Accessory Guide

CONTENTS

HOSE KITS

Carrier's Aquazone hose kits combine high quality and reliable operation to facilitate installation and individual balancing for Aquazone water source heat pump (WSHP) units. Each hose kit is tagged with a Carrier model number. Multiple hose kits ship together in boxes which are labeled by total quantity. See Fig. 1 for hose kit examples. Kits are pre-assembled based on the physical water piping connections and design flow rate for individual units. All hose kits include braided stainless steel, fire retardant hoses. Thermoplastic tube, bonded to the stainless steel braided hose, prevents kinking during installation. Kits are shipped in pairs to streamline matching of kits for individual units. See Table 1 for hose kit water connection specifications. Stainless steel hose construction accommodates all boiler/tower and geothermal applications, providing maximum corrosion protection and structural integrity. See Fig. 2 for configurations and sizing.

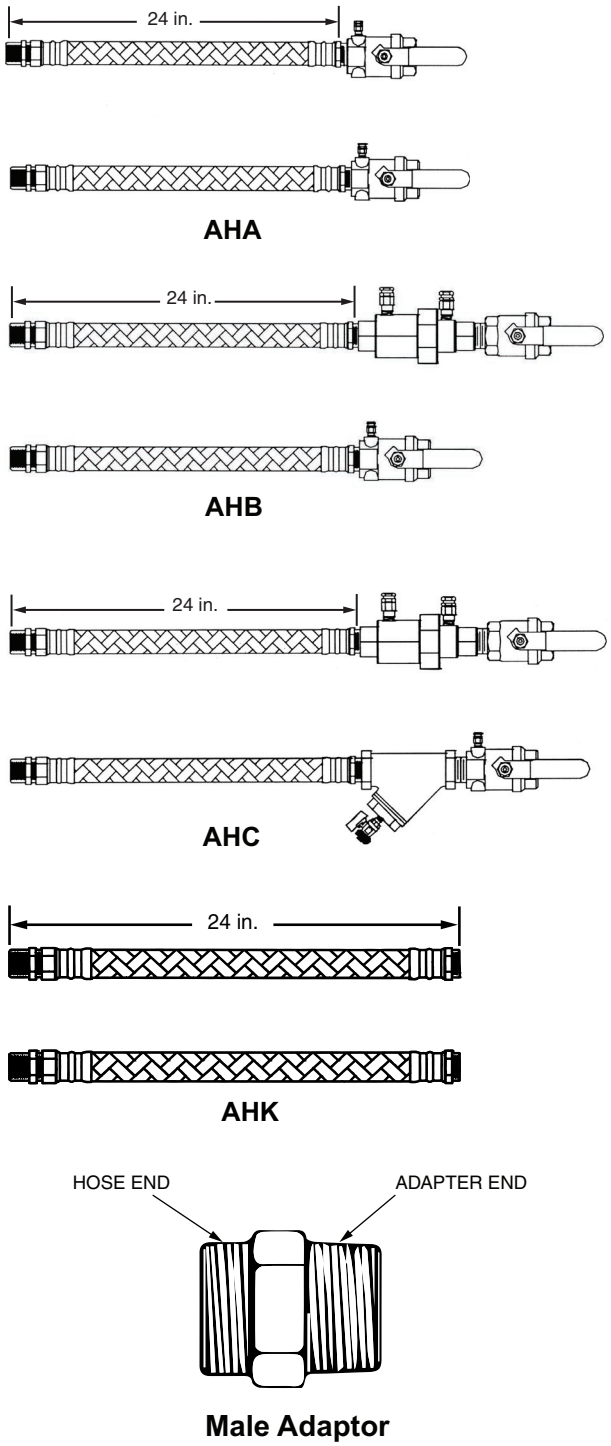
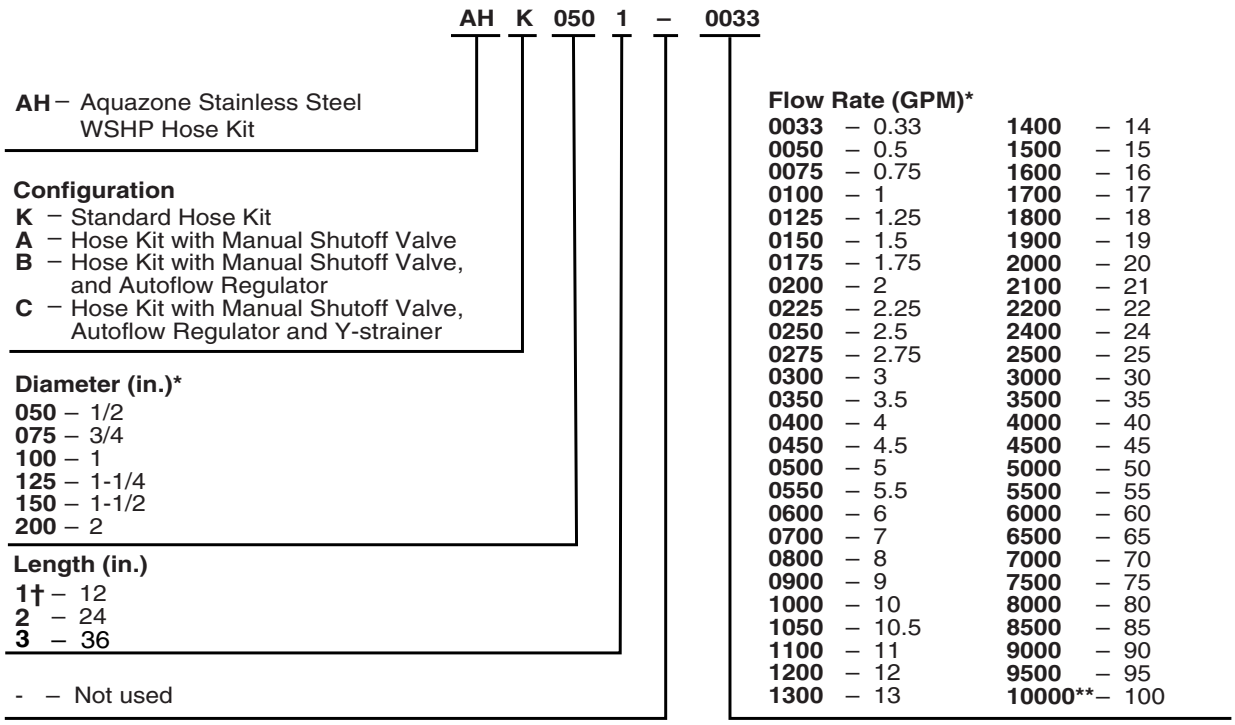


Fig. 1 — Aquazone Hose Kits

Table 1 — Hose Kit Water Connections

UNIT SIZE	WATER CONNECTION DIAMETER (FPT), in.						
	50PC	50PS	50PT	50VQP	50HQP	50PEC	50PSW
007	3/4	3/4	—	—	—	—	—
009	3/4	3/4	—	—	—	5/8 or 1/2	—
012	3/4	3/4	—	—	—	5/8 or 1/2	—
015	3/4	3/4	—	—	—	5/8 or 1/2	—
018	3/4	3/4	—	—	—	5/8 or 1/2	—
024	3/4	3/4	3/4	—	—	—	—
025	—	—	—	—	—	—	3/4
030	3/4	1	—	—	—	—	—
035	—	—	—	—	—	—	3/4
036	3/4	1	1	—	—	—	—
041	3/4	—	—	—	—	—	—
042	3/4	1	—	—	—	—	—
048	1	1	1	—	—	—	—
049	—	—	—	—	—	—	1
060	1	1	1	—	—	—	—
061	—	—	—	—	—	—	1
070	1	1	1	—	—	—	—
071	—	—	—	—	—	—	1
072	—	—	—	1	1	—	—
096	—	—	—	1	1	—	—
120	—	—	—	1-1/2*	1-1/4*	—	—
122	—	—	—	—	—	—	1-1/4
150	—	—	—	—	1-1/2*	—	—
151	—	—	—	1-1/2*	—	—	—
180	—	—	—	—	1-1/2*	—	1-1/2
181	—	—	—	1-1/2*	—	—	—
210	—	—	—	2	—	—	1-1/2
240	—	—	—	2	—	—	2
242	—	—	—	—	2	—	—
300	—	—	—	2	—	—	—
360	—	—	—	2	—	—	2
420	—	—	—	—	—	—	2

NOTE: All Carrier hose kits have threaded connections except 5/8 in. sweat connections.
*With optional water side economizer kit the water in connection will be 2 in. and will require a field provided adapter.



* Not all diameters or flow rates available on all hose kits. Refer to following pages for further information.

† Only available on AHK hose kits.

** Requires additional model number digit.

Fig. 2 — Model Number Nomenclature

AHK**** 1/2 in. to 2 in. Stainless Steel Braided Hose Kit

This hose kit provides a flexible connection of the WSHP to the loop water piping. (See Fig. 3 and Table 2.)

SPECIFICATIONS

Designed for water source heat pump applications.

Stainless steel braided hoses

- Reinforced EPDM (ethylene propylene diene monomer rubber) hose core, stainless steel hose braid, and brass OT58 fittings.
- Swivel connection female ends provides a union between WSHP and the hose kit.
- Two NPSH (hose end) to MNPT (WSHP end) adapters provided and installed on each hose kit.

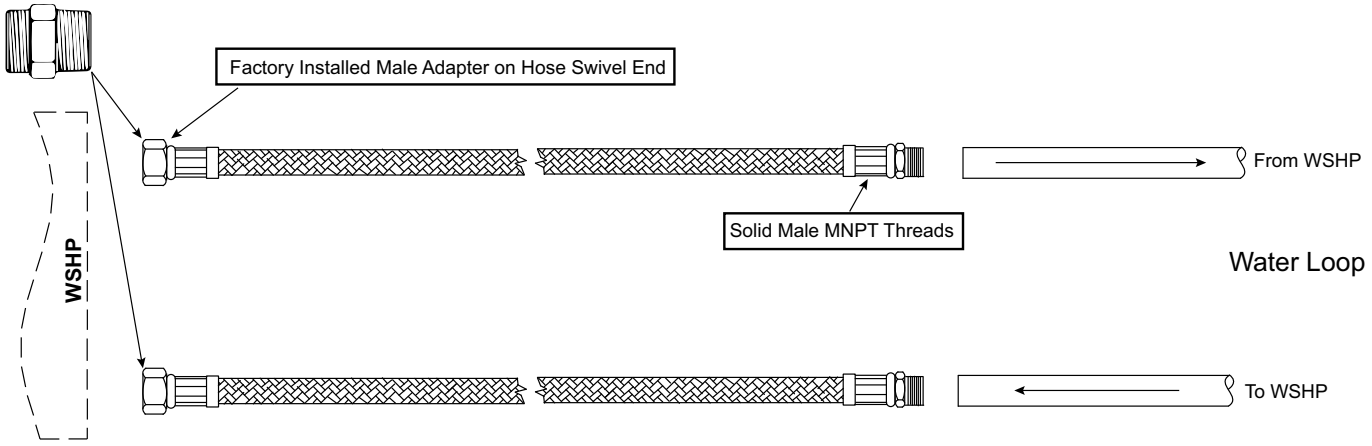


Fig. 3 — AHK** 1/2 in. to 2 in. Stainless Steel Braided Hose Kit**

Table 2 — AHK** 1/2 in. to 2 in. Stainless Steel Braided Hose Kit Specifications**

Model Number		AHK0501	AHK0502	AHK0503	AHK0752	AHK0753	AHK1002	AHK1003
Connection Diameter (in.)		1/2			3/4		1	
Kit Connection Type	WSHP Side	Swivel Male NPT Threads (Includes Factory Installed NPSH to MNPT Male Adapter)						
	Water Loop Side	Solid Male NPT Threads						
Hose Length (in.)		12	24	36	24	36	24	36
Temperature Range (°F)		5 to 248						
Max Working Pressure (psi)		400				300		
Min. Bend Radius (in.)		3-9/16					4-3/8	
Cv (Constant Volume)		3.9	3.5	3.2	12.8	11.5	21.5	19.6

Model Number		AHK1252	AHK1253	AHK1502	AHK1503	AHK2002	AHK2003
Connection Diameter (in.)		1-1/4		1-1/2		2	
Kit Connection Type	WSHP Side	Swivel Male NPT Threads (Includes Factory Installed NPSH to MNPT Male Adapter)					
	Water Loop Side	Solid Male NPT Threads					
Hose Length (in.)		24	36	24	36	24	36
Temperature Range (°F)		5 to 248					
Max Working Pressure (psi)		400				300	
Min. Bend Radius (in.)		5-1/8		7-1/8		9-1/2	
Cv (Constant Volume)		29	27.6	54	51	68	65

AHA**** 3/4 in. to 1-1/2 in. Stainless Steel Braided Hose Kit with Ball Valves

This hose kit provides a flexible connection between the WSHP and the water loop piping and manual shut off valves with pressure/temperature ports for servicing. (See Fig. 4 and Table 3.)

SPECIFICATIONS

Designed for water source heat pump applications.

Stainless Steel Braided Hose

- Reinforced EPDM (ethylene propylene diene rubber) hose core, stainless steel hose braid, and brass OT58 fittings.
- Swivel connection with female ends provides a union between WSHP and the hose kit.
- Two NPSH (hose end) to MNPT (WSHP end) adapters provided and installed on each hose kit.

Ball Valve

- Hot forged brass ASTM B238 ball valve with integral 1/4 in. FNPT P/T (pressure/temperature) ports and union end.

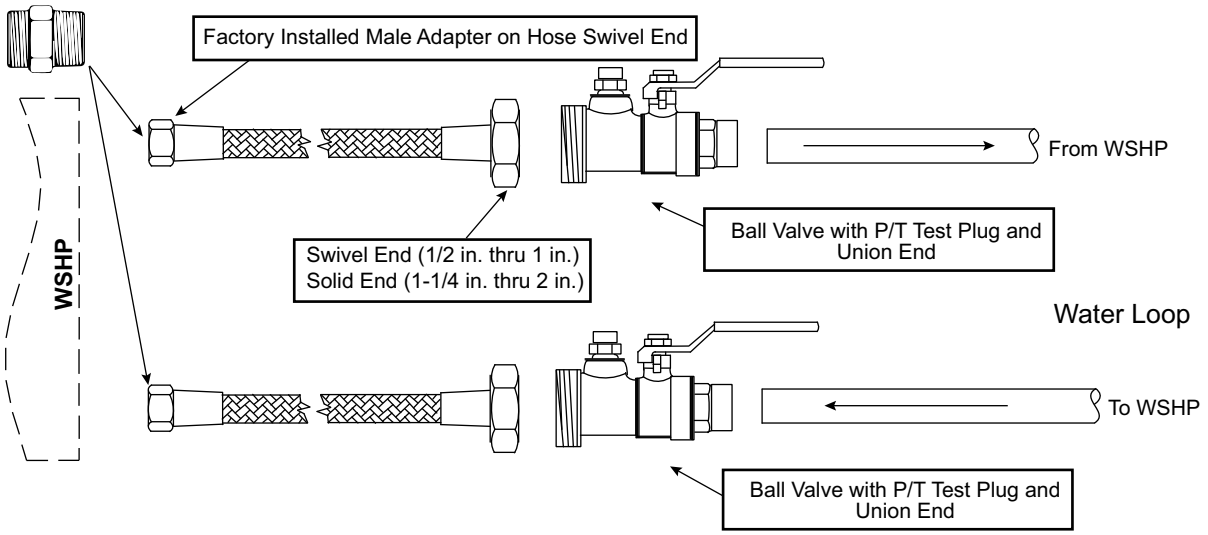


Fig. 4 — AHA** 3/4 in. to 1-1/2 in. Stainless Steel Braided Hose Kit with Ball Valves**

Table 3 — AHA** 3/4 in. to 1-1/2 in. Stainless Steel Braided Hose Kit with Ball Valves**

Model Number		AHA0502	AHA0503	AHA0752	AHA0753	AHA1002	AHA1003
Connection Diameter (in.)		1/2		3/4		1	
Kit Connection Type	WSHP Side	Swivel Male NPT Threads (Includes Factory Installed NPSH to MNPT Male Adapter)					
	Water Loop Side	Union End with Female NPT Threads					
Hose Length (in.)		24	36	24	36	24	36
Max Temperature (°F)		248					
Max Working Pressure (psi)		400					
Min. Bend Radius (in.)		3-9/16				4-3/8	
Cv	Hose	3.5	3.2	12.8	11.5	21.5	19.6
	Shut Off Valve	21		42		42	

Model Number		AHA1252	AHA1253	AHA1502	AHA1503	AHA2002	AHA2003
Connection Diameter (in.)		1-1/4		1-1/2		2	
Kit Connection Type	WSHP Side	Swivel Male NPT Threads (Includes Factory Installed NPSH to MNPT Male Adapter)					
	Water Loop Side	Union End with Female NPT Threads					
Hose Length (in)		24	36	24	36	24	36
Max Temperature (°F)		248					
Max Working Pressure (psi)		300					
Min. Bend Radius (in.)		5-1/8		7-1/8		9-1/2	
Cv	Hose	29	27.6	54	51	68	65
	Shut Off Valve	132		132		345	

AHB**** 1/2 in. to 2 in. Stainless Steel Braided Hose Kit with Manual Shutoff Valve and Auto-flow Regulator

This hose kit provides a flexible connection between the WSHP and the water loop piping, manual shut off with pressure/temperature ports for servicing and auto-flow regulation to provide a constant flow rate regardless of pressure changes in the system. (See Fig. 5.) This hose kit is ordered for a specific desired flow rate to be maintained by the auto-flow regulator. See Table 4 and flow rates in Application Data section, page 16 for additional information.

SPECIFICATIONS

Designed for water source heat pump applications:

Stainless Steel Braided Hose

- Reinforced EPDM (ethylene propylene diene rubber) hose core, stainless steel hose braid, and brass OT58 fittings.
- Swivel connection with female end provides a union between WSHP and the hose kit.
- Two NPSH (hose end) and MNPT (WSHP end) adapters provided and installed on each hose kit.

Ball Valve

- Hot forged brass ASTM B238 ball valve with integral 1/4 in. FNPT P/T (pressure/temperature) ports and union end.

Combination Auto Flow Regulator and Ball Valve

- Hot forged brass ASTM B238 body with integral 1/4 in. FNPT P/T (pressure/temperature) ports and union end. Removable, non-clogging flow cartridge.

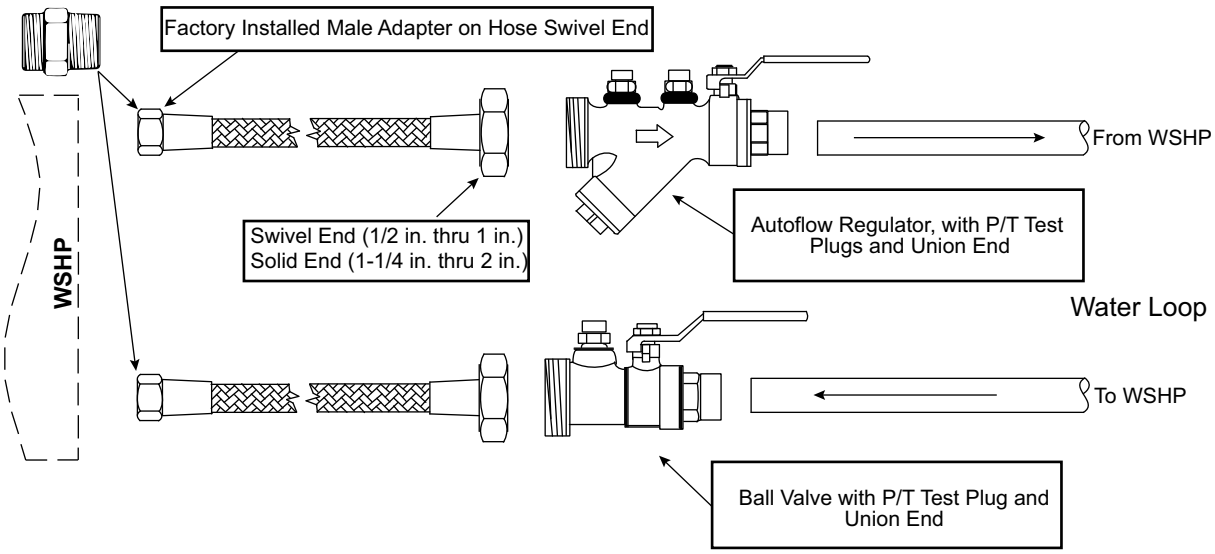


Fig. 5 — AHB** 1/2 in. to 2 in. Stainless Steel Braided Hose Kit**

Table 4 — AHB**** Stainless Steel Braided Hose Kit with Ball Valve and Auto-flow Regulator

Model Number		AHB0502	AHB0503	AHB0752	AHB0753	AHB1002	AHB1003
Connection Diameter (in.)		1/2		3/4		1	
Kit Connection Type	WSHP Side	Swivel Male NPT Threads (Includes Factory Installed NPSH to MNPT Male Adapter)					
	Water Loop Side	Union End with Female NPT Threads					
Hose Length (in.)		24	36	24	36	24	36
Max Temperature (°F)		248					
Max Working Pressure (psi)		400					
Min. Bend Radius (in.)		3 -9/16				4-3/8	
Cv	Hose	3.9	3.2	12.8	11.5	21.5	19.6
	Shut Off Valve	21		42			
	Regulator*	14		14		32	
Regulator PSID Range		2-45 (0.5-10.5 gpm) 5-65 (11-15 gpm)				2-45	
Available Regulator Flow Rate (gpm)		0.5-10.5				0.5-22.0	

*Based on valve body only.

Model Number		AHB1252	AHB1253	AHB1502	AHB1503	AHB2002	AHB2003
Connection Diameter (in.)		1-1/4		1-1/2		2	
Kit Connection Type	WSHP Side	Swivel Male NPT Threads (Includes Factory Installed NPSH to MNPT Male Adapter)					
	Water Loop Side	Union End with Female NPT Threads					
Hose Length (in.)		24	36	24	36	24	36
Max Temperature (°F)		248					
Max Working Pressure (psi)		300					
Min. Bend Radius (in.)		5-1/8		7-1/8		9-1/2	
Cv	Hose	29	27.6	54	51	68	65
	Shut Off Valve	132				345	
	Regulator*	32		77		77	
Regulator PSID Range		2-45					
Available Regulator Flow Rate (gpm)		8.0-22.0		8.0-70.0		25.0-70.0	

*Based on valve body only.

AHC**** 1/2 in. to 2 in. Stainless Steel Braided Hose Kit with Manual Shutoff Valve, Autoflow Regulator and Y-Strainer

This hose kit provides a flexible connection between the WSHP and the water loop piping, manual shut off with pressure/temperature ports for servicing, auto-flow regulation to provide a constant flow rate regardless of pressure changes in the system, and a 20 mesh wye strainer with a blow-down valve. This hose kit is ordered for a specific desired flow rate to be maintained by the auto-flow regulator. See Fig. 6, Table 5, and flow rates in Application Data section, page 16 for additional information.

SPECIFICATIONS

Designed for water source heat pump applications.

Stainless Steel Braided Hose

- Reinforced EPDM (ethylene propylene diene rubber) hose core, stainless steel hose braid, and brass OT58 fittings.
- Swivel connection with female end provides a union between WSHP and the hose kit.
- Two NPSH (hose end) and MNPT (WSHP end) adapters provided and installed on each hose kit.

Combination Auto Flow Regulator and Ball Valve

- Hot forged brass ASTM B238 body with integral 1/4 in. FNPT P/T (pressure/temperature) ports and union end. Removable, non-clogging flow cartridge.

Combination Strainer and Ball Valve

- Hot forged brass ASTM B238 body with two integral 1/4 in. FNPT P/T (pressure/temperature) ports and union end. Strainer basket is 20 mesh, 304 Stainless Steel.

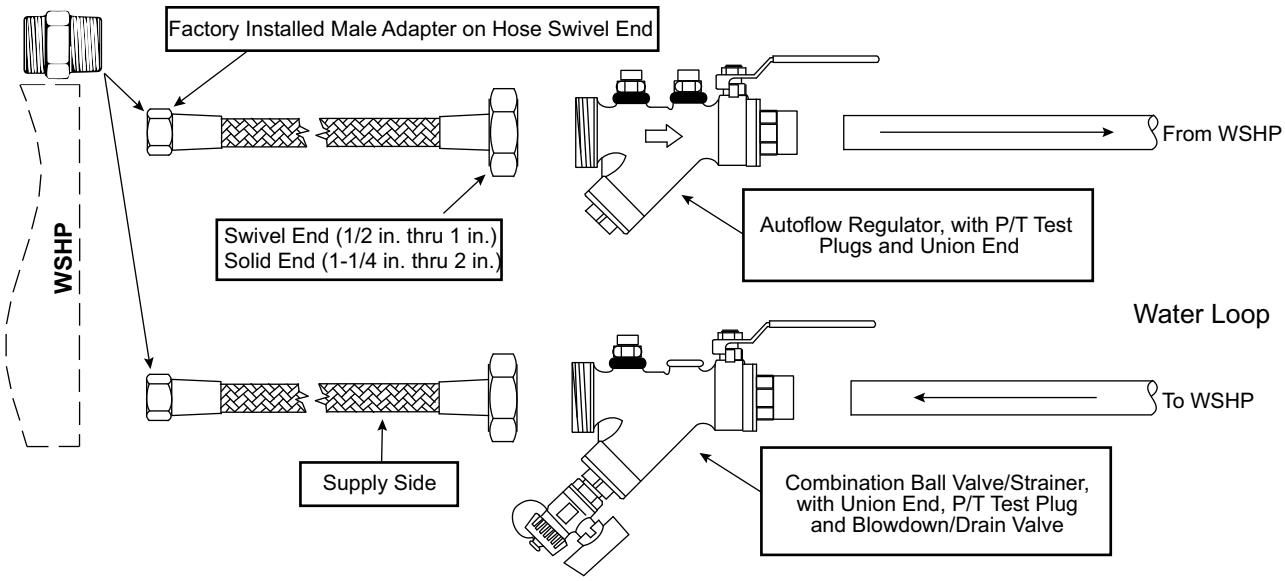


Fig. 6 — AHC** 1/2 in. to 2 in. Stainless Steel Braided Hose Kit**

Table 5 — AHC**** Stainless Steel Braided Hose Kit with Ball Valve, Auto-flow Regulator, and Strainer

Model Number		AHC0502	AHC0503	AHC0752	AHC0753	AHC1002	AHC1003
Connection Diameter (in.)		1/2		3/4		1	
Kit Connection Type	WSHP Side	Swivel Male NPT Threads (Includes Factory Installed NPSH to MNPT Male Adapter)					
	Water Loop Side	Union End with Female NPT Threads					
Hose Length (in.)		24	36	24	36	24	36
Max Temperature (°F)		248					
Max Working Pressure (psi)		400					
Min. Bend Radius (in.)		3-9/16				4-3/8	
Cv	Hose	3.9	3.2	12.8	11.5	21.5	19.6
	Shut Off Valve	21	21	42	42	42	42
	Regulator*	14				32	
	Strainer	5.5				9	
Regulator PSID Range		2-45 (0.5-10.5 gpm) 5-65 (11-15 gpm)				2-45	
Available Regulator Flow Rate (gpm)		0.5-10.5				0.5-22.0	

*Based on valve body only.

Model Number		AHC1252	AHC1253	AHC1502	AHC1503	AHC2002	AHC2003
Connection Diameter (in.)		1-1/4		1-1/2		2	
Kit Connection Type	WSHP Side	Swivel Male NPT Threads (Includes Factory Installed NPSH to MNPT Male Adapter)					
	Water Loop Side	Union End with Female NPT Threads					
Hose Length (in.)		24	36	24	36	24	36
Max Temperature (°F)		248					
Max Working Pressure (psi)		300					
Min. Bend Radius (in.)		5-1/8		7-1/8		9-1/2	
Cv	Hose	29	27.6	54	51	68	65
	Shut Off Valve	132	132	132	132	345	345
	Regulator*	32	—	77			—
	Strainer	28				68	
Regulator PSID Range		2-45					
Available Regulator Flow Rate (gpm)		8.0-22.0		8.0-77.0		25.0-70.0	

*Based on valve body only.

BALL VALVES

ABV***MP Ball Valve

Carrier's ball valves can be field installed between supply and return lines and the WSHP. These valves provide manual stoppage of water flow during maintenance or when service is needed. Valves include an interchangeable union end, 1/4 in. FNPT pressure and temperature port with P/T test plug, and memory stop. Refer to Fig. 7 and Table 6 for model type and dimensions.

On the ABV***MP model valves the P/T ports can be used to measure flow. A gage device can be inserted in the port and the pressure drop through the circuit can be determined by taking the difference across two valves installed on the inlet and outlet of a WSHP. The memory stop on the valve is used to lock the valve in a particular position.

SPECIFICATIONS

- 600 WOG (water, oil, gas), 325°F
- Blowout-proof shaft
- Double shaft seals

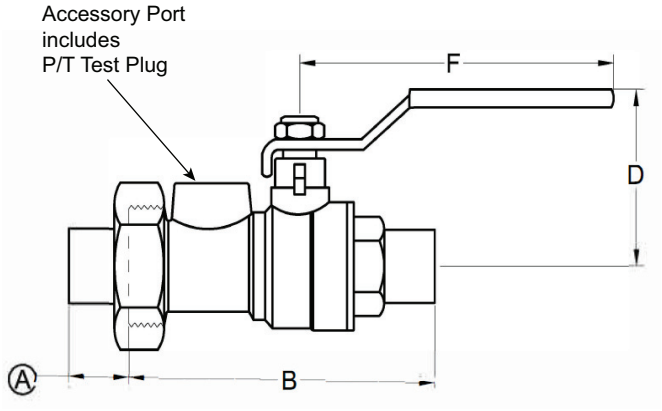


Fig. 7 — Ball Valve with Accessory Port, P/T Test Plug, and Memory Stop (ABV*MP)**

Table 6 — Ball Valves With P/T Port & Memory Stop (ABV*MP)**

MODEL NUMBER	SIZE (IN.)	CONNECTION TYPE	Cv	DIMENSIONS (IN.)			
				A	B	F	D
ABV050MP	1/2	FNTP Fixed End x NPT Union End	8	2	.5	3.35	1.85
ABV075MP	3/4	FNTP Fixed End x FNPT Union End	14	2.2	.75	3.54	2.05
ABV100MP	1		32	2.6	1	3.74	2.15
ABV125MP	1-1/4		59	3	1.25	4.53	2.39
ABV150MP	1-1/2		118	3.5	1.5	5.55	2.89
ABV200MP	2		345	1.36	5	5.5	3.4

SOLENOID WATER VALVES

Carrier's motorized water valves are normally closed, 2-position water valves field installed on the WSHP supply line. The valve opens to allow 100% of the fluid flow through the WSHP and closes to shut off flow to the WSHP. Motorized isolation valves are often wired to be energized when the compressor contact is energized. See WSHP unit wiring diagram for recommended wiring. This allows for reduced operating cost by shutting off flow to units that do not have an active call for heating or cooling. Use of motorized isolation valves requires a variable flow system with variable speed system pumps and/or a system bypass.

Two models of accessory solenoid water valves are available. Model AMV***FHS for sizes 3/4 in. through 1 in. and model 23B004*N01 for sizes 1-1/4 in. through 2 in. (See Tables 7-9.)

Table 7 — AMV*FHS**

VALVE SPECIFICATION	ACTUATOR SPECIFICATIONS
• Action: 2-way NC • Valve Body Rating: ANSI Class 125 • Leakage Rating: ANSI Class III • Close Off Ratings: According to ANSI/FCI 70-2 • Medium Temperature Range: 34°F (1°C) to 230°F (110°C) • Flow Characteristic: Linear	• Control Signal: 2-position • Operating Voltage: 24Vac +/- 20% • Power Consumption: 9.8 VA • Agency Certification: UL listed to UL873 cUL certified to Canadian Standard C22.2 No. 24-93 • Mounting Location: NEMA 1 (interior only) • Weight: 1.18 lb (0.54 kg) • Dimensions in. (mm): 3.4 (85) x 4.4 (111) W x 2.3 (58) D

Table 8 — 23B004*N01

VALVE SPECIFICATION	ACTUATOR SPECIFICATIONS
• Forged brass body and chrome plated brass ball • Fluid Temperature Limit: 23°F to 203°F • Valve Body Pressure Rating 580 psig • Maximum Close Off Pressure: 220 psig • Recommended Operating Pressure: 50 psig • Flow Characteristic: Equal percentage	• Control Signal: 2-position • Operating Voltage: AC 24V + 25%/ –20% • Power Consumption: 2.1 VA • Travel Time: 60 seconds • Weight: 1.25 lbs

Table 9 — Solenoid Water Valves Physical Data

MODEL NUMBER	DIAMETER (IN.)	FLOW COEFFICIENT
AMV075FHS	3/4	4.1
AMV100FHS	1	7
23B0040N01	1-1/4	18.7
23B0041N01	1-1/2	46.8
23B0042N01	2	73.7

STRAINER

Carrier's strainers are field installed on the return line of the WSHP. These strainers are a combination strainer and ball valve and equipped with a union end, blow down port, and two accessory ports. The strainers provide a 20-mesh removable filter screen. (See Fig. 8 and Table 10.)

SPECIFICATIONS

- 600 WOG (water, oil, gas), 325°F
- Blowout-proof shaft
- Double shaft seals

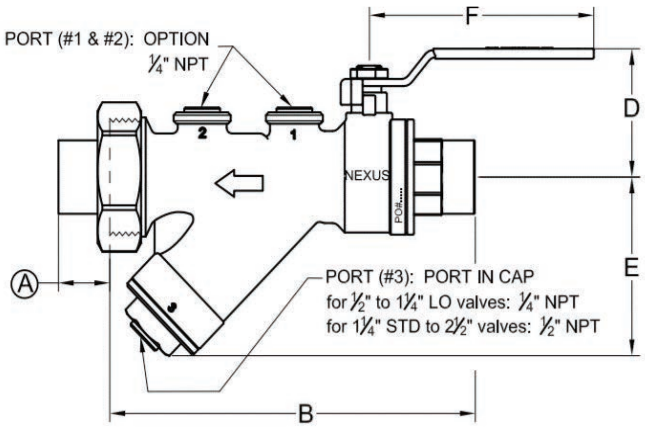


Fig. 8 — Strainer and Ball Valve Dimensions

Table 10 — Strainer Dimensions

MODEL NUMBER	DIAMETER SIZE (IN.)	CONNECTION TYPE	Cv	DIMENSIONS (IN.)				
				A	B	E	D	F
AYS050B	1/2	FNPT Union x FNPT	5.5	1	3.9	1.6	1.7	1.9
AYS075B	3/4		9	1	4.9	2.4	1.8	3.1
AYS100B	1		9	1.2	5.1	2.4	1.8	3.1
AYS125B	1-1/4		28	1.57	6.3	3.5	2.5	4.3
AYS150B	1-1/2		28	1.37	6.3	3.5	2.5	4.3
AYS200B	2		68	1.36	9.1	5.1	3.4	5.5

ELECTRIC DUCT HEATERS

AH**** Electric Duct Heaters (5 to 20 kW)

Carrier's electric duct heaters provide an economical heating source that is able to easily integrate into an existing HVAC (Heating, Ventilation and Air-Conditioning) system and new installations. These heaters provide space heating, primary heating, auxiliary heating, and reheating in a wide variety of configurations. The design of the heaters allows for free flow air. See Fig. 9-10 and Tables 11-12 for electric duct heater specifications and dimensions.

SPECIFICATIONS

- UL approved and CSA listed
- Automatic limit switch for primary over temperature protection
- Manual reset limit switch for secondary over temperature protection
- Power and control terminal board

Table 11 — AH** Electric Duct Heaters Specifications**

kW	MODEL NUMBER	VOLTAGE	PHASE	AMPS	STAGES
5	AH05JS	208	1	24	1
	AH05GS	240		20.8	
	AH05ES	277		18.1	
	AH05KS	208	3	13.9	
	AH05HS	240		12	
	AH05FS	480		6	
10	AH10JL	208	1	47.6	2
	AH10JM				
	AH10GL	240		41.7	
	AH10GM				
	AH10EL	277		36.1	
	AH10EM				
	AH10KL	208	3	27.8	
	AH10KM				
	AH10HL	240		24.1	
	AH10HM				
	AH10FL	480		12.0	
	AH10FM				
15	AH15JL	208	1	72.1	2
	AH15JM				
	AH15GL	240		62.5	
	AH15GM				
	AH15EL	277		54.2	
	AH15EM				
	AH15KL	208	3	41.6	
	AH15KM				
	AH15HL	240		36.1	
	AH15HM				
	AH15FL	480		18.0	
	AH15FM				
19.8	AH20JL	208	1	95.2	2
20.0	AH20GL	240		83.3	
20.0	AH20EL	277		72.2	
17.2	AH20KL	208	3	47.7	
19.9	AH20HL	240		47.9	
20.0	AH20FL	480		24.1	

Table 12 — AH** Electric Duct Heater Dimensions**

kW	MODEL NUMBER	DIMENSION (IN.)					MIN. CFM ENTERING AIR TEMPERATURE		
		W	H	D	B	A	<78°F	79-90°F	91-100°F
5	AH05*S	11.50	12.00	4.25	12.00	13.94	395	485	635
	AH05GS								
	AH05ES								
	AH05KS				13.00				
	AH05HS								
	AH05FS								
10	AH10J-EL	15.50	15.00	4.25	13.00	16.94	735	890	1140
	AH10K-FL				14.00				
	AH10J-EM	12.50	14.00		13.00	15.94	675	790	990
	AH10K-FM				14.00				
15	AH15J-EL	15.50	15.00	4.25	17.00	16.94	970	1130	1400
	AH15K-FL				18.00				
	AH15J-EM	12.50	14.00		14.00	15.94	890	1010	1255
	AH15K-FM								
19.8	AH20JL	15.5	15.00	4.25	17.00	16.94	1180	1340	1665
20.0	AH20GL								
20.0	AH20EL								
17.2	AH20KL				14.00				
19.9	AH20HL								
20.0	AH20FL								

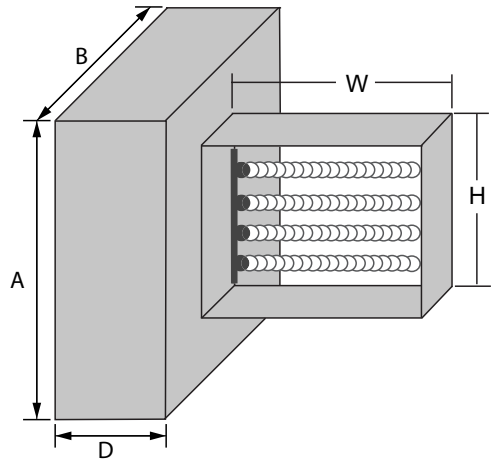


Fig. 9 — AH**Electric Duct Heater**

WSHP Electric Duct Heater Installation Guidance

For safe operation and best performance, the following procedures for Carrier's WSHP Electric duct heaters must be adhered to.

Heaters may be installed in the sides of either horizontal or vertical ducts but never in the top or bottom of a horizontal duct. Heaters installed in vertical ducts are tested and approved for UP airflow only.

WSHP electric duct heaters must be installed:

- A minimum of 4 ft from the discharge of the WSHP
- At least 2 ft from either side of a duct elbow or turn.
- At least 2 ft from any canvas of a duct connector.
- At least 4 ft downstream from an air filter.
- At least 4 ft upstream from a humidifier.

To install a slip-in heater (Fig. 10), cut an opening, as required in the side of the duct. Slide heater in the duct using control box as template to mark the mounting screw holes. Remove unit and drill mounting holes. Mount unit duct with sheet metal screws. Connect high and low voltage supplies along with fan interlock circuit (see Fig. 11 for typical wiring diagram). Larger heaters may require hangers (see Table 13 for sizing).

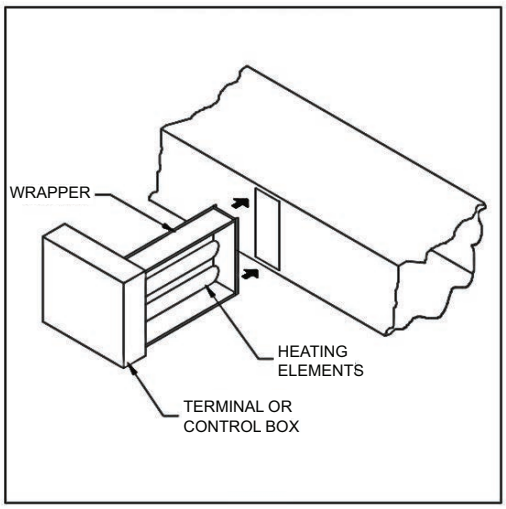


Fig. 10 — Slip-In Heater

Table 13 — WSHP Heater Sizing

HEATER SIZE	WSHP Sizes
5 kW AH05**	50PC 012-70
	50PS 012-70
	50PT All Sizes
	50HQP,VQP All Sizes
10 kW AH10**	50PC 024-070
	50PS 024-070
	50PT All Sizes
	50HQP,VQP All Sizes
15 kW AH15**	50PC 030-070
	50PS 030-070
	50PT 036-070
	50HQP,VQP All Sizes
20 kW AH20**	50PC 036-070
	50PS 036-070
	50PT 036-070
	50HQP,VQP All Sizes

Electric Duct Heaters Controls

Carrier's WSHP standard control package does not control electric duct heaters. The duct heaters sequence of operations can be controlled by either a thermostat or an aquastat - if the boilerless control option on the WSHP is selected. If Carrier's WSHP Open controller is installed, the duct heater will turn on if heating is required and the space temperature is greater than 1°F below the heating setpoint and the SAT is below the "Aux Heat Control Setpoint." For more information on the control of an accessory duct heater with the WSHP Open controller, please reference the latest WSHP Open Integration Guide.

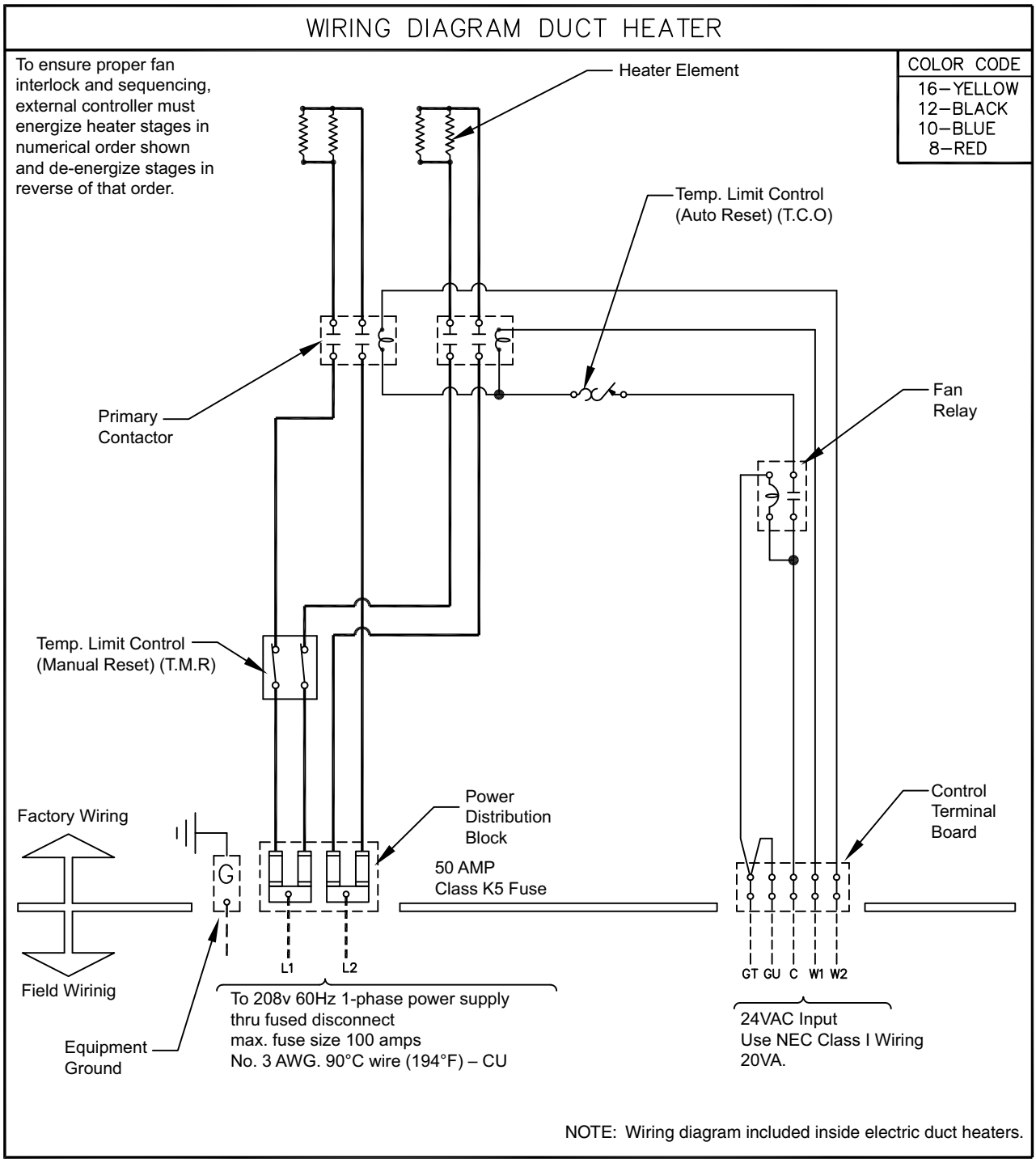


Fig. 11 — Typical Wiring Diagram for Electric Duct Heaters

APPLICATION DATA

Flow Rate Application Data

Individual WSHP system capacity and energy usage can be manipulated by changing either the water loop flow rate of the WSHP system, or the flow rate (GPM). As the capacity and energy usage is altered, so too are the operating and installation costs. The decision as to lower or raise the system GPM is truly a trade-off where the positives and negatives of increasing or decreasing are appropriately weighed.

Raising the GPM of the system will most often raise the overall system capacity. However, increasing system GPM also means likely increasing the size of the loop pump, cooling tower, boiler and/or the size of the loop piping, which can result in an increase in overall system operating and/or first cost. Thus, the added capacity of increasing system flow rate may not outweigh the added costs.

While lowering the GPM of the system will often result in a lower system capacity, the overall system cost savings associated with the possibility of a smaller loop pump, cooling tower, boiler and/or loop piping may provide significant cost benefits. However, a lower water loop flow may require a cooling tower and/or boiler to work harder, and thus experience higher operating costs. Refer to equations in section, How to Determine Flow Rates and see Table 14.

How to Determine Flow Rates

Flow rate (GPM) can be determined if the following information is available: the entering water temperature, an estimation of the leaving water temperature, and the type of fluid being used. The formula is as follows:

$$\textbf{GPM} = \frac{Q}{Cp \times \Delta T}$$

$$\textbf{GPM} = \frac{Q}{500 \times \Delta T}$$

Average GPMs:

Water Loop (Boiler/Tower):
2 to 3.0 GPM

Geothermal:
1.5 to 2.0 GPM

Lower GPM provides lower capacity but higher LWT

(Leaving-Water Temperature

LEGEND

Q = Rate Of Heat Transfer (Btu/hr)
GPM = Flow Rate (Gallons Per Minute)
ΔT = Temperature Difference (in °F)
Cp = Specific Heat Of Fluid

In the equation, the factor "500" is based on using water as the heat transfer fluid. This fluid factor is obtained by using the weight of a gallon of water (8.33 lb) multiplied by the specific heat of the water (1.0) multiplied by 60 (minutes). When using water, the product comes out to 499.8 (or rounded to 500).

Example: 4 Ton, 50PC WSHP with a nominal heat transfer rate of 48,000 Btu/hr and a desired water temperature change of 10°F, the resulting flow rate (GPM) is 9.6 or about 2.5 GPM per ton. Using these values, the equation is:

$$\text{GPM} = \frac{48{,}000}{500 \times 10} \qquad \text{GPM} = 9.6$$

The resulting flow rate (GPM) is 9.6 or about 2.5 GPM per ton (see Table 14).

Table 14 — Aquazone Hose Kit Flow Rates (For Selecting AHB and AHC Model Hose Kits)

	FLOW RATES	
MODEL SUFFIX	FLOW RATE (gpm)	HOSE KIT DIAMETER (in.)
-0033	.33	1/2
-0050	.5	1/2
-0075	.75	1/2 and 3/4
-0100	1.0	1/2 and 3/4
-0125	1.25	1/2 and 3/4
-0150	1.5	1/2 and 3/4
-0175	1.75	1/2 and 3/4
-0200	2.0	1/2 and 3/4
-0225	2.25	1/2 and 3/4
-0250	2.5	1/2 and 3/4
-0275	2.75	1/2 and 3/4
-0300	3.0	1/2 and 3/4
-0350	3.5	1/2 and 3/4
-0400	4.0	3/4
-0450	4.5	1/2 and 3/4
-0500	5.0	3/4
-0550	5.5	3/4
-0600	6.0	3/4
-0700	7.0	3/4
-0800	8.0	3/4, 1, and 1-1/4
-0900	9.0	3/4, 1, and 1-1/4
-1000	10.0	3/4, 1, and 1-1/4
-1050	10.5	3/4 and 1
-1100	11.0	3/4, 1, and 1-1/4
-1200	12.0	3/4, 1, and 1-1/4
-1300	13.0	3/4, 1, and 1-1/4
-1400	14.0	3/4, 1, and 1-1/4
-1500	15.0	3/4, 1, 1-1/4, and 1-1/2
-1600	16.0	1, and 1-1/4
-1700	17.0	1-1/4
-1800	18.0	1-1/4
-1900	19.0	1-1/4
-2000	20.0	1-1/4, 1-1/2, and 2
-2100	21.0	1, and 1-1/4
-2200	22.0	1, and 1-1/4
-2400	24.0	1, and 1-1/4
-2500	25.0	1-1/2, and 2
-3000	30.0	1-1/2, and 2
-3500	35.0	2
-4000	40.0	2
-4500	45.0	2
-5000	50.0	2
-5500	55.0	2
-6000	60.0	2
-6500	65.0	2
-7000	70.0	2
-7500	75.0	2
-8000	80.0	2
-8500	85.0	2
-9000	90	2
-9500	95	2
-10000	100	2

When To Use An Auto-flow Regulator

Water source heat pumps are designed and selected to provide a specific amount of cooling and heating capacity at specific operating conditions. While all HVAC equipment is designed around specific return and supply air conditions, WSHPs differentiate themselves by also requiring specific water loop conditions. As a result, it is extremely important that these water loop conditions remain as constant as possible during operation of the WSHP to ensure that both cooling and heating demands are met.

One major component of these water loop conditions is the water loop flow rate, often referenced as the GPM or gallons per minute. One method of controlling the GPM is by manually balancing each WSHP, however this is often very time consuming (each WSHP requires manual balancing), and the flow rate through a manually balanced valve tends to fluctuate over time, often requiring frequent re-balancing. A better method to ensure a constant water loop flow rate at each WSHP is to use an automatic flow control device, or an auto-flow regulator. An auto-flow regulator is a pressure independent automatic flow limiting valve, with the main component being an internal flow cartridge that is factory set to a specific flow rate, or GPM.

Auto-flow regulators are utilized at each WSHP (each WSHP will have its own auto-flow regulator) and the auto-flow regulator will maintain the designed GPM over a wide water loop pressure differential. Thus, as the water loop pressure changes (which can be common in systems as different WSHPs on the same water loop are turning on/off and their isolation valves open/close as a result), the water loop flow rate to each WSHP remains constant. Additionally, the system installation is much easier with auto-flow regulators compared to manually balanced systems, and the "fluctuation" seen in manually balanced systems is no longer an issue.

Understanding water loop differential pressure changes can best be done by looking at some examples of WSHP systems.

Figure 12 shows a standard closed loop system with a boiler and cooling tower where the overall water loop flow rate is 36 GPM. Since there are 4 WSHPs of equal capacity, each WSHP will receive an equal amount of water equaling 9 GPM per WSHP. In this example system, there are neither isolation valves nor auto-flow regulators so the water flow through each unit is an equal amount regardless of whether or not the WSHP is operating.

Figure 13 now shows the same system with only isolation valves and no auto-flow regulators at each WSHP. As some of the WSHPs turn off, their isolation valves shut, and the operating WSHPs will be receiving more water flow then they were designed for. As a result, these units will likely not be providing the designed capacity.

Figure 14 has the same system as shown in Fig. 13 installed with Carrier's auto-flow regulators and solenoid valves. The auto-flow regulator valves allow the WSHPs that are operating to maintain the designed GPM and maintain capacity. This creates a balanced system so each unit receives the exact amount of water it is designed for.

All figures shown assume that the water loop pump is a constant volume pump. However, it is becoming more and more common for loop pumps to be operated by VFDs (variable frequency drive). Figure 15 shows the same system as Fig. 12-15, but now with a VFD added to the loop pump. As some of the WSHPs shut down and their isolation valves close, the VFD will sense the change in overall loop pressure of the system and will adjust the overall GPM. In this situation, an auto-flow regulator may not be required if the sole purpose is to ensure design water flow through each WSHP since the VFD can assist in accomplishing this.

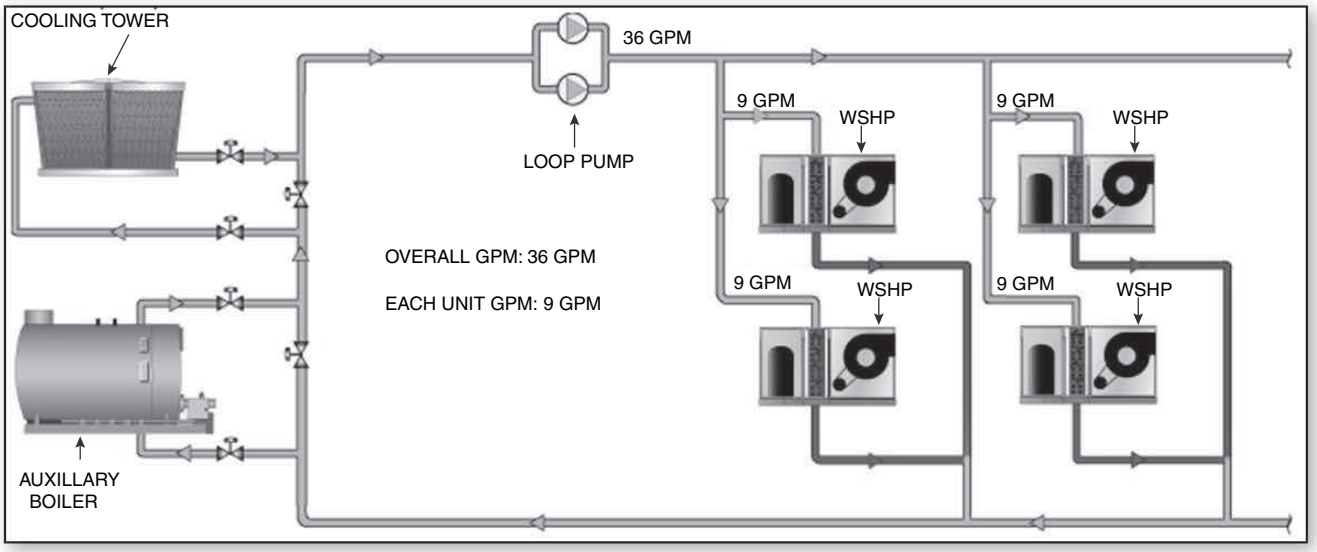


Fig. 12 — Standard Closed Water Loop System with Boiler and Cooling Tower

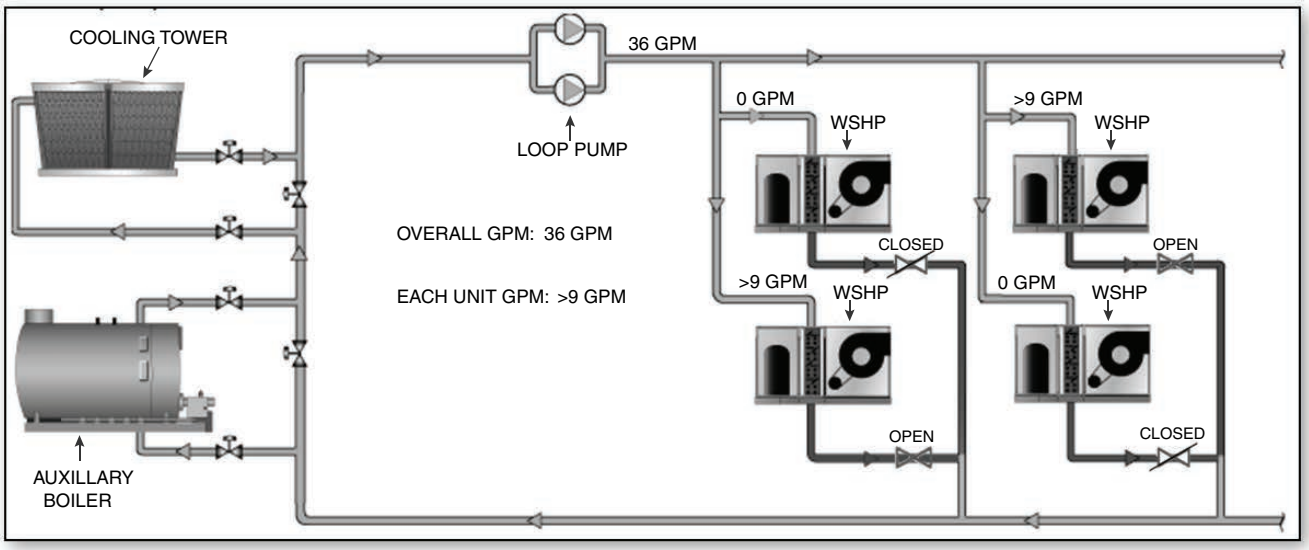


Fig. 13 — Water Loop System with Isolation Valves

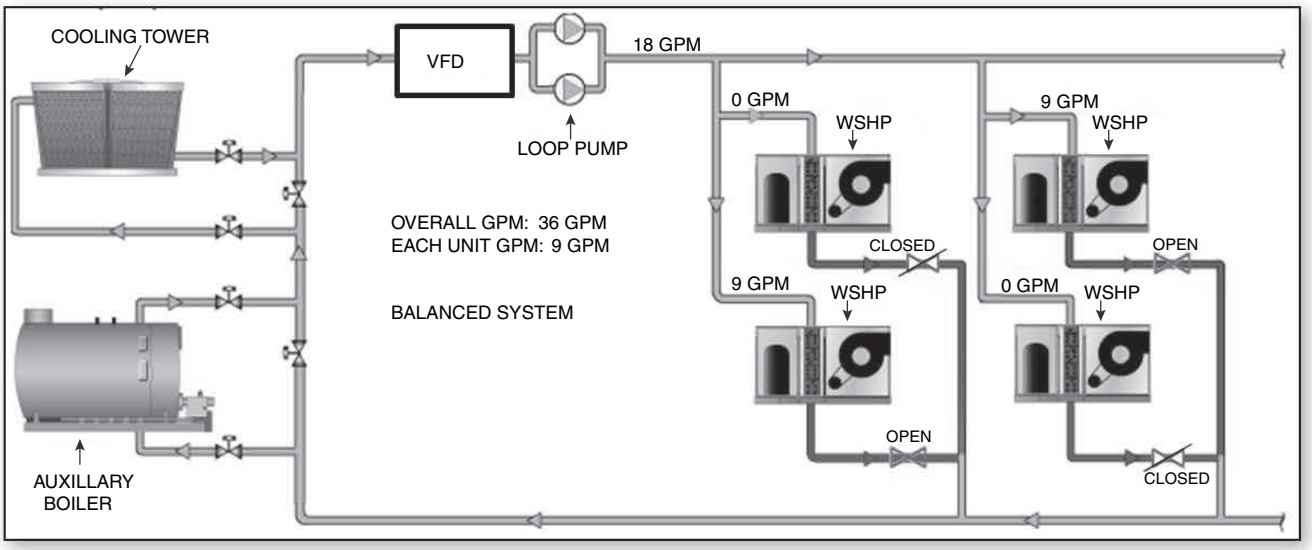


Fig. 14 — Water Loop System with Autoflow Regulator and Solenoid Valve

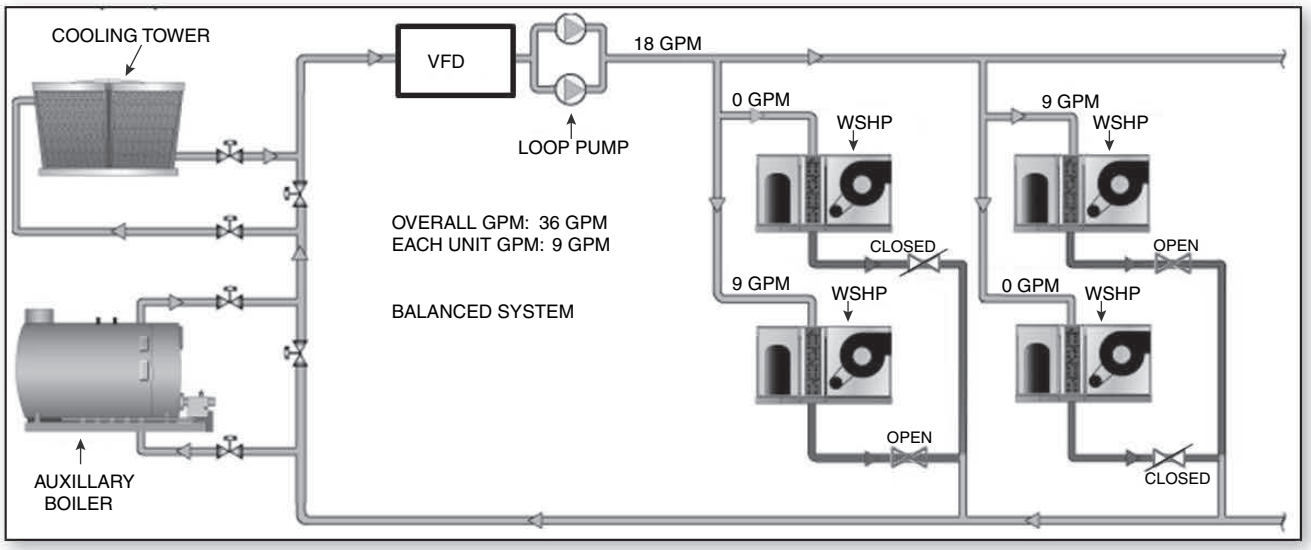


Fig. 15 — Water Loop System with Variable Frequency Drive

Sensible Heat Equation

Knowing what size electric heater is needed can be based of knowing the volume of airflow through the WSHP and the required temperature rise of the air.

The formula is as follows:

$$Q = (p)(V)(Cp)(DT)$$

LEGEND

Cp = Specific Heat Of Air (Btu/lb F)
V = Volume Flow Rate
p = Density Of The Air Standard Conditions (lb/ft^3)
DT = Flow Coefficient

$$Q = 1.085(CFM)(\Delta T)$$
$$Q = 1.085(2400)(8°F)$$
$$Q = 20{,}832Btuh$$
$$Q = \frac{48{,}000\ MBtuh}{500 \times 10\ MBtuh/kW\ Q}$$

Utilizing the properties of air the equation is simplified to:

$$Q = 1.085(CFM)(\Delta T)$$

Example: 6-Ton 50PS WSHP with a CFM of 2400 and the next goal is to have a ΔT of 8°F. What size heater should be selected? The resulting heating to obtain this ΔT at this flow rate is a 6.1kW heater.

$$Q = 1.085(CFM)(\Delta T)$$
$$Q = 1.085(2400)(8°F)$$
$$Q = 20{,}832Btuh$$
$$Q = \frac{48{,}000\ MBtuh}{500 \times 10\ MBtuh/kW\ Q} = 6.1kW$$

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