1.20	1.30	1.40	1.50
4100	BHP	1.73	1.81	1.90	1.97	2.05	2.12	2.20	2.27	2.34	2.42	2.52	2.62	2.70	2.80	2.90	
	Sheave/Mtr	A	A	A	A	A	A	A	A	A	A	A	C	C	C	C	
	RPM	885	915	945	970	1000	1025	1055	1080	1105	1130	1155	1180	1200	1225	1250	
	Turns Open	6	5.5	4.5	4	4	3	2.5	2	2	1.5	1	3.5	3	2.5	2	
4200	BHP	1.87	1.94	2.02	2.08	2.16	2.24	2.32	2.40	2.48	2.58	2.68	2.76	2.86	2.96		
	Sheave/Mtr	A	A	A	A	A	A	A	A	A	A	C	C	C	C		
	RPM	905	935	965	990	1020	1045	1070	1095	1120	1145	1170	1190	1215	1240		
	Turns Open	5.5	5	4.5	4	3.5	3	2.5	2	1.5	1	3.5	3.5	3	2.5		
4300	BHP	2.00	2.07	2.16	2.23	2.31	2.41	2.49	2.57	2.66	2.74	2.84	2.94	3.02	3.15		
	Sheave/Mtr	A	A	A	A	A	A	A	A	A	C	C	C	E	E		
	RPM	930	955	985	1010	1035	1065	1090	1115	1140	1160	1185	1210	1230	1255		
	Turns Open	5	4.5	4	3.5	3	2.5	2	1.5	1.5	4	3.5	3	2.5	2		
4400	BHP	2.14	2.22	2.32	2.40	2.48	2.56	2.65	2.74	2.82	2.92	3.00	3.10	3.18			
	Sheave/Mtr	A	A	A	A	A	A	A	A	A	C	E	E	E			
	RPM	950	975	1005	1030	1055	1080	1110	1135	1155	1180	1200	1225	1245			
	Turns Open	4.5	4	3.5	3	3	2.5	2	1.5	1	4	3	3	2.5			
4500	BHP	2.30	2.38	2.46	2.54	2.62	2.72	2.80	2.88	3.00	3.08	3.16	3.26				
	Sheave/Mtr	A	A	A	A	A	A	A	A	D	E	E	E				
	RPM	970	995	1020	1045	1070	1100	1125	1145	1170	1195	1215	1240				
	Turns Open	4.5	4	3.5	3	2.5	2	1.5	1.5	1	3.5	3	2.5				
4600	BHP	2.39	2.45	2.54	2.63	2.72	2.83	2.92	3.00	3.10	3.18	3.28	3.38				
	Sheave/Mtr	A	A	A	A	A	A	A	D	D	E	E	E				
	RPM	980	1000	1025	1050	1075	1105	1130	1150	1175	1195	1220	1245				
	Turns Open	4	3.5	3.5	3	2.5	2	1.5	1	1	3.5	3	2.5				
4700	BHP	2.46	2.52	2.62	2.72	2.82	2.92	3.02	3.12	3.22	3.32	3.40	3.50				
	Sheave/Mtr	A	A	A	A	A	A	D	D	E	E	E	E				
	RPM	985	1005	1030	1055	1080	1105	1130	1155	1180	1205	1225	1250				
	Turns Open	4	3.5	3	2.5	2	1.5	1.5	1	4	3.5	2.5	2.5				
4800	BHP	2.57	2.64	2.74	2.84	2.94	3.04	3.14	3.24	3.32	3.42	3.52	3.60				
	Sheave/Mtr	A	A	A	A	A	D	D	D	E	E	E	E				
	RPM	990	1010	1035	1060	1085	1110	1135	1160	1180	1205	1230	1250				
	Turns Open	4	3.5	3	2.5	2	1.5	1	1	3.5	3	2.5	2				
4900	BHP	2.68	2.78	2.88	3.00	3.06	3.16	3.26	3.36	3.44	3.54	3.64	3.75				
	Sheave/Mtr	A	A	A	D	D	D	D	E	E	E	E	E				
	RPM	995	1020	1045	1070	1090	1115	1140	1165	1185	1210	1235	1255				
	Turns Open	3.5	3	3	2.5	1.5	1.5	1	4	3.5	3	2.5	2				
5000	BHP	2.82	2.92	3.00	3.10	3.20	3.28	3.38	3.48	3.56	3.66	3.74					
	Sheave/Mtr	A	A	D	D	D	D	D	E	E	E	E					
	RPM	1005	1030	1050	1075	1100	1120	1145	1170	1190	1215	1235					
	Turns Open	3.5	3	2.5	2	1.5	1	1	3.5	3	2.5	2					

A = Standard Static/Standard Motor, B = Low Static/Standard Motor, C = High Static/Standard Motor, D = Standard Static/Large Motor, E = High Static/Large Motor  
 Unit factory shipped with standard static sheave and drive at 2.5 turns open. Other speed require field selection.  
 For applications requiring higher static pressures, contact your local representative. Performance data does not include drive losses and is based on sea level conditions.  
 Do not operate in black regions. All airflow is rated at lowest Voltage if unit is dual Voltage rated, i.e. 208V for 208-230V units.



### Blower Performance Data – HBV160 Standard Unit

All Data is Wet Coil

SCFM	ESP	0.00	0.10	0.20	0.30	0.40	0.50	0.60	0.70	0.80	0.90	1.00	1.10	1.20	1.30	1.40	1.50		
4200	BHP			0.69	0.78	0.86	0.95	1.02	1.11	1.21	1.32	1.41	1.50	1.57	1.64	1.72	1.80		
	Sheave/Mtr			B	B	B	B	A	A	A	A	A	A	A	C	C	C		
	RPM			547	594	640	685	725	765	805	845	880	915	945	975	1005	1030		
	Turns Open			5.5	4	3	1.5	6	5	4	3.5	2.5	2	1	3.5	3	2.5		
4400	BHP			0.75	0.83	0.92	1.01	1.11	1.21	1.31	1.41	1.51	1.60	1.68	1.76	1.85	1.94		
	Sheave/Mtr			B	B	B	B	A	A	A	A	A	A	A	C	C	C		
	RPM			563	609	655	695	735	775	815	855	890	925	955	985	1015	1045		
	Turns Open			5	3.5	2.5	1.5	5.5	5	4	3	2.5	1.5	1	3.5	2.5	2		
4600	BHP		0.75	0.85	0.95	1.03	1.11	1.19	1.30	1.40	1.50	1.60	1.70	1.78	1.89	2.00	2.10		
	Sheave/Mtr			B	B	B	B	A	A	A	A	A	A	C	C	C	C		
	RPM			526	573	625	665	705	745	785	825	860	895	930	960	995	1025	1050	
	Turns Open			6	4.5	3	2.5	1	5.5	4.5	3.5	3	2.5	1.5	4	3	2.5	2	
4800	BHP		0.83	0.94	1.03	1.12	1.20	1.30	1.40	1.53	1.63	1.73	1.82	1.92	2.00	2.12	2.22		
	Sheave/Mtr			B	B	B	B	A	A	A	A	A	A	C	C	C	C		
	RPM			542	594	640	680	720	760	795	835	870	905	935	970	1000	1030	1055	
	Turns Open			5.5	4	3	2	6	5	4.5	3.5	3	2	1	3.5	3	2	1.5	
5000	BHP		0.93	1.02	1.11	1.20	1.31	1.41	1.52	1.64	1.76	1.85	1.95	2.03	2.12	2.24	2.36		
	Sheave/Mtr			B	B	B	B	A	A	A	A	A	A	C	C	C	C		
	RPM			563	609	650	690	735	770	805	840	880	910	945	975	1005	1035	1065	
	Turns Open			5	3.5	2.5	1.5	5.5	5	4	3.5	2.5	2	1	3.5	3	2	1.5	
5200	BHP	0.93	1.02	1.10	1.20	1.29	1.39	1.50	1.61	1.72	1.83	1.94	2.06	2.15	2.26	2.38	2.50		
	Sheave/Mtr			B	B	B	B	A	A	A	A	A	A	A	C	C	C		
	RPM			542	583	625	665	705	745	780	815	850	885	920	955	985	1015	1045	1075
	Turns Open			5.5	4.5	3	2	1	5.5	4.5	4	3	2.5	1.5	1	3	2.5	2	1.5
5400	BHP	1.03	1.10	1.19	1.29	1.39	1.50	1.59	1.70	1.80	1.92	2.03	2.16	2.26	2.38	2.50	2.62		
	Sheave/Mtr			B	B	B	B	A	A	A	A	A	C	C	C	C	C		
	RPM			563	599	640	680	720	760	790	825	860	895	925	960	990	1020	1050	1080
	Turns Open			5	4	3	2	1	5	4.5	3.5	3	2.5	1.5	4	3	2.5	1.5	1
5600	BHP	1.12	1.19	1.28	1.39	1.50	1.61	1.72	1.84	1.93	2.06	2.17	2.29	2.40	2.54	2.69	2.83		
	Sheave/Mtr			B	B	B	B	A	A	A	A	A	A	C	C	C	C		
	RPM			583	620	655	695	735	770	805	840	870	905	935	970	1000	1030	1060	1090
	Turns Open			4.5	3.5	2.5	1.5	5.5	5	4	3.5	2.5	2	1.5	3.5	3	2	1.5	1
5800	BHP	1.17	1.28	1.39	1.49	1.60	1.70	1.81	1.90	2.02	2.14	2.28	2.40	2.52	2.67	2.81	2.96		
	Sheave/Mtr			B	B	B	B	A	A	A	A	A	A	C	C	C	C		
	RPM			588	630	670	710	750	780	815	845	880	910	945	975	1005	1035	1065	1095
	Turns Open			4	3	2	1	5.5	4.5	4	3	2.5	2	1	3.5	2.5	2	1.5	1
6000	BHP	1.25	1.40	1.51	1.61	1.73	1.84	1.94	2.05	2.18	2.30	2.42	2.54	2.67	2.79	2.94	3.08		
	Sheave/Mtr			B	B	B	A	A	A	A	A	A	C	C	C	C	E		
	RPM			604	645	685	720	760	795	825	860	895	925	955	985	1015	1040	1070	1100
	Turns Open			4	2.5	1.5	6	5	4.5	3.5	3	2	1.5	1	3	2.5	2	1.5	1
6200	BHP	1.40	1.51	1.62	1.75	1.86	1.98	2.09	2.20	2.34	2.49	2.63	2.78	2.92	3.06	3.18			
	Sheave/Mtr			B	B	B	A	A	A	A	A	A	C	C	C	E	E		
	RPM			625	660	695	735	770	805	840	875	905	935	965	995	1025	1055	1080	
	Turns Open			3.5	2.5	1.5	5.5	5	4	3.5	2.5	2	1.5	4	3	2	1.5	1	
6400	BHP	1.55	1.68	1.79	1.90	2.04	2.18	2.32	2.44	2.56	2.68	2.80	2.92	3.07	3.19	3.33			
	Sheave/Mtr			B	B	B	A	A	A	A	A	A	C	C	E	E	E		
	RPM			640	680	715	750	785	820	855	885	915	945	975	1005	1035	1060	1090	
	Turns Open			3	2	1	5	4.5	3.5	3	2.5	1.5	1	3.5	2.5	2	1.5	1	
6600	BHP	1.73	1.84	1.94	2.06	2.20	2.34	2.46	2.58	2.70	2.82	2.94	3.07	3.19	3.34	3.46			
	Sheave/Mtr			B	B	A	A	A	A	A	A	A	C	E	E	E	E		
	RPM			665	700	730	765	800	835	865	895	925	955	985	1015	1040	1070	1095	
	Turns Open			2.5	1.5	5.5	5	4	3.5	3	2	1.5	1	3	2.5	2	1.5	1	
6800	BHP	1.87	1.98	2.08	2.20	2.34	2.48	2.62	2.74	2.86	2.96	3.08	3.24	3.38	3.55				
	Sheave/Mtr			B	B	A	A	A	A	A	A	C	E	E	E	E			
	RPM			685	715	745	775	810	845	880	910	940	965	995	1025	1050	1080		
	Turns Open			2	1	5.5	4.5	4	3	2.5	2	1	4	3	2.5	2	1		
7000	BHP	2.03	2.13	2.22	2.36	2.50	2.62	2.76	2.88	3.00	3.12	3.22	3.37	3.49	3.61				
	Sheave/Mtr			B	A	A	A	A	A	D	E	E	E	E	E				
	RPM			705	730	755	790	825	855	890	920	950	980	1005	1035	1060	1085		
	Turns Open			1.5	6	5	4.5	3.5	3	2.5	1.5	1	3.5	3	2	1.5	1		

A = Standard Static/Standard Motor, B = Low Static/Standard Motor, C = High Static/Standard Motor, D = Standard Static/Large Motor, E = High Static/Large Motor  
 Unit factory shipped with standard static sheave and drive at 2.5 turns open. Other speed require field selection.  
 For applications requiring higher static pressures, contact your local representative. Performance data does not include drive losses and is based on sea level conditions.  
 Do not operate in black regions. All airflow is rated at lowest Voltage if unit is dual Voltage rated, i.e. 208V for 208-230V units.



### Blower Performance Data – HBV192 Standard Unit

All Data is Wet Coil

SCFM	ESP	0.00	0.10	0.20	0.30	0.40	0.50	0.60	0.70	0.80	0.90	1.00	1.10	1.20	1.30	1.40	1.50	
4800	BHP		0.98	1.07	1.16	1.24	1.34	1.47	1.59	1.69	1.78	1.87	1.96	2.06	2.18	2.30	2.42	
	Sheave/Mtr		B	B	B	B	A	A	A	A	A	A	A	C	C	C	C	
	RPM		615	660	700	740	775	815	855	890	920	955	985	1015	1045	1075	1105	
	Turns Open		5.5	4.5	3	2	5.5	4	3.5	3	2.5	1.5	1	5.5	5	4.5	4	
5000	BHP	0.99	1.07	1.18	1.27	1.37	1.49	1.60	1.73	1.82	1.92	2.00	2.10	2.22	2.32	2.44	2.56	
	Sheave/Mtr		B	B	B	B	A	A	A	A	A	A	A	C	C	C	C	
	RPM		594	635	680	720	760	795	830	870	900	935	965	1000	1030	1055	1085	1115
	Turns Open		6	5	4	2.5	5.5	5	3.5	3.5	3	2	1.5	1	5	4.5	4	3.5
5200	BHP	1.09	1.18	1.28	1.36	1.48	1.59	1.70	1.82	1.93	2.02	2.14	2.24	2.36	2.48	2.60	2.72	
	Sheave/Mtr		B	B	B	B	A	A	A	A	A	A	C	C	C	C	C	
	RPM		620	660	700	735	775	810	845	880	915	945	980	1010	1040	1070	1100	1130
	Turns Open		5.5	4.5	3.5	2	5.5	4.5	3.5	3	2.5	2	1	5.5	5	4.5	4	3.5
5400	BHP	1.19	1.29	1.39	1.48	1.59	1.70	1.80	1.92	2.03	2.16	2.26	2.38	2.50	2.62	2.74	2.87	
	Sheave/Mtr		B	B	B	A	A	A	A	A	A	A	C	C	C	C	C	
	RPM		640	680	720	755	790	825	860	895	925	960	990	1020	1050	1080	1110	1140
	Turns Open		5	4	2.5	6	5	4.5	3.5	3	2.5	1.5	1	5.5	5	4	3.5	3
5600	BHP	1.30	1.40	1.51	1.62	1.74	1.85	1.95	2.08	2.18	2.31	2.42	2.57	2.71	2.86	2.98	3.12	
	Sheave/Mtr		B	B	B	A	A	A	A	A	A	C	C	C	C	C	E	
	RPM		660	700	740	775	810	845	875	910	940	975	1005	1035	1065	1095	1120	1150
	Turns Open		4.5	3.5	2	5.5	5	4	3	2.5	2	1.5	5.5	5	4.5	4	3.5	3
5800	BHP	1.41	1.52	1.63	1.73	1.84	1.95	2.06	2.18	2.32	2.44	2.57	2.72	2.86	3.00	3.15	3.27	
	Sheave/Mtr		B	B	A	A	A	A	A	A	A	C	C	C	E	E	E	
	RPM		680	720	760	790	825	860	890	920	955	985	1015	1045	1075	1105	1135	1160
	Turns Open		4	3	6	5	4.5	3.5	3	2.5	1.5	1	5.5	5	4.5	4	3	3
6000	BHP	1.56	1.67	1.78	1.89	2.00	2.12	2.24	2.36	2.48	2.60	2.74	2.89	3.01	3.15	3.30	3.42	
	Sheave/Mtr		B	B	A	A	A	A	A	A	C	C	C	E	E	E	E	
	RPM		700	740	775	810	845	880	910	940	970	1000	1030	1060	1085	1115	1145	1170
	Turns Open		3.5	2.5	5.5	5	4	3	2.5	2	1.5	6	5	4.5	4	3.5	3	2.5
6200	BHP	1.70	1.83	1.94	2.06	2.17	2.30	2.44	2.58	2.73	2.87	3.02	3.14	3.28	3.40	3.54	3.66	
	Sheave/Mtr		B	A	A	A	A	A	A	A	C	E	E	E	E	E	E	
	RPM		720	760	795	830	865	895	925	955	985	1015	1045	1070	1100	1125	1155	1180
	Turns Open		3	5.5	5	4.5	3.5	3	2.5	1.5	1	5.5	5	4.5	4	3.5	3	2.5
6400	BHP	1.88	2.02	2.16	2.28	2.42	2.54	2.66	2.78	2.90	3.04	3.16	3.31	3.43	3.58	3.72	3.86	
	Sheave/Mtr		B	A	A	A	A	A	A	C	E	E	E	E	E	E	E	
	RPM		745	780	815	845	880	910	940	970	1000	1030	1055	1085	1110	1140	1165	1190
	Turns Open		2.5	5	4.5	4	3.5	2.5	2	1.5	6	5	4.5	4	3.5	3	2.5	2
6600	BHP	2.06	2.18	2.32	2.46	2.58	2.70	2.82	2.94	3.07	3.19	3.34	3.46	3.60	3.74	3.88	4.02	
	Sheave/Mtr		A	A	A	A	A	A	A	E	E	E	E	E	E	E	E	
	RPM		765	795	830	865	895	925	955	985	1015	1040	1070	1095	1125	1150	1175	1200
	Turns Open		5.5	5	4.5	3.5	3	2.5	1.5	1	5.5	5	4.5	4	3.5	3	2.5	2
6800	BHP	2.22	2.36	2.50	2.62	2.74	2.86	3.00	3.10	3.27	3.41	3.58	3.72	3.85	3.97	4.11	4.23	
	Sheave/Mtr		A	A	A	A	A	D	D	E	E	E	E	E	E	E	E	
	RPM		780	815	850	880	910	940	970	1000	1030	1055	1085	1110	1135	1160	1190	1215
	Turns Open		5.5	4.5	4	3.5	2.5	2	1.5	1	5	4.5	4	3.5	3	2.5	2	2
7000	BHP	2.40	2.54	2.66	2.80	2.92	3.04	3.14	3.27	3.39	3.54	3.66	3.78	3.96	4.12	4.28	4.44	
	Sheave/Mtr		A	A	A	A	D	D	E	E	E	E	E	E	E	E	E	
	RPM		800	835	865	900	930	960	985	1015	1040	1070	1095	1120	1150	1175	1200	1225
	Turns Open		5	4	3.5	3	2	1.5	1	5.5	5	4.5	4	3.5	3	2.5	2	1.5
7200	BHP	2.58	2.70	2.85	2.99	3.14	3.28	3.42	3.54	3.66	3.81	3.93	4.06	4.22	4.38	4.54	4.70	
	Sheave/Mtr		A	A	A	D	D	E	E	E	E	E	E	E	E	E	E	
	RPM		820	850	885	915	945	975	1005	1030	1055	1085	1110	1135	1160	1185	1210	1235
	Turns Open		4.5	4	3	3	2	1.5	5.5	5	4.5	4	3.5	3	2.5	2.5	2	1.5
7400	BHP	2.76	2.88	3.02	3.16	3.31	3.45	3.61	3.75	3.92	4.06	4.20	4.36	4.52	4.68	4.81	4.97	
	Sheave/Mtr		A	A	D	D	D	D	E	E	E	E	E	E	E	E	E	
	RPM		840	870	900	930	960	990	1020	1045	1075	1100	1125	1150	1175	1200	1220	1245
	Turns Open		4	3.5	3	2.5	1.5	1	5.5	5	4.5	4	3.5	3	2.5	2	1.5	1.5
7600	BHP	2.94	3.07	3.22	3.36	3.50	3.63	3.82	3.98	4.14	4.34	4.50	4.66	4.78	4.94			
	Sheave/Mtr		A	D	D	D	D	E	E	E	E	E	E	E	E			
	RPM		860	890	920	950	980	1005	1035	1060	1085	1115	1140	1165	1185	1210		
	Turns Open		4	3	2.5	2	1	5.5	5	4.5	4	3.5	3	2.5	2	2		
7800	BHP	3.22	3.34	3.49	3.63	3.78	3.96	4.12	4.28	4.44	4.63	4.76	4.92					
	Sheave/Mtr		D	D	D	D	D	E	E	E	E	E	E					
	RPM		880	905	935	965	995	1025	1050	1075	1100	1130	1150	1175				
	Turns Open		3.5	3	2	1.5	1	5.5	5	4.5	4	3.5	3	2.5				
8000	BHP	3.41	3.58	3.75	3.92	4.06	4.26	4.42	4.58	4.74	4.90							
	Sheave/Mtr		D	D	D	D	E	E	E	E	E							
	RPM		895	925	955	985	1010	1040	1065	1090	1115	1140						
	Turns Open		3	2.5	1.5	1	5.5	5	4.5	4	3.5	3						

A = Standard Static/Standard Motor, B = Low Static/Standard Motor, C = High Static/Standard Motor, D = Standard Static/Large Motor, E = High Static/Large Motor  
 Unit factory shipped with standard static sheave and drive at 2.5 turns open. Other speed require field selection.  
 For applications requiring higher static pressures, contact your local representative. Performance data does not include drive losses and is based on sea level conditions.  
 Do not operate in black regions. All airflow is rated at lowest Voltage if unit is dual Voltage rated, i.e. 208V for 208-230V units.

### Blower Performance Data – HBV240 Standard Unit

All Data is Wet Coil

SCFM	ESP	0.00	0.10	0.20	0.30	0.40	0.50	0.60	0.70	0.80	0.90	1.00	1.10	1.20	1.30	1.40	1.50
6000	BHP				1.78	1.89	2.00	2.12	2.24	2.36	2.48	2.60	2.74	2.89	3.01	3.15	3.30
	Sheave/Mtr				B	B	B	A	A	A	A	A	A	A	A	C	C
	RPM				775	810	845	880	910	940	970	1000	1030	1060	1085	1115	1145
	Turns Open				5.5	4.5	4	6	5	4.5	3.5	3	2.5	1.5	1	3.5	3
6200	BHP		1.82	1.93	2.04	2.15	2.30	2.44	2.58	2.73	2.87	2.99	3.14	3.26	3.40	3.52	
	Sheave/Mtr		B	B	B	B	A	A	A	A	A	A	A	A	C	C	C
	RPM		755	790	825	860	895	925	955	985	1015	1040	1070	1095	1125	1150	
	Turns Open		6	5	4.5	3.5	5.5	5	4	3.5	2.5	2	1.5	4	3.5	3	
6400	BHP		2.00	2.14	2.26	2.40	2.52	2.64	2.76	2.88	3.02	3.14	3.28	3.40	3.56	3.70	
	Sheave/Mtr		B	B	B	B	A	A	A	A	A	A	A	A	C	C	C
	RPM		775	810	840	875	905	935	965	995	1025	1050	1080	1105	1135	1160	
	Turns Open		5.5	4.5	4	3	5.5	4.5	4	3	2.5	2	1	4	3	2.5	
6600	BHP		2.02	2.16	2.30	2.42	2.56	2.68	2.80	2.92	3.05	3.17	3.29	3.43	3.55	3.71	3.85
	Sheave/Mtr		B	B	B	B	A	A	A	A	A	A	A	A	C	C	C
	RPM		755	790	825	855	890	920	950	980	1010	1035	1060	1090	1115	1145	1170
	Turns Open		6	5.5	4.5	3.5	6	5	4	3.5	3	2	1.5	1	3.5	3	2.5
6800	BHP		2.18	2.32	2.46	2.58	2.70	2.84	2.94	3.06	3.21	3.35	3.52	3.66	3.82	3.94	4.06
	Sheave/Mtr		B	B	B	B	A	A	A	A	A	A	A	C	C	C	C
	RPM		770	805	840	870	900	935	960	990	1020	1045	1075	1100	1130	1155	1180
	Turns Open		5.5	5	4	3	5.5	4.5	4	3	2.5	2	1	4	3.5	2.5	2
7000	BHP	2.22	2.34	2.48	2.62	2.74	2.86	2.98	3.10	3.22	3.34	3.49	3.61	3.73	3.90	4.06	4.22
	Sheave/Mtr	B	B	B	B	A	A	A	A	A	A	A	A	C	C	C	C
	RPM	755	785	820	855	885	915	945	975	1005	1030	1060	1085	1110	1140	1165	1190
	Turns Open	6	5.5	4.5	3.5	6	5	4.5	3.5	3	2.5	1.5	1	3.5	3	2.5	2
7200	BHP	2.38	2.52	2.64	2.78	2.92	3.06	3.21	3.35	3.47	3.62	3.74	3.88	4.00	4.16	4.32	4.48
	Sheave/Mtr	B	B	B	B	A	A	A	A	A	A	A	C	C	C	C	C
	RPM	770	805	835	870	900	930	960	990	1015	1045	1070	1100	1125	1150	1175	1200
	Turns Open	5.5	5	4	3.5	5.5	4.5	4	3	2.5	2	1.5	4	3.5	3	2	1.5
7400	BHP	2.56	2.68	2.82	2.95	3.09	3.24	3.38	3.53	3.67	3.84	3.98	4.12	4.26	4.42	4.58	4.74
	Sheave/Mtr	B	B	B	A	A	A	A	A	A	A	A	C	C	C	C	C
	RPM	790	820	855	885	915	945	975	1005	1030	1060	1085	1110	1135	1160	1185	1210
	Turns Open	5	4.5	3.5	6	5	4.5	3.5	3	2.5	1.5	1	3.5	3	2.5	2	1.5
7600	BHP	2.74	2.86	2.98	3.12	3.26	3.41	3.55	3.70	3.89	4.05	4.21	4.40	4.53	4.69	4.85	5.01
	Sheave/Mtr	B	B	B	A	A	A	A	A	A	A	C	C	C	C	C	E
	RPM	810	840	870	900	930	960	990	1015	1045	1070	1095	1125	1145	1170	1195	1220
	Turns Open	4.5	4	3.5	5.5	4.5	4	3	2.5	2	1.5	4	3.5	3	2.5	2	1.5
7800	BHP	2.98	3.13	3.25	3.39	3.54	3.68	3.83	3.99	4.15	4.34	4.50	4.66	4.82	4.95	5.11	5.27
	Sheave/Mtr	B	B	A	A	A	A	A	A	A	C	C	C	C	C	E	E
	RPM	830	860	885	915	945	975	1005	1030	1055	1085	1110	1135	1160	1180	1205	1230
	Turns Open	4	3.5	6	5	4.5	3.5	3	2.5	1.5	0	3.5	3	2.5	2	1.5	1
8000	BHP	3.18	3.30	3.44	3.61	3.78	3.94	4.10	4.29	4.45	4.61	4.77	4.93	5.09	5.25	5.38	5.54
	Sheave/Mtr	B	B	A	A	A	A	A	A	A	C	C	C	E	E	E	E
	RPM	850	875	900	930	960	990	1015	1045	1070	1095	1120	1145	1170	1195	1215	1240
	Turns Open	4	3.5	5.5	4.5	4	3.5	2.5	2	1.5	4	3.5	3	2.5	2	1.5	1
8200	BHP	3.35	3.48	3.65	3.79	3.96	4.13	4.27	4.44	4.58	4.72	4.88	5.08	5.24	5.44	5.64	
	Sheave/Mtr	B	A	A	A	A	A	A	A	A	C	C	E	E	E	E	
	RPM	865	890	920	945	975	1005	1030	1060	1085	1110	1135	1160	1180	1205	1230	
	7000	3.5	5.5	5	4.5	3.5	3	2.5	1.5	1	3.5	3	2.5	2	1.5	1	
8400	BHP	3.62	3.74	3.89	4.03	4.18	4.33	4.49	4.65	4.81	4.97	5.16	5.36	5.56	5.72	5.92	
	Sheave/Mtr	A	A	A	A	A	A	A	A	C	C	E	E	E	E	E	
	RPM	880	905	935	965	995	1020	1045	1070	1095	1120	1145	1170	1195	1215	1240	
Turns Open	6	5.5	4.5	4	3	2.5	2	1.5	4	3.5	3	2.5	2	1.5	1		

A = Standard Static/Standard Motor, B = Low Static/Standard Motor, C = High Static/Standard Motor, D = Standard Static/Large Motor, E = High Static/Large Motor  
 Unit factory shipped with standard static sheave and drive at 2.5 turns open. Other speed require field selection.  
 For applications requiring higher static pressures, contact your local representative. Performance data does not include drive losses and is based on sea level conditions.  
 Do not operate in black regions. All airflow is rated at lowest Voltage if unit is dual Voltage rated, i.e. 208V for 208-230V units.

Table Continued on Next Page



### Blower Performance Data – HBV240 Standard Unit

Table Continued from Previous Page

All Data is Wet Coil

SCFM	ESP	0.00	0.10	0.20	0.30	0.40	0.50	0.60	0.70	0.80	0.90	1.00	1.10	1.20	1.30	1.40	1.50
6000	BHP				1.78	1.89	2.00	2.12	2.24	2.36	2.48	2.60	2.74	2.89	3.01	3.15	3.30
	Sheave/Mtr				B	B	B	A	A	A	A	A	A	A	A	C	C
	RPM				775	810	845	880	910	940	970	1000	1030	1060	1085	1115	1145
	Turns Open				5.5	4.5	4	6	5	4.5	3.5	3	2.5	1.5	1	3.5	3
6200	BHP		1.82	1.93	2.04	2.15	2.30	2.44	2.58	2.73	2.87	2.99	3.14	3.26	3.40	3.52	
	Sheave/Mtr		B	B	B	A	A	A	A	A	A	A	A	C	C	C	
	RPM		755	790	825	860	895	925	955	985	1015	1040	1070	1095	1125	1150	
	Turns Open		6	5	4.5	3.5	5.5	5	4	3.5	2.5	2	1.5	4	3.5	3	
6400	BHP		2.00	2.14	2.26	2.40	2.52	2.64	2.76	2.88	3.02	3.14	3.28	3.40	3.56	3.70	
	Sheave/Mtr		B	B	B	A	A	A	A	A	A	A	C	C	C		
	RPM		775	810	840	875	905	935	965	995	1025	1050	1080	1105	1135	1160	
	Turns Open		5.5	4.5	4	3	5.5	4.5	4	3	2.5	2	1	4	3	2.5	
6600	BHP		2.02	2.16	2.30	2.42	2.56	2.68	2.80	2.92	3.05	3.17	3.29	3.43	3.55	3.71	3.85
	Sheave/Mtr		B	B	B	B	A	A	A	A	A	A	A	C	C	C	
	RPM		755	790	825	855	890	920	950	980	1010	1035	1060	1090	1115	1145	1170
	Turns Open		6	5.5	4.5	3.5	6	5	4	3.5	3	2	1.5	1	3.5	3	2.5
6800	BHP		2.18	2.32	2.46	2.58	2.70	2.84	2.94	3.06	3.21	3.35	3.52	3.66	3.82	3.94	4.06
	Sheave/Mtr		B	B	B	B	A	A	A	A	A	A	C	C	C	C	
	RPM		770	805	840	870	900	935	960	990	1020	1045	1075	1100	1130	1155	1180
	Turns Open		5.5	5	4	3	5.5	4.5	4	3	2.5	2	1	4	3.5	2.5	2
8600	BHP	3.81	3.98	4.12	4.29	4.46	4.62	4.78	4.94	5.10	5.28	5.48	5.64	5.84	6.04	6.20	
	Sheave/Mtr	A	A	A	A	A	A	A	A	E	E	E	E	E	E	E	
	RPM	895	925	950	980	1010	1035	1060	1085	1110	1135	1160	1180	1205	1230	1250	
	Turns Open	5.5	5	4	3.5	3	2	1.5	1	3.5	3	2.5	2	1.5	1.5	1	
8800	BHP	4.06	4.22	4.41	4.57	4.73	4.92	5.08	5.24	5.40	5.60	5.76	5.96	6.16	6.32		
	Sheave/Mtr	A	A	A	A	A	A	D	E	E	E	E	E	E	E		
	RPM	915	940	970	995	1020	1050	1075	1100	1125	1150	1170	1195	1220	1240		
	Turns Open	5	4.5	3.5	3	2.5	1.5	1	4	3	3	2.5	2	1.5	1		
9000	BHP	4.38	4.54	4.70	4.86	5.02	5.18	5.34	5.50	5.68	5.88	6.08	6.24	6.44	6.60		
	Sheave/Mtr	A	A	A	A	D	D	D	E	E	E	E	E	E	E		
	RPM	935	960	985	1010	1035	1060	1085	1110	1135	1160	1185	1205	1230	1250		
	Turns Open	4.5	4	3.5	3	2	1.5	1	3.5	3	2.5	2	1.5	1			
9200	BHP	4.65	4.76	4.90	5.08	5.26	5.44	5.62	5.80	6.00	6.16	6.36	6.56	6.72			
	Sheave/Mtr	A	A	A	D	D	D	E	E	E	E	E	E	E			
	RPM	955	975	1000	1025	1050	1075	1100	1125	1150	1170	1195	1220	1240			
	Turns Open	4	3.5	3	2.5	1.5	1	4	3.5	2.5	2.5	2	1.5	1			
9400	BHP	4.83	4.94	5.12	5.32	5.52	5.72	5.92	6.12	6.32	6.48	6.68	6.88				
	Sheave/Mtr	A	A	D	D	D	D	E	E	E	E	E	E				
	RPM	970	990	1015	1040	1065	1090	1115	1140	1165	1185	1210	1235				
	Turns Open	3.5	3.5	2.5	2	1.5	1	3.5	3	2.5	2	1.5	1				
9600	BHP	5.10	5.24	5.44	5.64	5.84	6.04	6.24	6.40	6.60	6.80	6.96	7.16				
	Sheave/Mtr	D	D	D	D	D	E	E	E	E	E	E	E				
	RPM	985	1005	1030	1055	1080	1105	1130	1150	1175	1200	1220	1245				
	Turns Open	3.5	3	2	1.5	1	4	3.5	3	2.5	2	1.5	1				

A = Standard Static/Standard Motor, B = Low Static/Standard Motor, C = High Static/Standard Motor, D = Standard Static/Large Motor, E = High Static/Large Motor  
 Unit factory shipped with standard static sheave and drive at 2.5 turns open. Other speed require field selection.  
 For applications requiring higher static pressures, contact your local representative. Performance data does not include drive losses and is based on sea level conditions.  
 Do not operate in black regions. All airflow is rated at lowest Voltage if unit is dual Voltage rated, i.e. 208V for 208-230V units.



## Blower Performance Data – HBV300 Standard Unit

All Data is Wet Coil

SCFM	ESP	0.00	0.10	0.20	0.30	0.40	0.50	0.60	0.70	0.80	0.90	1.00	1.10	1.20	1.30	1.40	1.50
7500	BHP	2.69	2.84	2.96	3.11	3.27	3.45	3.60	3.78	3.96	4.08	4.23	4.38	4.53	4.69	4.86	5.03
	Sheave/Mtr	B	B	B	B	A	A	A	A	A	A	A	A	A	C	C	C
	RPM	890	925	955	990	1020	1050	1075	1105	1135	1155	1180	1205	1230	1255	1275	1295
	Turns Open	4.5	3.5	2.5	2	5.5	5	4.5	3.5	3	3	2	1.5	1	3.5	3	2.5
7800	BHP	2.87	3.04	3.18	3.36	3.54	3.72	3.87	4.05	4.20	4.35	4.50	4.65	4.80	4.97	5.14	5.30
	Sheave/Mtr	B	B	B	A	A	A	A	A	A	A	A	A	C	C	C	C
	RPM	910	945	975	1010	1040	1070	1095	1125	1150	1175	1200	1225	1250	1270	1290	1310
	Turns Open	4	3	2	5.5	5	4.5	4	3	2.5	2.5	1.5	1	4	3	2.5	2.5
8100	BHP	3.10	3.26	3.42	3.60	3.78	3.96	4.14	4.34	4.52	4.70	4.88	5.06	5.21	5.35	5.53	5.68
	Sheave/Mtr	B	B	B	A	A	A	A	A	A	A	A	C	C	C	C	C
	RPM	935	965	995	1025	1055	1085	1115	1145	1170	1195	1220	1245	1265	1285	1310	1330
	Turns Open	3.5	2.5	1.5	5.5	5	4	3.5	3	2.5	2	1.5	4	3.5	3	2.5	2
8400	BHP	3.36	3.52	3.74	3.92	4.14	4.36	4.57	4.75	4.93	5.11	5.29	5.47	5.62	5.80	5.94	6.12
	Sheave/Mtr	B	B	A	A	A	A	A	A	A	A	A	C	C	C	C	C
	RPM	955	985	1020	1045	1075	1105	1135	1160	1185	1210	1235	1260	1280	1305	1325	1350
	Turns Open	3	2	5.5	5	4.5	3.5	3	2.5	2	1.5	1	3.5	3	2.5	2	1.5
8700	BHP	3.60	3.79	4.00	4.22	4.43	4.65	4.83	5.01	5.19	5.37	5.55	5.76	5.97	6.14	6.35	6.56
	Sheave/Mtr	B	A	A	A	A	A	A	A	A	A	C	C	C	C	C	C
	RPM	975	1005	1035	1065	1095	1125	1150	1175	1200	1225	1250	1275	1300	1320	1345	1370
	Turns Open	2.5	6	5	4.5	4	3	3	2	1.5	1	3.5	3	2.5	2	1.5	1
9000	BHP	3.90	4.12	4.30	4.51	4.73	4.91	5.09	5.30	5.48	5.66	5.89	6.08	6.32	6.56	6.76	
	Sheave/Mtr	A	A	A	A	A	A	A	A	A	C	C	C	C	C	C	
	RPM	1000	1030	1055	1085	1115	1140	1165	1195	1220	1245	1270	1290	1315	1340	1360	
	Turns Open	6	5.5	4.5	4	3.5	3	2.5	1.5	1	3.5	3	2.5	2	1.5	1.5	
9300	BHP	4.34	4.56	4.74	4.96	5.14	5.35	5.53	5.71	5.89	6.08	6.29	6.50	6.67	6.88	7.05	
	Sheave/Mtr	A	A	A	A	A	A	A	A	A	C	C	C	C	C	C	
	RPM	1020	1050	1075	1105	1130	1160	1185	1210	1235	1260	1285	1310	1330	1355	1375	
	Turns Open	5.5	5	4.5	3.5	3	2.5	2	1.5	1	3	3	2.5	2	1.5	1	
9600	BHP	4.64	4.85	5.03	5.25	5.46	5.67	5.88	6.13	6.34	6.52	6.66	6.84	7.02	7.16		
	Sheave/Mtr	A	A	A	A	A	A	A	A	C	C	C	C	C	C		
	RPM	1040	1070	1095	1125	1150	1175	1200	1230	1255	1280	1300	1325	1350	1370		
	Turns Open	5	4.5	4	3.5	3	2	1.5	1	3.5	3	2.5	2	1.5	1		
9900	BHP	4.93	5.15	5.33	5.53	5.78	5.99	6.20	6.41	6.62	6.83	7.04	7.21	7.42			
	Sheave/Mtr	A	A	A	A	A	A	A	C	C	C	C	C	C			
	RPM	1060	1090	1115	1140	1170	1195	1220	1245	1270	1295	1320	1340	1365			
	Turns Open	4.5	4	3.5	3	2.5	1.5	1.5	3.5	3	2.5	2	2	1.5			
10200	BHP	5.36	5.57	5.77	5.95	6.17	6.35	6.53	6.74	6.94	7.18	7.42	7.61				
	Sheave/Mtr	A	A	A	A	A	A	C	C	C	C	C	E				
	RPM	1085	1110	1135	1160	1190	1215	1240	1265	1285	1310	1335	1355				
	Turns Open	4	3.5	3	2.5	2	1.5	4	3	3	2.5	2	1.5				
10500	BHP	5.52	5.75	5.99	6.23	6.47	6.71	6.95	7.19	7.43	7.62	7.86	8.10				
	Sheave/Mtr	A	A	A	A	A	A	C	C	C	E	E	E				
	RPM	1100	1130	1155	1180	1205	1230	1255	1280	1305	1325	1350	1375				
	Turns Open	4	3	2.5	2	1.5	1	3.5	3	2.5	2	1.5	1				
10800	BHP	6.00	6.24	6.48	6.72	6.96	7.20	7.39	7.63	7.87	8.11	8.30					
	Sheave/Mtr	A	A	A	A	A	C	C	E	E	E	E					
	RPM	1125	1150	1175	1200	1225	1250	1270	1295	1320	1345	1365					
	7000	3.5	3	5	1.5	1	3.5	3.5	2.5	2	1.5	1.5					

A = Standard Static/Standard Motor, B = Low Static/Standard Motor, C = High Static/Standard Motor, D = Standard Static/Large Motor, E = High Static/Large Motor  
 Unit factory shipped with standard static sheave and drive at 2.5 turns open. Other speed require field selection.  
 For applications requiring higher static pressures, contact your local representative. Performance data does not include drive losses and is based on sea level conditions.  
 Do not operate in black regions. All airflow is rated at lowest Voltage if unit is dual Voltage rated, i.e. 208V for 208-230V units.

## Unit Starting and Operating Conditions

### Operating Limits

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

Power Supply – A voltage variation of +/- 10% of nameplate utilization voltage is acceptable.

Determination of operating limits is dependent primarily upon three factors: 1) return air temperature. 2) water temperature, and 3) ambient temperature. When any one of these factors is at minimum or maximum levels, the other two factors should be at normal levels to ensure proper unit operation. Extreme variations in temperature and humidity and/or corrosive water or air will adversely affect unit performance, reliability, and service life. Consult Table 9a for operating limits.

### Commissioning Conditions

Consult Table 9b for the particular model. Starting conditions vary depending upon model and are based upon the following notes:

#### Notes:

1. Conditions in Table 9b are not normal or continuous operating conditions. Minimum/maximum limits are start-up conditions to bring the building space up to occupancy temperatures. Units are not designed to operate under these conditions on a regular basis.
2. Voltage utilization range complies with AHRI Standard 110.

**Table 9a: Operating Limits**

Starting Limits	HBH/HBV	
	Cooling	Heating
<b>Air Limits</b>		
Min. ambient air, DB	45°F [7°C]	39°F [4°C]
Rated ambient air, DB	80.6°F [27°C]	68°F [20°C]
Max. ambient air, DB	110°F [43°C]	85°F [29°C]
Min. entering air, DB/WB	60/50°F [16/10°C]	50°F [10°C]
Rated entering air, DB/WB	80.6/66.2°F [27/19°C]	68°F [20°C]
Max. entering air, DB/WB	95/75°F [35/24°C]	80°F [27°C]
<b>Water Limits</b>		
Min. entering water	30°F [-1°C]	20°F [-6.7°C]
Normal entering water	50-110°F [10-43°C]	30-70°F [-1 to 21°C]
Max. entering water	120°F [49°C]	90°F [32°C]
<b>Normal Water Flow</b>	1.5 to 3.0 gpm / ton [1.6 to 3.2 l/m per kW]	

**Table 9b: Commissioning Limits**

Commissioning Limits	HBH/HBV	
	Cooling	Heating
<b>Air Limits</b>		
Min. ambient air, DB	45°F [7°C]	39°F [4°C]
Rated ambient air, DB	80.6°F [27°C]	68°F [20°C]
Max. ambient air, DB	110°F [43°C]	85°F [29°C]
Min. entering air, DB/WB	50/45°F [10/7°C]	40°F [4.5°C]
Rated entering air, DB/WB	80.6/66.2°F [27/19°C]	68°F [20°C]
Max. entering air, DB/WB	110/83°F [43/28°C]	80°F [27°C]
<b>Water Limits</b>		
Min. entering water	30°F [-1°C]	20°F [-6.7°C]
Normal entering water	50-110°F [10-43°C]	30-70°F [-1 to 21°C]
Max. entering water	120°F [49°C]	90°F [32°C]
<b>Normal Water Flow</b>	1.5 to 3.0 gpm / ton [1.6 to 3.2 l/m per kW]	

## Piping System Cleaning and Flushing

Piping System Cleaning and Flushing - Cleaning and flushing the WLHP piping system is the single most important step to ensure proper start-up and continued efficient operation of the system.

Follow the instructions below to properly clean and flush the system:

1. Ensure that electrical power to the unit is disconnected.
2. Install the system with the supply hose connected directly to the return riser valve. Use a single length of flexible hose.
3. Open all air vents. Fill the system with water. DO NOT allow system to overflow. Bleed all air from the system. Pressurize and check the system for leaks and repair as appropriate.
4. Verify that all strainers are in place (MARS recommends a strainer with a #20 stainless steel wire mesh). Start the pumps, and systematically check each vent to ensure that all air is bled from the system.
5. Verify that make-up water is available. Adjust make-up water as required to replace the air which was bled from the system. Check and adjust the water/air level in the expansion tank.
6. Set the boiler to raise the loop temperature to approximately 86°F [30°C]. Open a drain at the lowest point in the system. Adjust the make-up water replacement rate to equal the rate of bleed.
7. Refill the system and add trisodium phosphate in a proportion of approximately 150 gallons [1/2 kg per 750 l] of water (or other equivalent approved cleaning agent). Reset the boiler to raise the loop temperature to 100°F [38°C]. Circulate the solution for a minimum of 8 to 24 hours. At the end of this period, shut off the circulating pump and drain the solution. Repeat system cleaning if desired.
8. When the cleaning process is complete, remove the short-circuited hoses. Reconnect the hoses to the proper supply, and return the connections to each of the units. Refill the system and bleed off all air.
9. Test the system pH with litmus paper. The system water should be in the range of pH 6.0 - 8.5 (see table 3). Add chemicals, as appropriate to maintain neutral pH levels.
10. When the system is successfully cleaned, flushed, refilled and bled, check the main system panels, safety cutouts and alarms. Set the controls to properly maintain loop temperatures.

DO NOT use "Stop Leak" or similar chemical agent in this system. Addition of chemicals of this type to the loop water will foul the heat exchanger and inhibit unit operation.

Note: The manufacturer strongly recommends all piping connections, both internal and external to the unit, be pressure tested by an appropriate method prior to any finishing of the interior space or before access to all connections is limited. Test pressure may not exceed the maximum allowable pressure for the unit and all components within the water system. The manufacturer will not be responsible or liable for damages from water leaks due to inadequate or lack of a pressurized leak test, or damages caused by exceeding the maximum pressure rating during installation.

**▲ WARNING! ▲**

**WARNING!** Polyolester Oil, commonly known as POE oil, is a synthetic oil used in many refrigeration systems including those with HFC-410A refrigerant. POE oil, if it ever comes in contact with PVC or CPVC piping, may cause failure of the PVC/CPVC. PVC/CPVC piping should never be used as supply or return water piping with water source heat pump products containing HFC-410A as system failures and property damage may result.

BEFORE POWERING SYSTEM, please check the following:

UNIT CHECKOUT

- ❑ Line voltage and wiring: Verify that voltage is within an acceptable range for the unit and wiring and fuses/breakers are properly sized. Verify that low voltage wiring is complete.
- ❑ Unit control transformer: Ensure that transformer has the properly selected voltage tap. Commercial 380-420V units are factory wired for 380V operation unless specified otherwise.
- ❑ Balancing/shutoff valves: Ensure that all isolation valves are open (after system flushing - see System Checkout) and water control valves are wired.
- ❑ Entering water and air: Ensure that entering water and air temperatures are within operating limits of Table 9.
- ❑ Low water temperature cutout: Verify that low water temperature cut-out on the CXM2/DXM2.5 control is properly set.
- ❑ Unit blower wheel: Manually rotate blower wheel to verify free rotation and ensure that all blower wheels are secured to the blower motor shaft and centered in housing.
- ❑ Blower motor: Verify motor bolts are tight. DO NOT oil motors upon start-up. Fan motors are pre-oiled at the factory.
- ❑ Check shaft pillow blocks, sheave and pulley are tight
- ❑ Verify sheave has been set to turns in design requirement. Record turns on start up log sheet.
- ❑ Verify belt is straight and proper tension
- ❑ Condensate line: Verify that condensate line is open, trapped, vented and properly pitched toward drain.
- ❑ Water flow balancing: Record inlet and outlet water temperatures for each heat pump upon startup. This check can eliminate nuisance trip outs and high velocity water flow that could erode heat exchangers.
- ❑ Unit air coil and filters: Ensure that filter is clean and accessible. Clean air coil of all manufacturing oils.
- ❑ Unit controls: Verify that CXM2 or DXM2.5 field selection options are properly set.

SYSTEM CHECKOUT

**Unit Starting and Operating Conditions**

- ❑ System water temperature: Check water temperature for proper range and also verify heating and cooling setpoints for proper operation.
- ❑ System pH: Check and adjust water pH if necessary to maintain a level between 6 and 8.5. Proper pH promotes longevity of hoses and fittings (see table 3).
- ❑ System flushing: Verify that all hoses are connected end to end when flushing to ensure that debris bypasses the unit heat exchanger, water valves and other components. Water used in the system must be potable quality initially and clean of dirt, piping slag, and strong chemical cleaning agents. Verify that all air is purged from the system. Air in the system can cause poor operation or system corrosion.
- ❑ Cooling tower/boiler: Check equipment for proper setpoints and operation.
- ❑ Standby pumps: Verify that the standby pump is properly installed and in operating condition.
- ❑ System controls: Verify that system controls function and operate in the proper sequence.
- ❑ Low water temperature cutout: Verify that low water temperature cut-out controls are provided for the outdoor portion of the loop. Otherwise, operating problems may occur.
- ❑ System control center: Verify that the control center and alarm panel have appropriate setpoints and are operating as designed.
- ❑ Miscellaneous: Note any questionable aspects of the installation.

**▲ CAUTION! ▲**

**CAUTION!** Verify that ALL water control valves are open and allow water flow prior to engaging the compressor. Freezing of the coax or water lines can permanently damage the heat pump.

**▲ CAUTION! ▲**

**CAUTION!** To avoid equipment damage, DO NOT leave system filled in a building without heat during the winter unless antifreeze is added to the water loop. Heat exchangers never fully drain by themselves and will freeze unless winterized with antifreeze.

## Unit Start-Up Procedure

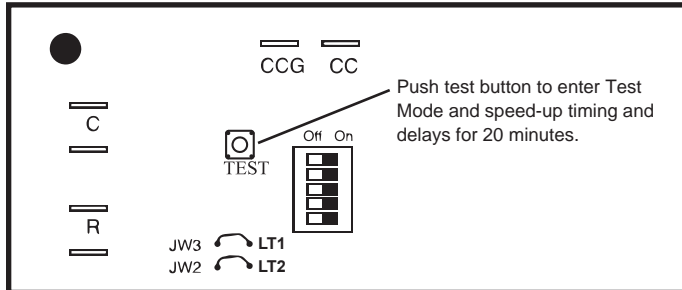
1. Turn the thermostat fan position to "ON". Blower should start.
2. Balance air flow at registers.
3. Adjust all valves to their full open positions. Turn on the line power to all heat pumps.
4. Room temperature should be within the minimum-maximum ranges of table 9. During start-up checks, loop water temperature entering the heat pump should be between 60°F [16°C] and 95°F [35°C].
5. Two factors determine the operating limits of MARS heat pumps, (a) return air temperature, and (b) water temperature. When any one of these factors is at a minimum or maximum level, the other factor must be at normal level to ensure proper unit operation.
  - a. Adjust the unit thermostat to the warmest setting. Place the thermostat mode switch in the "COOL" position. Slowly reduce thermostat setting until the compressor activates.
  - b. Check for cool air delivery at the unit grille within a few minutes after the unit has begun to operate.
  - c. Note: Units have a five minute time delay in the control circuit that can be eliminated on the CXM2/DXM2.5 control board as shown below in Figure 21. See controls description for details.
  - d. Verify that the compressor is on and that the water flow rate is correct by measuring pressure drop through the heat exchanger using the P/T plugs and comparing to tables 10a through 10e.
  - e. Check the elevation and cleanliness of the condensate lines. Dripping may be a sign of a blocked line. Check that the condensate trap is filled to provide a water seal. Check the temperature of both entering and leaving water. If temperature is within range table, proceed with the test. If temperature is outside of the operating range, check refrigerant pressures and compare to tables 12 through 15. Verify correct water flow by comparing unit pressure drop across the heat exchanger versus the data in tables 10a through 10e. Heat of rejection (HR) can be calculated and compared to submittal data capacity pages. The formula for HR for systems with water is as follows:  

$$HR \text{ (Btuh)} = TD \times GPM \times 500$$
 where TD is the temperature difference between the entering and leaving water, and GPM is the flow rate in U.S. GPM, determined by comparing the pressure drop across the heat exchanger to tables 8a through 8e. In S-I units, the formula is as follows:  

$$HR \text{ (kW)} = TD \times l/s \times 4.18$$
  - f. Check air temperature drop across the air coil when compressor is operating. Air temperature drop should be between 15°F and 25°F [8°C and 14°C].
  - g. Turn thermostat to "OFF" position. A hissing noise indicates proper functioning of the reversing valve.
6. Allow five (5) minutes between tests for pressure to equalize before beginning heating test.
  - a. Adjust the thermostat to the lowest setting. Place the thermostat mode switch in the "HEAT" position.
  - b. Slowly raise the thermostat to a higher temperature until the compressor activates.
  - c. Check for warm air delivery within a few minutes after the unit has begun to operate.
  - d. Refer to table 17. Check the temperature of both entering and leaving water. If temperature is within range, proceed with the test. If temperature is outside of the operating range, check refrigerant pressures and compare to tables 11 through 16. Verify correct water flow by comparing unit pressure drop across the heat exchanger versus the data in tables 10a through 10e. Heat of extraction (HE) can be calculated and compared to submittal data capacity pages. The formula for HE for systems with water is as follows:  $HE \text{ (Btuh)} = TD \times GPM \times 500$ , where TD is the temperature difference between the entering and leaving water, and GPM is the flow rate in U.S. GPM, determined by comparing the pressure drop across the heat exchanger to tables 10a through 10e.
  - e. In S-I units, Check air temperature rise across the air coil when compressor is operating. Air temperature rise should be between 20°F and 30°F [11°C and 17°C].
  - f. Check for vibration, noise, and water leaks.
7. If unit fails to operate, perform troubleshooting analysis (see troubleshooting section). If the check described fails to reveal the problem and the unit still does not operate, contact a trained service technician to ensure proper diagnosis and repair of the equipment.
8. When testing is complete, set system to maintain desired comfort level.
9. BE CERTAIN TO FILL OUT AND FORWARD ALL WARRANTY REGISTRATION PAPERS TO MARS.

**Note: If performance during any mode appears abnormal, refer to the CXM2/DXM2.5 section or troubleshooting section of this manual. To obtain maximum performance, the air coil should be cleaned before start-up. A 10% solution of dishwasher detergent and water is recommended.**

**Figure 21: Test Mode Button**



**⚠ WARNING! ⚠**

**WARNING!** When the disconnect switch is closed, high voltage is present in some areas of the electrical panel. Exercise caution when working with energized equipment.

**⚠ CAUTION! ⚠**

**CAUTION!** Verify that ALL water control valves are open and allow water flow prior to engaging the compressor. Freezing of the coax or water lines can permanently damage the heat pump.

**UNIT OPERATING CONDITIONS**

**Table 10a: TC Coax Water Pressure Drop**

Model	U.S. GPM	l/s	l/m	Pressure Drop, psi [kPa]*			
				30°F [-1°C]	50°F [10°C]	70°F [21°C]	90°F [32°C]
HBH/V072	10	0.631	37.85	1.2 [8.3]	0.9 [6.2]	0.5 [3.4]	0.3 [2.1]
	15	0.946	56.781	3.3 [22.8]	2.8 [19.1]	2.1 [14.5]	1.8 [12.4]
	20	1.262	75.708	6.2 [42.7]	5.3 [36.5]	4.2 [29.0]	3.8 [26.2]
HBH/V096	12	0.757	45.425	2.1 [14.5]	1.7 [11.7]	1.3 [9.0]	1.1 [7.6]
	18	1.136	68.137	5.3 [36.5]	4.5 [31.0]	3.6 [24.8]	3.3 [22.8]
	24	1.514	90.85	9.3 [64.1]	7.9 [54.5]	6.6 [45.5]	6.1 [42.1]
HBH/V120	15	0.946	56.781	4 [27.6]	3.2 [22.1]	2.2 [15.2]	2 [13.8]
	22.5	1.42	85.172	8.6 [59.3]	7.2 [49.6]	5.5 [37.9]	5.1 [35.2]
	30	1.893	113.562	14.5 [100.0]	12.2 [83.4]	9.8 [67.6]	9.2 [63.4]
HBV160	21.0	1.32	79.20	7.6 [52.5]	4.4 [30.3]	4.0 [27.6]	3.8 [26.3]
	31.5	1.99	119.40	14.3 [98.8]	9.1 [62.9]	8.4 [58.02]	7.9 [54.6]
	42.0	2.65	159.00	22.3 [154.0]	15.2 [105.0]	14.1 [97.4]	13 [89.8]
HBV192	24.0	1.51	90.60	10.1 [69.8]	7.6 [52.5]	6.2 [42.8]	5.9 [40.8]
	36.0	2.27	136.20	18.6 [128.5]	12.6 [87.0]	11.6 [80.1]	11.1 [76.7]
	48.0	3.03	181.80	28.7 [198.2]	20.2 [139.5]	18.8 [129.9]	17.7 [122.3]
HBV240	30.0	1.89	113.40	8.3 [57.3]	6.6 [45.6]	5.6 [38.7]	5.3 [36.6]
	45.0	2.84	170.40	15.5 [107.1]	11.1 [76.7]	10.4 [71.8]	9.9 [68.4]
	60.0	3.79	227.40	24.4 [168.5]	17.8 [122.9]	16.8 [116.0]	15.9 [109.8]
HBV300	37.5	2.37	142.20	11.6 [80.1]	7.9 [54.6]	6.4 [44.2]	5.9 [40.8]
	56.3	3.55	213.00	21.3 [147.1]	13.6 [93.9]	12.6 [87.0]	11.8 [81.5]
	75.0	4.73	283.80	32.9 [227.2]	22.3 [154.0]	20.8 [143.6]	19.6 [135.4]

**\*Note: To convert kPa to millibars, multiply by 10.**

## Unit Operating Conditions

### Operating Pressure/Temperature tables include the following notes:

- Airflow is at nominal (rated) conditions;
- Entering air is based upon 70°F [21°C] DB in heating and 80/67°F [27/19°C] in cooling;
- Subcooling is based upon head pressure at compressor service port;
- Cooling air and water values can vary greatly with changes in humidity level.

**Table 11: HBH/V072-120 Series Typical Unit Operating Pressures and Temperatures (60Hz - I-P Units)**

Entering Water Temp °F	Water Flow GPM/ton	Cooling						Heating					
		Suction Pressure PSIG	Discharge Pressure PSIG	Superheat	Subcooling	Water Temp Rise °F	Air Temp Drop °F DB	Suction Pressure PSIG	Discharge Pressure PSIG	Superheat	Subcooling	Water Temp Drop °F	Air Temp Rise °F DB
20	1.5												
	2.25												
	3												
30*	1.5	122 - 125	197 - 204	13 - 16	15 - 20	20 - 24	22 - 23	60 - 63	289 - 306	9 - 12	8 - 17	3 - 4	20 - 22
	2.25	116 - 119	177 - 184	17 - 19	15 - 18	13 - 16	21 - 22	67 - 71	297 - 315	10 - 12	9 - 18	8 - 9	22 - 23
	3	112 - 115	168 - 173	19 - 21	14 - 18	10 - 12	21 - 22	71 - 75	301 - 321	10 - 12	10 - 19	6 - 7	23 - 24
50	1.5	128 - 134	240 - 252	11 - 14	13 - 16	20 - 22	21 - 22	97 - 102	333 - 355	9 - 11	13 - 21	11 - 12	29 - 30
	2.25	122 - 131	219 - 233	12 - 17	12 - 16	13 - 15	21 - 22	104 - 108	339 - 361	9 - 11	13 - 21	8 - 9	30 - 31
	3	119 - 129	209 - 224	13 - 18	11 - 15	10 - 11	21 - 22	107 - 122	342 - 369	9 - 11	13 - 20	6 - 7	31 - 32
70	1.5	132 - 139	311 - 329	9 - 12	12 - 15	19 - 21	20 - 21	130 - 135	367 - 392	9 - 11	13 - 21	14 - 16	35 - 37
	2.25	131 - 137	287 - 306	10 - 13	10 - 12	13 - 14	20 - 21	139 - 144	375 - 402	10 - 11	13 - 20	10 - 12	37 - 38
	3	131 - 136	275 - 294	10 - 13	9 - 11	9 - 11	20 - 21	145 - 149	380 - 407	10 - 11	13 - 19	8 - 9	38 - 39
90	1.5	137 - 144	400 - 420	8 - 10	13 - 16	19 - 20	19 - 20	164 - 169	401 - 430	10 - 13	13 - 17	18 - 20	41 - 43
	2.25	135 - 142	373 - 395	9 - 11	10 - 12	12 - 14	19 - 20	175 - 178	411 - 442	12 - 16	14 - 17	12 - 14	43 - 45
	3	135 - 141	359 - 383	9 - 12	9 - 11	9 - 10	19 - 20	179 - 187	415 - 455	13 - 18	14 - 16	9 - 11	44 - 46
100	1.5	139 - 147	448 - 471	8 - 9	13 - 16	18 - 20	18 - 19						
	2.25	138 - 146	420 - 445	8 - 10	11 - 13	12 - 13	18 - 19						
	3	138 - 146	405 - 432	8 - 10	10 - 11	9 - 10	18 - 19						
120	1.5	144 - 153	549 - 583	7 - 8	15 - 17	17 - 19	17 - 18						
	2.25	143 - 153	525 - 557	7 - 8	12 - 14	11 - 13	17 - 18						
	3	143 - 152	511 - 543	8 - 9	11 - 13	9 - 10	17 - 18						

\*Based on 15% Methanol antifreeze solution

**Table 11A: HBV160-300 Series Typical Unit Operating Pressures and Temperatures (60Hz - I-P Units)**

Entering Water Temp °F	Water Flow GPM/ton	Cooling						Heating					
		Suction Pressure PSIG	Discharge Pressure PSIG	Superheat	Subcooling	Water Temp Rise °F	Air Temp Drop °F DB	Suction Pressure PSIG	Discharge Pressure PSIG	Superheat	Subcooling	Water Temp Drop °F	Air Temp Rise °F DB
20*	1.5												
	2.25												
	3.0												
30*	1.5	118 - 121	166 - 197	12 - 21	14 - 24			54 - 76	280 - 302	5 - 18	8 - 20	3 - 6	18 - 23
	2.25	109 - 119	154 - 167	13 - 22	12 - 24	9 - 24	17 - 23	59 - 66	285 - 309	5 - 13	10 - 21		
	3.0	104 - 117	153 - 166	17 - 24	11 - 24			64 - 70	289 - 316	5 - 17	10 - 16	4 - 10	19 - 23
50	1.5	127 - 135	232 - 247	7 - 12	11 - 20			85 - 96	315 - 342	7 - 12	11 - 25		
	2.25	122 - 133	215 - 228	10 - 16	10 - 19	9 - 24	17 - 23	97 - 104	323 - 355	7 - 12	12 - 25	5 - 13	24 - 31
	3.0	121 - 131	206 - 218	11 - 17	9 - 18			99 - 108	325 - 357	7 - 12	13 - 25		
70	1.5	130 - 139	304 - 317	6 - 11	10 - 16			121 - 131	354 - 387	8 - 13	11 - 26		
	2.25	128 - 139	284 - 295	6 - 11	7 - 14	10 - 21	17 - 23	132 - 140	363 - 398	8 - 13	12 - 27	7 - 17	31 - 39
	3.0	127 - 138	272 - 284	6 - 12	6 - 12			137 - 149	374 - 418	8 - 18	13 - 28		
90	1.5	136 - 145	404 - 420	4 - 10	6 - 14			158 - 168	386 - 428	10 - 16	6 - 22		
	2.25	134 - 143	381 - 406	5 - 11	5 - 13	10 - 21	17 - 21	173 - 182	400 - 441	10 - 17	6 - 22	9 - 21	37 - 45
	3.0	133 - 142	369 - 392	6 - 12	5 - 12			175 - 190	405 - 445	11 - 17	6 - 22		
100	1.5	137 - 146	434 - 445	4 - 9	6 - 16								
	2.25	135 - 145	407 - 425	5 - 9	4 - 13	8 - 19	17 - 21						
	3.0	134 - 144	395 - 413	5 - 10	4 - 12								
120	1.5	141 - 152	537 - 553	4 - 9	4 - 11								
	2.25	140 - 151	512 - 531	5 - 9	4 - 10	8 - 19	16 - 20						
	3.0	139 - 149	500 - 517	5 - 9	4 - 9								

\*Based on 15% Methanol antifreeze solution

**Table 12: Water Temperature Change Through Heat Exchanger**

Water Flow, gpm [l/m]	Rise, Cooling °F, [°C]	Drop, Heating °F, [°C]
For Closed Loop: Ground Source or Closed Loop Systems at 3 gpm per ton [3.2 l/m per kW]	9 - 12 [5 - 6.7]	4 - 8 [2.2 - 4.4]
For Open Loop: Ground Water Systems at 1.5 gpm per ton [1.6 l/m per kW]	20 - 26 [11.1 - 14.4]	10 - 17 [5.6 - 9.4]





## Start-Up Log Sheet

**Installer:** Complete unit and system checkout and follow unit start-up procedures in the IOM. Use this form to record unit information, temperatures and pressures during start-up. Keep this form for future reference.

**Job Name:** \_\_\_\_\_ **Street Address:** \_\_\_\_\_

**Model Number:** \_\_\_\_\_ **Serial Number:** \_\_\_\_\_

**Unit Location in Building:** \_\_\_\_\_

**Date:** \_\_\_\_\_ **Sales Order No:** \_\_\_\_\_

In order to minimize troubleshooting and costly system failures, complete the following checks and data entries before the system is put into full operation.

**External Static:** \_\_\_\_\_

**Sheave Setting:** \_\_\_\_\_ **Turns Open**

**Temperatures: F or C**

**Antifreeze:** \_\_\_\_\_ %

**Pressures: PSIG or kPa**

**Type:** \_\_\_\_\_

	Cooling Mode		Heating Mode
Return-Air Temperature	DB	WB	DB
Supply-Air Temperature	DB	WB	DB
Temperature Differential			
Entering Fluid Temperature			
Leaving Fluid Temperature			
Temperature Differential			
Water Coil Heat Exchanger (Water Pressure IN)			
Water Coil Heat Exchanger (Water Pressure OUT)			
Pressure Differential			
Flow Rate GPM (l/s)			
<b>Compressor</b>			
Amps			
Volts			
Discharge Line Temperature			
<b>Motor</b>			
Amps			
Volts			

Allow unit to run 15 minutes in each mode before taking data.

Do not connect gauge lines

## Preventive Maintenance

### Water Coil Maintenance -

(Direct ground water applications only)

If the system is installed in an area with a known high mineral content (125 P.P.M. or greater) in the water, it is best to establish a periodic maintenance schedule with the owner so the coil can be checked regularly. Consult the well water applications section of this manual for a more detailed water coil material selection. Should periodic coil cleaning be necessary, use standard coil cleaning procedures, which are compatible with the heat exchanger material and copper water lines. Generally, the more water flowing through the unit, the less chance for scaling. Therefore, 1.5 gpm per ton [1.6 l/m per kW] is recommended as a minimum flow. Minimum flow rate for entering water temperatures below 50°F [10°C] is 2.0 gpm per ton [2.2 l/m per kW].

### Water Coil Maintenance -

(All other water loop applications)

Generally water coil maintenance is not needed for closed loop systems. However, if the piping is known to have high dirt or debris content, it is best to establish a periodic maintenance schedule with the owner so the water coil can be checked regularly. Dirty installations are typically the result of deterioration of iron or galvanized piping or components in the system. Open cooling towers requiring heavy chemical treatment and mineral buildup through water use can also contribute to higher maintenance. Should periodic coil cleaning be necessary, use standard coil cleaning procedures, which are compatible with both the heat exchanger material and copper water lines. Generally, the more water flowing through the unit, the less chance for scaling. However, flow rates over 3 gpm per ton (3.9 l/m per kW) can produce water (or debris) velocities that can erode the heat exchanger wall and ultimately produce leaks.

**Filters** - Filters must be clean to obtain maximum performance. Filters should be inspected every month under normal operating conditions and be replaced when necessary. Units should never be operated without a filter.

Washable, high efficiency, electrostatic filters, when dirty, can exhibit a very high pressure drop for the fan motor and reduce air flow, resulting in poor performance. It is especially important to provide consistent washing of these filters (in the opposite direction of the normal air flow) once per month using a high pressure wash similar to those found at self-serve car washes.

**Condensate Drain** - In areas where airborne bacteria may produce a “slimy” substance in the drain pan, it may be necessary to treat the drain pan chemically with an algaecide approximately every three months to minimize the problem. The condensate pan may also need to be cleaned periodically to ensure indoor air quality. The condensate drain can pick up lint and dirt, especially with dirty filters. Inspect the drain twice a year to avoid the possibility of plugging and eventual overflow.

**Compressor** - Conduct annual amperage checks to ensure that amp draw is no more than 10% greater than indicated on the serial plate data.

**Fan Motors** - All units have lubricated fan motors. Fan motors should never be lubricated unless obvious, dry operation is suspected. Periodic maintenance oiling is not recommended, as it will result in dirt accumulating in the excess oil and cause eventual motor failure. Conduct annual dry operation check and amperage check to ensure amp draw is no more than 10% greater than indicated on serial plate data.

**Belt** - Check that the belt is tight. Retighten if needed. Replace if it is split or cracked.

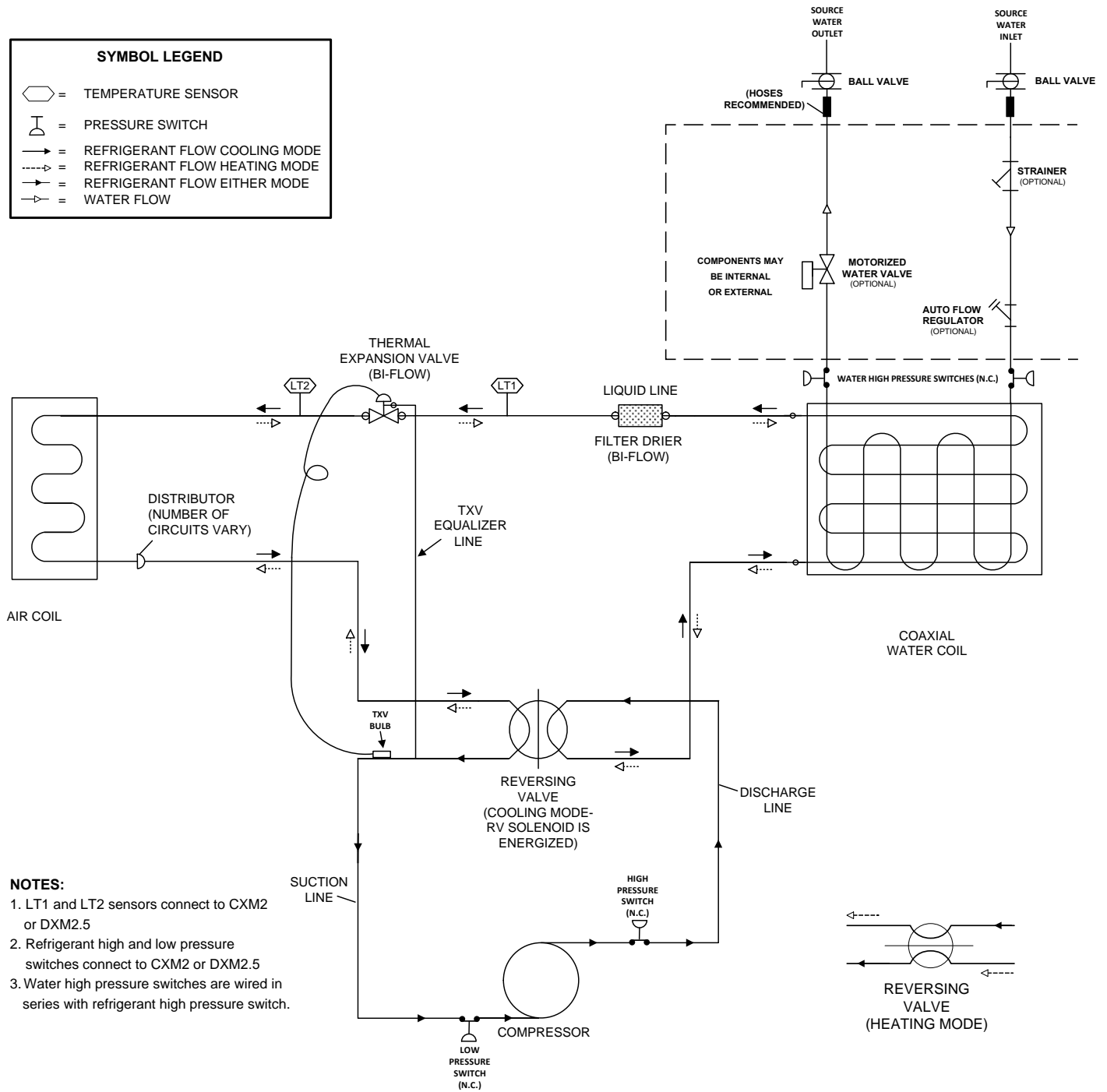
**Air Coil** - The air coil must be cleaned to obtain maximum performance. Check once a year under normal operating conditions and, if dirty, brush or vacuum clean. Care must be taken not to damage the aluminum fins while cleaning. **CAUTION: Fin edges are sharp.**

**Refrigerant System** - To maintain sealed circuit integrity, do not install service gauges unless unit operation appears abnormal. Reference the operating charts for pressures and temperatures. Verify that air and water flow rates are at proper levels before servicing the refrigerant circuit.

### Circuit Diagram with Safety Devices

**SYMBOL LEGEND**

- = TEMPERATURE SENSOR
- = PRESSURE SWITCH
- = REFRIGERANT FLOW COOLING MODE
- = REFRIGERANT FLOW HEATING MODE
- = REFRIGERANT FLOW EITHER MODE
- = WATER FLOW



## Functional Troubleshooting

Fault	Htg	Cig	Possible Cause	Solution
Main power problems	X	X	Green Status LED Off	Check line voltage circuit breaker and disconnect.
				Check for line voltage between L1 and L2 on the contactor.
				Check for 24VAC between R and C on CXM2/DXM2.5'
				Check primary/secondary voltage on transformer.
HP Fault Code 2 High Pressure	X	X	Reduced or no water flow in cooling	Check pump operation or valve operation/setting. Check water flow adjust to proper flow rate.
			Water Temperature out of range in cooling	Bring water temp within design parameters.
	X		Reduced or no air flow in heating	Check for dirty air filter and clean or replace.
				Check fan motor operation and airflow restrictions.
				Dirty Air Coil- construction dust etc.
				Too high of external static. Check static vs blower table.
	X		Air temperature out of range in heating	Bring return air temp within design parameters.
	X	X	Overcharged with refrigerant	Check superheat/subcooling vs typical operating condition table.
X	X	Bad HP Switch	Check switch continuity and operation. Replace.	
LP/LOC Fault Code 3 Low Pressure / Loss of Charge	X	X	Insufficient charge	Check for refrigerant leaks
			Compressor pump down at start-up	Check charge and start-up water flow.
LT1 Fault Code 4 Water coil low temperature limit	X		Reduced or no water flow in heating	Check pump operation or water valve operation/setting. Plugged strainer or filter. Clean or replace.. Check water flow adjust to proper flow rate.
			Inadequate antifreeze level	Check antifreeze density with hydrometer.
			Improper temperature limit setting (30°F vs 10°F [-1°C vs -2°C])	Clip JW3 jumper for antifreeze (10°F [-12°C]) use.
			Water Temperature out of range	Bring water temp within design parameters.
			Bad thermistor	Check temp and impedance correlation per chart
LT2 Fault Code 5 Air coil low temperature limit	X	X	Reduced or no air flow in cooling	Check for dirty air filter and clean or replace. Check fan motor operation and airflow restrictions. Too high of external static. Check static vs blower table.
			Air Temperature out of range	Too much cold vent air? Bring entering air temp within design parameters.
			Improper temperature limit setting (30°F vs 10°F [-1°C vs -12°C])	Normal airside applications will require 30°F [-1°C] only.
			Bad thermistor	Check temp and impedance correlation per chart.
			Blocked drain	Check for blockage and clean drain.
Condensate Fault Code 6	X	X	Improper trap	Check trap dimensions and location ahead of vent. Check for piping slope away from unit. Check slope of unit toward outlet.
			Poor drainage	Poor venting. Check vent location.
			Moisture on sensor	Check for moisture shorting to air coil.
			Plugged air filter	Replace air filter.
			Restricted Return Air Flow	Find and eliminate restriction. Increase return duct and/or grille size.
			Over/Under Voltage Code 7 (Auto resetting)	X
Over Voltage	Check power supply voltage and 24VAC before and during operation. Check 24VAC and unit transformer tap for correct power supply voltage.			
Heating mode LT2>125°F [52°C]	Check for poor air flow or overcharged unit.			
Cooling Mode LT1>125°F [52°C] OR LT2<40°F [4°C])	Check for poor water flow, or air flow.			
Swapped Thermistor Code 9	X	X	LT1 and LT2 swapped	Reverse position of thermistors
No Fault Code Shown	X	X	No compressor operation	See "Only Fan Operates".
			Compressor overload	Check and replace if necessary.
			Control board	Reset power and check operation.
Unit Short Cycles	X	X	Dirty air filter	Check and clean air filter.
			Unit in "test mode"	Reset power or wait 20 minutes for auto exit.
			Unit selection	Unit may be oversized for space. Check sizing for actual load of space.
			Compressor overload	Check and replace if necessary
Only Fan Runs	X	X	Thermostat position	Ensure thermostat set for heating or cooling operation.
			Unit locked out	Check for lockout codes. Reset power.
			Compressor Overload	Check compressor overload. Replace if necessary.
			Thermostat wiring	Check thermostat wiring at heat pump. Jumper Y and R for compressor operation in test mode.
Only Compressor Runs	X	X	Thermostat wiring	Check G wiring at heat pump. Jumper G and R for fan operation
			Fan motor relay	Jumper G and R for fan operation. Check for Line voltage across BR contacts.
			Fan motor	Check fan power enable relay operation (if present).
			Fan motor	Check for line voltage at motor. Check capacitor.
			Thermostat wiring	Check thermostat wiring at heat pump. Jumper Y and R for compressor operation in test mode
Unit Doesn't Operate in Cooling		X	Reversing valve	Set for cooling demand and check 24VAC on RV coil and at CXM2/DXM2.5 board If RV is stuck, run high pressure up by reducing water flow and while operating engage and disengage RV coil voltage to push valve.
			Thermostat setup	Check for 'O' RV setup not 'B'.
			Thermostat wiring	Check O wiring at heat pump. Jumper O and R for RV coil 'click'.
			Thermostat wiring	Put thermostat in cooling mode. Check 24 VAC on O (check between C and O); check for 24 VAC on W (check between W and C). There should be voltage on O, but not on W. If voltage is present on W, thermostat may be bad or wired incorrectly.

## Performance Troubleshooting

Performance Troubleshooting	Htg	Clg	Possible Cause	Solution
Insufficient capacity/ Not cooling or heating	X	X	Dirty filter	Replace or clean.
	X		Reduced or no air flow in heating	Check for dirty air filter and clean or replace.
				Check fan motor operation and airflow restrictions.
				Too high of external static. Check static vs. blower table.
		X	Reduced or no air flow in cooling	Check for dirty air filter and clean or replace.
				Check fan motor operation and airflow restrictions.
				Too high of external static. Check static vs. blower table.
	X	X	Leaky duct work	Check supply and return air temperatures at the unit and at distant duct registers if significantly different, duct leaks are present.
	X	X	Low refrigerant charge	Check superheat and subcooling per chart.
	X	X	Restricted metering device	Check superheat and subcooling per chart. Replace.
	X	X	Defective reversing valve	Perform RV touch test.
	X	X	Thermostat improperly located	Check location and for air drafts behind stat.
X	X	Unit undersized	Recheck loads & sizing. Check sensible clg. load and heat pump capacity.	
X	X	Scaling in water heat exchanger	Perform scaling check and clean if necessary.	
X	X	Inlet water too hot or too cold	Check load, loop sizing, loop backfill, ground moisture.	
High Head Pressure	X		Reduced or no air flow in heating	Check for dirty air filter and clean or replace.
				Check fan motor operation and air flow restrictions.
				Too high of external static. Check static vs. blower table.
		X	Reduced or no water flow in cooling	Check pump operation or valve operation/setting. Check water flow. Adjust to proper flow rate.
		X	Inlet water too hot	Check load, loop sizing, loop backfill, ground moisture.
	X		Air temperature out of range in heating	Bring return air temperature within design parameters.
		X	Scaling in water heat exchanger	Perform scaling check and clean if necessary.
	X	X	Unit overcharged	Check superheat and subcooling. Re-weigh in charge.
X	X	Non-condensables in system	Vacuum system and re-weigh in charge.	
X	X	Restricted metering device.	Check superheat and subcooling per chart. Replace.	
Low Suction Pressure	X		Reduced water flow in heating.	Check pump operation or water valve operation/setting.
				Plugged strainer or filter. Clean or replace.
				Check water flow. Adjust to proper flow rate.
	X		Water temperature out of range.	Bring water temperature within design parameters.
		X	Reduced air flow in cooling.	Check for dirty air filter and clean or replace. Check fan motor operation and air flow restrictions. Too high of external static. Check static vs. blower table.
	X	Air temperature out of range	Too much cold vent air? Bring entering air temperature within design parameters.	
Low Discharge Air Temperature in Heating	X	X	Insufficient charge	Check for refrigerant leaks.
	X		Too high of air flow	Check fan motor speed selection and air flow chart.
High humidity	X		Poor performance	See 'Insufficient Capacity'
		X	Too high of air flow	Check fan motor speed selection and airflow chart.
	X		Unit oversized	Recheck loads & sizing. Check sensible clg load and heat pump capacity.

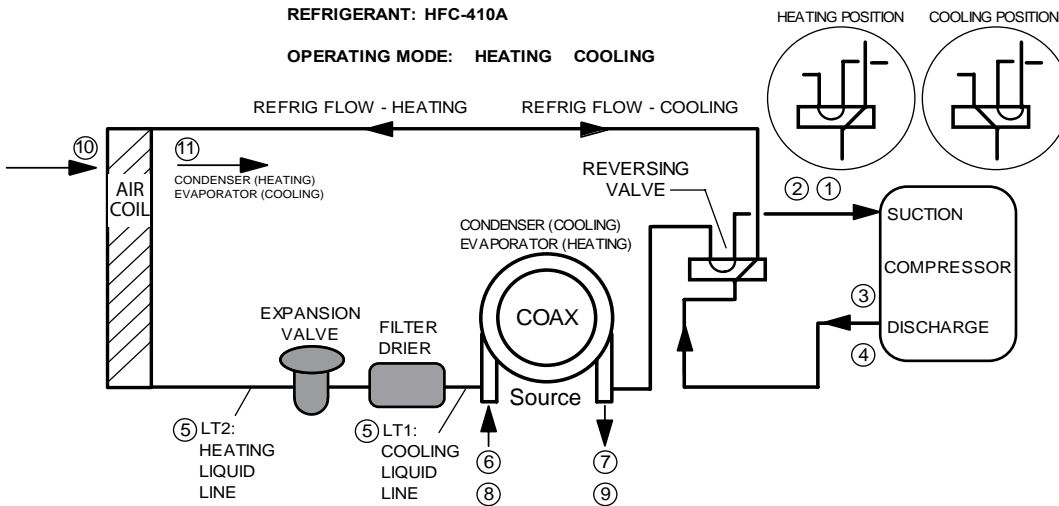
## Functional Troubleshooting Form

Water-to-Air Units

Customer: \_\_\_\_\_ Loop Type: \_\_\_\_\_ Startup Date: \_\_\_\_\_

Model #: \_\_\_\_\_ Serial #: \_\_\_\_\_ Antifreeze Type & %: \_\_\_\_\_

Complaint: \_\_\_\_\_



Description	Heating	Cooling	Notes
Voltage			
Compressor Amps			
1 Suction Temp			
2 Suction Press			
2a Saturation Temp			
2b Superheat			
3 Discharge Temp			
4 Discharge Press			
4a Saturation Temp			
4b Subcooling			
5 Liquid Line Temp			
6 Source Water In Tmp			
7 Source Water Out Tmp			Temp Diff. =
8 Source Water In Pres			
9 Source Water Out Pres			
9a Press Drop			
9b Flow Rate			
10 Return Air Temp			
11 Supply Air Temp			

Heat of Extraction (Absorption) or Heat of Rejection:

HE or HR =

Fluid Factor: (for Btuh)  
500 (Water); 485 (Antifreeze)

Fluid Factor: (for kW)  
4.18 (Water); 4.05 (Antifreeze)

\_\_\_\_\_ Flow Rate x \_\_\_\_\_ Temp. Diff x \_\_\_\_\_ Fluid Factor

Superheat = Suction temperature - suction saturation temp. = \_\_\_\_\_ (deg F)

Subcooling = Discharge saturation temp. - liquid line temp. = \_\_\_\_\_ (deg F)

**Note: Never connect refrigerant gauges during startup procedures. Conduct water-side analysis using P/T ports to determine water flow and temperature difference. If water-side analysis shows poor performance, refrigerant troubleshooting may be required. Connect refrigerant gauges as a last resort.**



**Notes**

## Revision History

Date:	Item:	Action:
1/24/23	All	Changed DXM and CXM controls to CXM2 and DXM2 controls.
02/10/15	All	Update Air Filter Sizes and Electrical Tables
06/13/14	Page 13 & 34	Change Text - Filter "rack" to "frame" Water Quality table updated
09/30/13	Edit Text - Page 29	Updated
11/09/12	POE Oil Warning	Added
	TCV072-120 Dimensional Data	Updated
	Water Quality Table	Updated
	Condensate Drain Connection	Updated
04/26/12	All	Added TCV sizes 160-300
02/09/12	Physical Data Table	Updated
10/07/11	Physical Data Table	Corrected TCV drain diameter
08/09/11	Unit Maximum Working Water Pressure	Updated to Reflect New Safeties
07/08/11	All	Added TCV072-120
01/03/11	Format - All Pages	Updated
07/26/10	Wiring Diagrams	Updated
07/07/10	Pre-Installation	Updated
06/11/10	Format - All Pages	Updated
11/5/09	Warranty	Updated
10/30/09	Functional Troubleshooting Table	Updated
10/15/09	First Published	

Due to ongoing product improvements, specifications and dimensions are subject to change and correction without notice or incurring obligations. Determining the application and suitability for use of any product is the responsibility of the installer. Additionally, the installer is responsible for verifying dimensional data on the actual product prior to beginning any installation preparations.

Incentive and rebate programs have precise requirements as to product performance and certification. All products meet applicable regulations in effect on date of manufacture; however, certifications are not necessarily granted for the life of a product. Therefore, it is the responsibility of the applicant to determine whether a specific model qualifies for these incentive/rebate programs.



1900 Wellworth Ave. • Jackson, MI 49203  
517.787.2100 • [www.marsdelivers.com](http://www.marsdelivers.com) • [www.heatcontroller.com](http://www.heatcontroller.com)

