Aquazone™ Water Source Heat Pump Accessories: Hose Kits, Ball Valves, Solenoid Water Valves, and Electric Heaters

Application Data

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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. 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. 1-6.

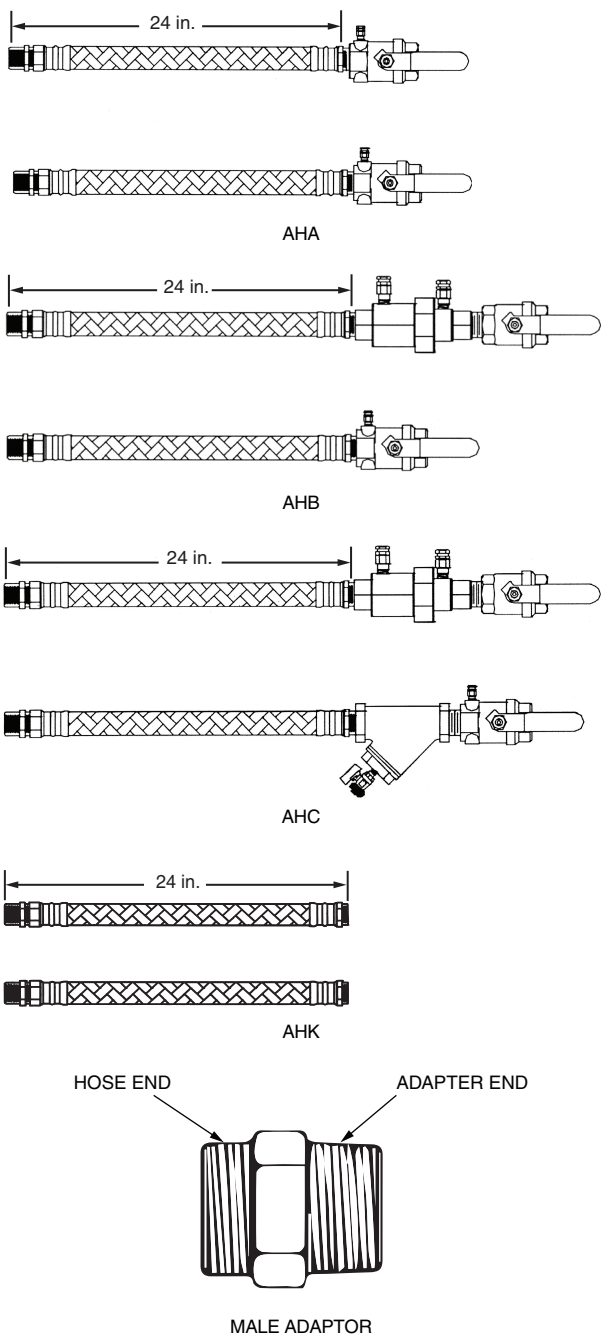
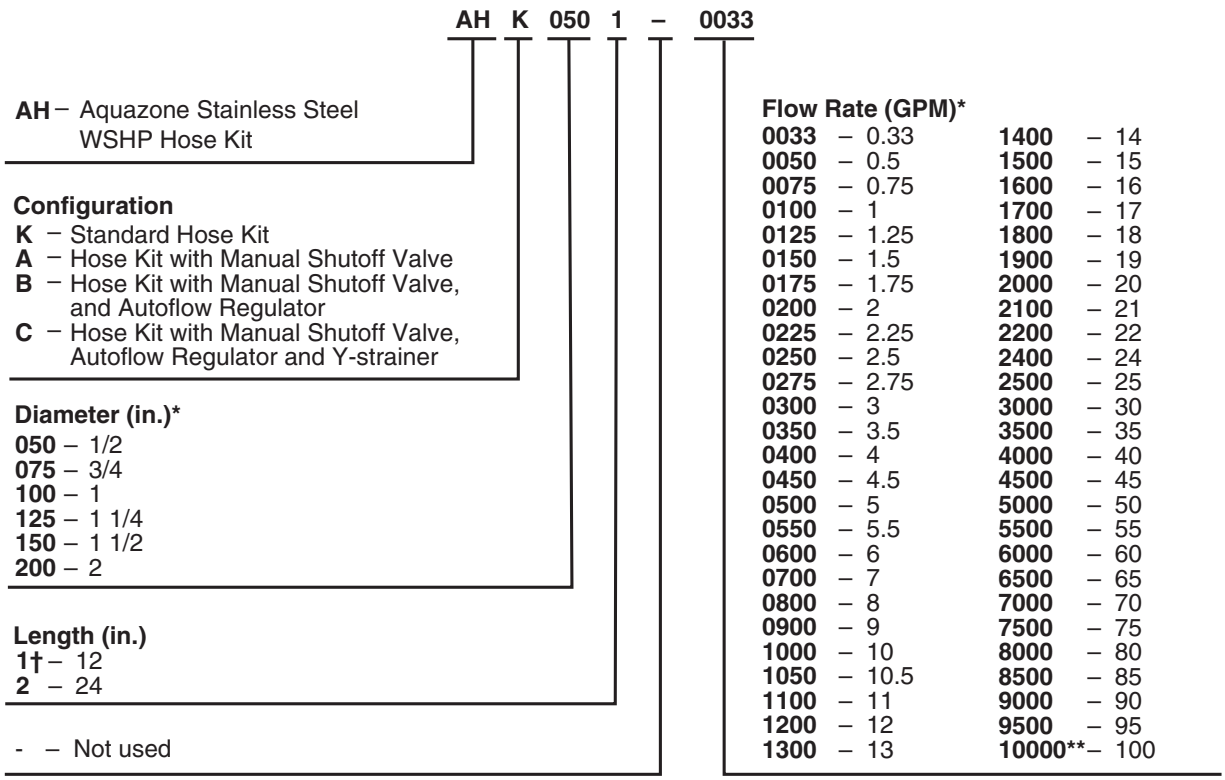


Fig. 1 — Aquazone Hose Kits

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	3/4	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.



* Not all diameters or flow rates available on all hose kits. Please 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 —** Standard hose kit connects the WSHP to the water pipes. See Fig. 3 and Table 2.

SPECIFICATIONS

- Designed for water source heat pump applications.
- Kevlar* synthetic fiber reinforced EPDM (ethylene propylene diene monomer rubber) hose core with stainless steel hose braid.
- Swivel connection with dual female ends provides union between heat pump and piping system.
- Two male adapters (Fig. 1) provided with each hose kit.

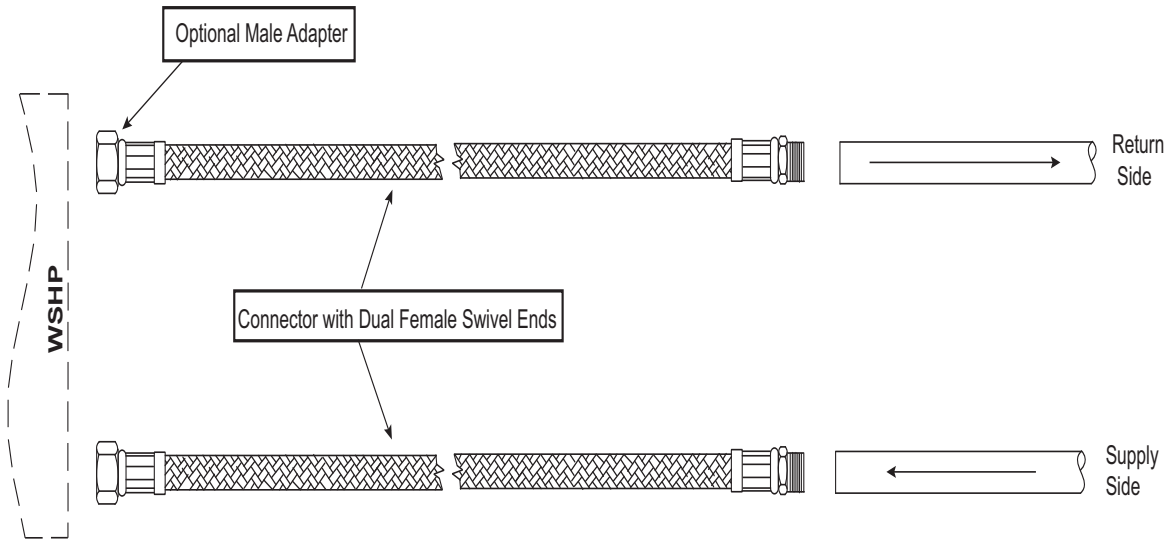


Fig. 3 — AHK** 1/2 in. to 2 in. Stainless Steel Braided Hose Kit**

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

AHK STAINLESS STEEL HOSE KIT			
KIT INCLUDES	**Supply Side:** stainless steel hose, swivel ends		
	Return Side: stainless steel hose, swivel ends		
MODEL NUMBER	**Models Available**	**Diameter (in.)**	**Braided Hose Length (in.)**
AHK0501	50PEC09-18	1/2	12
AHK0752	50PC007-042 50PS007-024 50PT024 50PSW025-035	3/4	24
AHK1002	50PC048-070 50PS030-070 50PT036-070 50HQP,VQP 072-096 50PSW049-071	1	24
AHK1252	50HQP120 50PSW122	1 1/4	24
AHK1502	50HQP150-180 50VQP120-181 50PSW180-210	1 1/2	24
AHK2002	50HQP242 50VQP210-360 50PSW240-420	2	24

*Kevlar is a registered trademark of DuPont.

AHA** 3/4 in. to 1-1/2 in. Stainless Steel Braided Hose Kit with Ball Valves —** Basic hose kit with manual shut-off valve manually stops water flow. See Fig. 4 and Tables 3 and 4.

SPECIFICATIONS

- Designed for water source heat pump applications.
- Kevlar synthetic fiber reinforced EPDM hose core with stainless steel hose braid
- Swivel connection with dual female ends provides union between heat pump and piping system.
- Brass OT58 fittings
- Ball valve with integral P/T (pressure/temperature) ports and union end.
- Two male adapters (Fig. 1) provided with each hose kit.

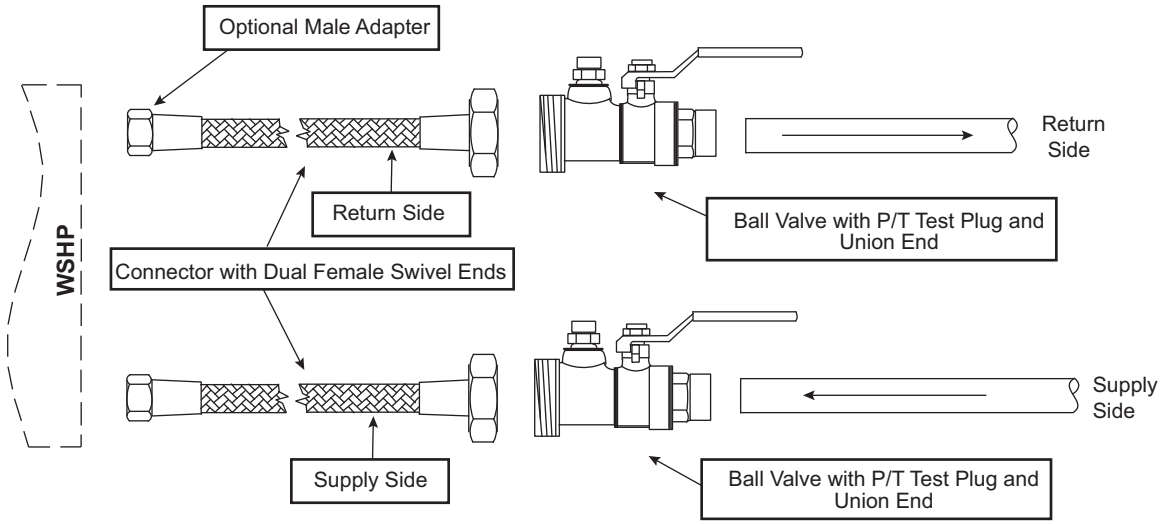


Fig. 4 — AHA** 3/4 in. to 1-1/2 in. Stainless Steel Braided Hose Kit with Ball Valves**

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

AHA STAINLESS STEEL HOSE KIT			
KIT INCLUDES	**Supply Side:** Ball Valve with P/T plug, stainless steel hose, swivel ends		
	Return Side: Ball Valve with P/T plug, stainless steel hose, swivel ends		
MODEL NUMBER	**Models Available**	**Diameter (in.)**	**Braided Hose Length (in.)**
AHA0752	50PC007-042 50PS007-024 50PT024 50PSW025-035	3/4	24
AHA1002	50PC048-070 50PS030-070 50PT036-070 50HQP,VQP072-096 50PSW049-071	1	24
AHA1252	50HQP120 50PSW122	1 1/4	24
AHA1502	50HQP150-180 50PSW180-210 50VQP180-210	1 1/2	24

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

MODEL NUMBER	WORKING PRESSURE (psi)	MINIMUM BURST PRESSURE (psi)	MINIMUM BEND RADIUS (in.)	FLOW COEFFICIENT
AHA0752	400	1600	3.560	12.8
AHA1002	400	1600	4.375	21.5
AHA1252	300	1200	5.125	29.0
AHA1502	300	1200	7.125	54.0
AHA2002	300	1200	9.500	68.0

AHB** 1/2 in. to 2 in. Stainless Steel Braided Hose Kit with Manual Shutoff Valve and Autoflow Regulator —** Hose kit with a manual shutoff valve and autoflow regulator maintains a set GPM. Autoflow regulator valves provide a constant flow rate; if the pressure changes (ex. additional heat pumps) each flow control valve will adjust to the conditions. See Fig. 5 and Tables 5, 6, and flow rates in Application Data section, page 13.

SPECIFICATIONS

- Designed for water source heat pump applications
- Kevlar synthetic fiber reinforced EPDM hose core with stainless steel hose braid
- Swivel connection with dual, female ends provides union between heat pump and piping system.
- Brass OT58 fittings
- Ball valve with integral P/T (pressure/temperature) ports and union end
- Two male adapters (Fig. 1) provided with each hose kit.

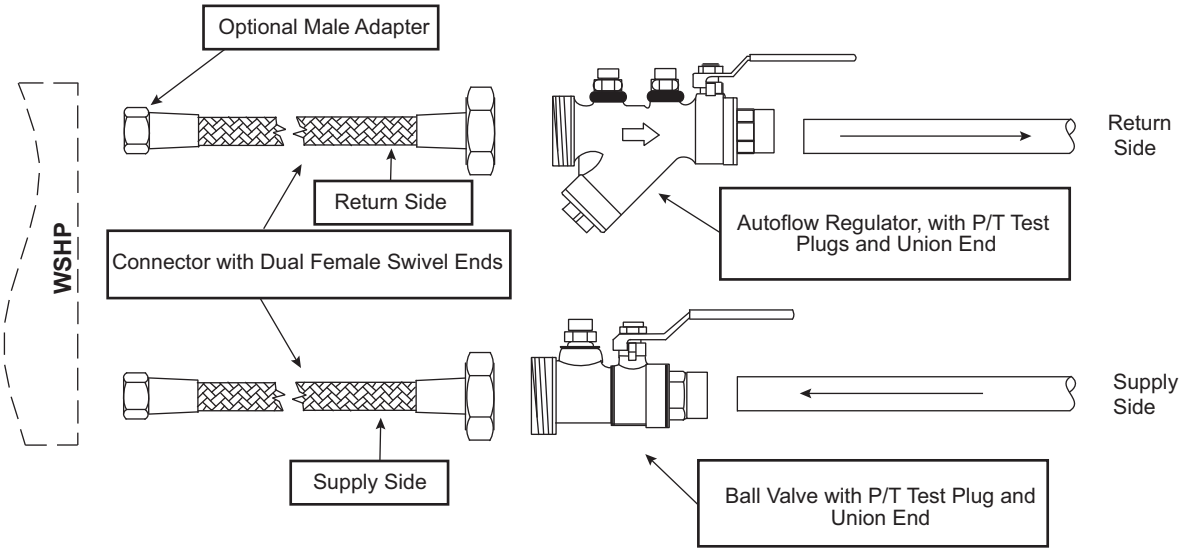


Fig. 5 — AHB** 1/2 in. to 2 in. Stainless Steel Braided Hose Kit**

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

AHB STAINLESS STEEL HOSE KIT			
KIT INCLUDES	**Supply Side:** Ball Valve with P/T plug, stainless steel hose, swivel ends		
	Return Side: Ball Valve with P/T plug, autoflow regulator, stainless steel hose, swivel ends		
MODEL NUMBER	**Models Available**	**Diameter (in.)**	**Braided Hose Length (in.)**
AHB0502	50PEC09-18	1/2	24
AHB0752	50PC007-042 50PS007-024 50PT024 50PSW025-035	3/4	24
AHB1002	50PC048-070 50PS030-070 50PT036-070 50PSW049-071 50HQP,VQP072-096	1	24
AHB1252	50PSW122 50HQP120	1 1/4	24
AHB1502	50PSW180-210 50HQP150-180 50VQP120-181	1 1/2	24
AHB2002	50HQP242 50VQP210-360 50PSW240-420	2	24

Table 6 — AHB** 1/2 in. to 2 in. Stainless Steel Braided Hose Kit Physical Data**

MODEL NUMBER	WORKING PRESSURE (psi)	MINIMUM BURST PRESSURE (psi)	MINIMUM BEND RADIUS (in.)
AHB0502	400	1600	3.562
AHB0752	400	1600	3.562
AHB1002	400	1600	4.375
AHB1252	300	1200	5.125
AHB1502	300	1200	7.125
AHB2002	300	1200	9.500

AHC** 1/2 in. to 2 in. Stainless Steel Braided Hose Kit with Manual Shutoff Valve, Autoflow Regulator and Y-Strainer —** Hose kit with a manual shutoff valve, autoflow regulator to maintains a set GPM and Y strainer for hard water applications. Autoflow regulator provides a constant flow rate; if the pressure changes (ex. additional heat pumps) each flow control valve will adjust to the conditions. The Y strainer can filter water with high mineral content which can cause damage over time to equipment. See Fig. 6 and Tables 7, 8, and flow rates in Application Data section, page 13.

SPECIFICATIONS

- Designed for water source heat pump applications.
- Kevlar synthetic fiber reinforced EPDM hose core with stainless steel hose braid
- Swivel connection with dual female ends provides union between heat pump and piping system.
- Brass OT58 fittings
- Ball valve with integral P/T (pressure/temperature) ports and union end
- Two male adapters (Fig. 1) provided with each hose kit.

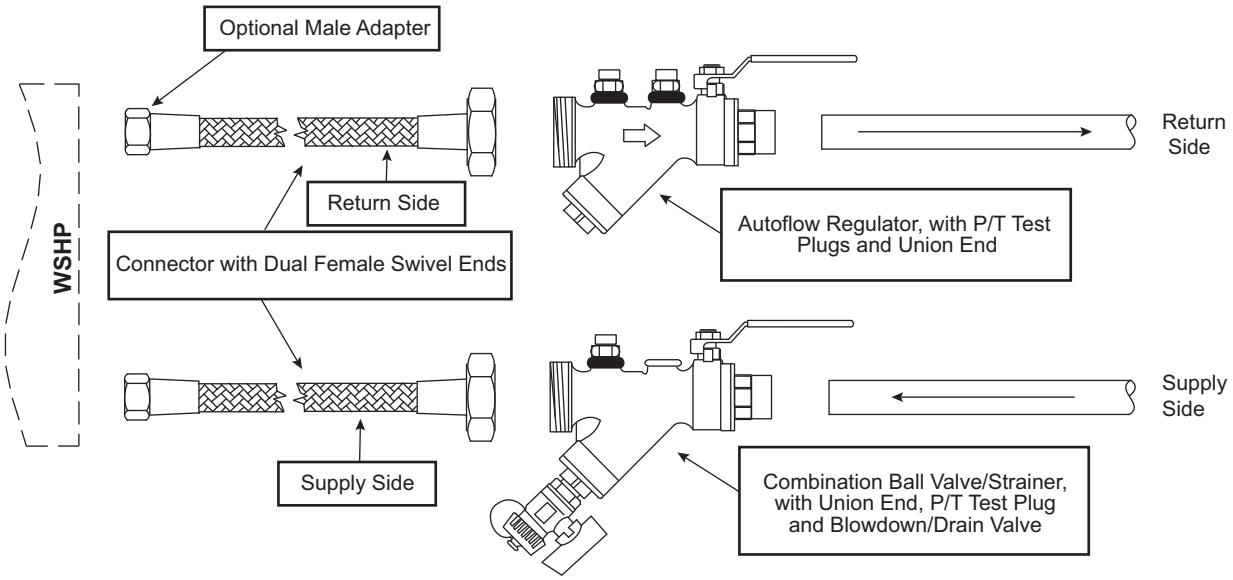


Fig. 6 — AHC** 1/2 in. to 2 in. Stainless Steel Braided Hose Kit**

Table 7 — AHC** 1/2 in. to 2 in. Stainless Steel Braided Hose Kit Specifications**

AHC STAINLESS STEEL HOSE KIT			
KIT INCLUDES	**Supply Side:** Combination Ball Valve/Strainer with P/T plug, stainless steel hose, blow down/drain valve and swivel end		
	Return Side: Ball Valve with P/T plug, autoflow regulator, stainless steel hose, and swivel ends		
MODEL NUMBER	**Models Available**	**Diameter (in.)**	**Braided Hose Length (in.)**
AHC0502	50PEC09-18	1/2	24
AHC0752	50PC007-042 50PS007-024 50PT024 50PSW 025-035	3/4	24
AHC1002	50PC048-070 50PS030-070 50PT036-070 50PSW049-071 50HQP,VQP072-096	1	24
AHC1252	50PSW122 50HQP120	1 1/4	24
AHC1502	50PSW180-210 50HQP150-180 50VQP120-181	1 1/2	24
AHC2002	50HQP242 50VQP210-360 50PSW240-420	2	24

Table 8 — AHC** 1/2 in. to 2 in. Stainless Steel Braided Hose Kit Physical Data**

MODEL NUMBER	WORKING PRESSURE (psi)	MINIMUM BURST PRESSURE (psi)	MINIMUM BEND RADIUS (in.)
AHC0502	400	1600	3.562
AHC0752	400	1600	3.562
AHC1002	400	1600	4.375
AHC1252	300	1200	5.125
AHC1502	300	1200	7.125
AHC2002	300	1200	9.500

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. 7 and 8 and Tables 9-17.

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

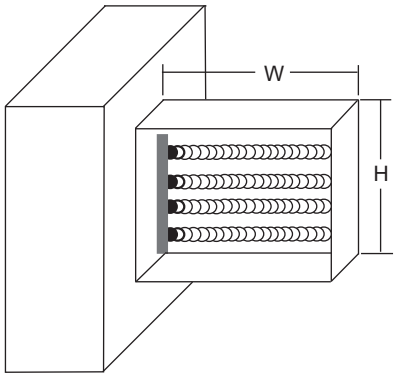


Fig. 7 — AH** Electric Duct Heater**

Table 9 — AH05 Electric Duct Heater Specifications**

MODEL NUMBER	kW	VOLTAGE	PHASE	AMPS	STAGES	DIMENSIONS	
						WIDTH (in.)	HEIGHT (in.)
AH05GS	5	240	1	20.8	1	11.5	12.0
AH05JS	5	208	1	24.0	1	11.5	12.0
AH05HS	5	240	3	12.0	1	11.5	12.0
AH05ES	5	277	1	18.1	1	11.5	12.0
AH05FS	5	480	3	6.0	1	11.5	12.0
AH05KS	5	208	3	13.9	1	11.5	12.0

Table 10 — AH05 Minimum CFM Air Temperature**

MODEL NUMBER	kW	MINIMUM CFM ENTERING AIR TEMPERATURE		
		<78 F	79-90 F	91-110 F
AH05GS	5	395	485	635
AH05JS	5	395	485	635
AH05HS	5	395	485	635
AH05ES	5	395	485	635
AH05FS	5	395	485	635
AH05KS	5	395	485	635

Table 11 — AH10 Electric Duct Heater Specifications**

MODEL NUMBER	kW	VOLTAGE	PHASE	AMPS	STAGES	DIMENSIONS	
						WIDTH (in.)	HEIGHT (in.)
AH10HL	10	240	3	24.1	2	15.5	15
AH10KL	10	208	3	27.8	2	15.5	15
AH10HM	10	240	3	24.1	2	12.5	14
AH10KM	10	208	3	27.8	2	12.5	14
AH10GL	10	240	1	41.7	2	15.5	15
AH10JL	9.9	208	1	47.6	2	15.5	15
AH10EL	10	277	1	36.1	2	15.5	15
AH10EM	10	277	1	36.1	2	12.5	14
AH10FL	10	480	3	12.0	2	15.5	15
AH10FM	10	480	3	12.0	2	12.5	14
AH10GM	10	240	1	41.7	2	12.5	14
AH10JM	9.9	208	1	47.6	2	12.5	14

Table 12 — AH10** Minimum CFM Air Temperature

MODEL NUMBER	kW	MINIMUM CFM ENTERING AIR TEMPERATURE		
		<78 F	79-90 F	91-110 F
AH10HL	10	735	890	1140
AH10KL	10	735	890	1140
AH10HM	10	675	790	990
AH10KM	10	675	790	990
AH10GL	10	735	890	1140
AH10JL	10	735	890	1140
AH10EL	10	735	890	1140
AH10EM	10	675	790	990
AH10FL	10	735	890	1140
AH10FM	10	675	790	990
AH10GM	10	675	790	990
AH10JM	10	675	790	990

Table 13 — AH15** Electric Duct Heater Specifications (15 kW)

MODEL NUMBER	kW	VOLTAGE	PHASE	AMPS	STAGES	DIMENSIONS	
						WIDTH (in.)	HEIGHT (in.)
AH15GL	15	240	1	62.5	2	15.5	15
AH15JL	15	208	1	72.1	2	15.5	15
AH15JM	15	208	1	72.1	2	12.5	14
AH15HL	15	240	3	36.1	2	15.5	15
AH15KL	15	208	3	41.6	2	15.5	15
AH15GM	15	240	1	62.5	2	12.5	14
AH15EL	15	277	1	54.2	2	15.5	15
AH15EM	15	277	1	54.2	2	12.5	14
AH15HM	15	240	3	36.1	2	12.5	14
AH15FL	15	480	3	18.0	2	15.5	15
AH15FM	15	480	3	18.0	2	12.5	14
AH15KM	15	208	3	41.6	2	12.5	14

Table 14 — AH15** Minimum CFM Air Temperature

MODEL NUMBER	kW	MINIMUM CFM ENTERING AIR TEMPERATURE		
		<78 F	79-90 F	91-110 F
AH15GL	15	970	1130	1400
AH15JL	15	970	1130	1400
AH15JM	15	890	1010	1255
AH15HL	15	970	1130	1400
AH15KL	15	970	1130	1400
AH15GM	15	890	1010	1255
AH15EL	15	970	1130	1400
AH15EM	15	890	1010	1255
AH15HM	15	890	1010	1255
AH15FL	15	970	1130	1400
AH15FM	15	890	1010	1255
AH15KM	15	890	1010	1255

Table 15 — AH20 Electric Duct Heater Specifications (20 kW)**

MODEL NUMBER	kW	VOLTAGE	PHASE	AMPS	STAGES	DIMENSIONS	
						WIDTH (in.)	HEIGHT (in.)
AH20HL	19.9	240	3	47.9	2	15.5	15
AH20KL	17.2	208	3	47.7	2	15.5	15
AH20GL	20.0	240	1	83.3	2	15.5	15
AH20JL	19.8	208	1	95.2	2	15.5	15
AH20EL	20.0	277	1	72.2	2	15.5	15
AH20FL	20.0	480	3	24.1	2	15.5	15

Table 16 — AH20 Minimum CFM Air Temperature**

MODEL NUMBER	kW	MINIMUM CFM ENTERING AIR TEMPERATURE		
		<78 F	79-90 F	91-110 F
AH20HL	20	1180	1340	1665
AH20KL	20	1180	1340	1665
AH20GL	20	1180	1340	1665
AH20JL	20	1180	1340	1665
AH20EL	20	1180	1340	1665
AH20FL	20	1180	1340	1665

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. 8), 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. 9 for typical wiring diagram). Larger heaters may require hangers (see Table 17 for sizing).

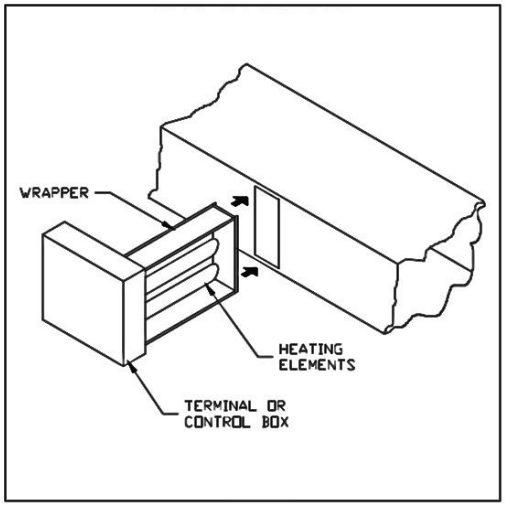


Fig. 8 — Slip-In Heater

Table 17 — 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.

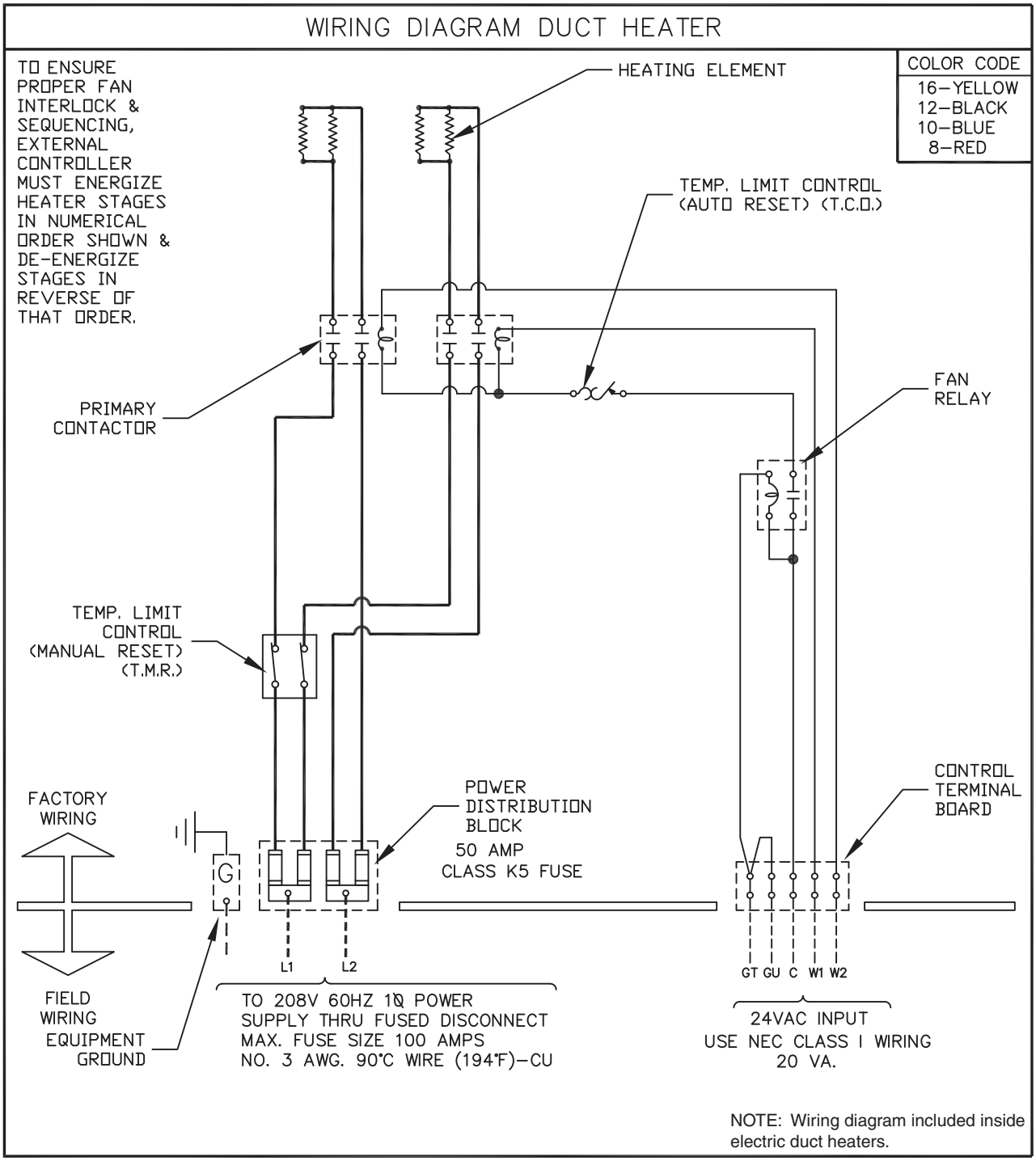


Fig. 9 — Typical Wiring Diagram for Electric Duct Heaters

BALL VALVES

ABV* Ball Valve —** Carrier's ball valves can be field-installed between the supply and return lines and the WSHP. These valves provide manual stoppage of water flow during maintenance or when service is needed. See Fig. 10 and Table 18.

SPECIFICATIONS

- 600 WOG, 325 F
- Interchangeable union end
- Blowout-proof shaft
- Double shaft seals

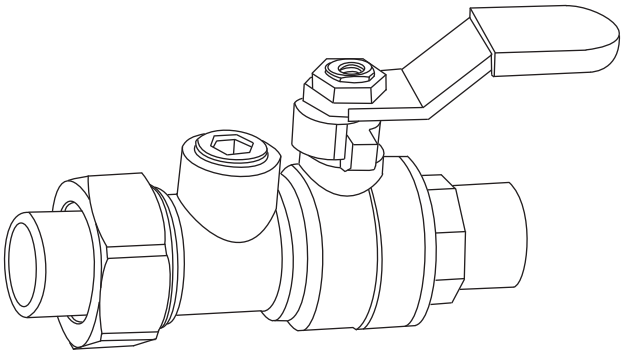


Fig. 10 — ABV* Ball Valve**

Table 18 — ABV* Ball Valve Physical Data**

MODEL NUMBER	DIAMETER (in.)
ABV050	1/2
ABV075	3/4
ABV100	1
ABV125	1 1/4
ABV150	1 1/2
ABV200	2

ABV*MP Ball Valve with P/T Ports and Memory Stop —** Carrier's ball valves can be field-installed between the supply and return lines and the WSHP. These valves provide manual stoppage of water flow during maintenance or when service is needed. The P/T ports are used to measure flow. A gage device can be inserted in the port that reads pressure drop through the valve or through the coil circuit. The memory stop on the ball valves is used to lock in the valve in a particular position. See Fig. 11 and Table 19.

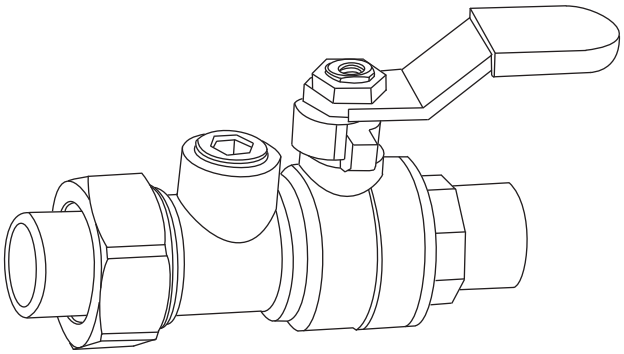


Fig. 11 — ABV*MP Ball Valve with P/T Ports and Memory Stop**

Table 19 — ABV*MP Ball Valve Physical Data**

MODEL NUMBER	DIAMETER (in.)
ABV050MP	1/2
ABV075MP	3/4
ABV100MP	1
ABV125MP	1 1/4
ABV150MP	1 1/2
ABV200MP	2

SOLENOID WATER VALVES

AMV*FHS —** Carrier's motorized water valves are normally closed, 2-position water valves. The valve opens to allow 100% of the fluid to flow through the coaxial heat exchanger, only when there is a call for compressor operation. The valve is wired to be energized when the compressor contact is energized. The ability able to close off fluid flow to the unit when there is no call for cooling or heating reduces system operating costs. These valves are best used with variable speed pumping, which reduces the speed of the primary loop pumps. See Tables 20 and 21.

AMV***FHS SPECIFICATIONS

- Operating voltage: 24 vac ±20%
- Power Consumption: 9.8 VA
- Valve body rating: ANSI (American National Standards Institute) Class 125
- Leakage rate: ANSI Class III
- Close off ratings: According to ANSI/FCI 70-2
- Medium temperature range: 34 F to 230 F (1 to 110 C)
- Flow characteristic: Linear

Table 20 — AMV*FHS Solenoid Water Valves Physical Data**

MODEL NUMBER	DIAMETER (in.)	FLOW COEFFICIENT
AMV075FHS	3/4	4.1
AMV100FHS	1	7

23B004*N01 SPECIFICATIONS

- Forged brass body and chrome-plated brass ball
- Fluid temperature limit: 23 F to 203 F (-5 C to 95 C)
- Valve body pressure rating: 580 psig (3,999 kpa)
- Maximum close-off pressure: 200 psig (1.378 kpa)
- Recommended operating pressure: 50 psig

Table 21 — 23B004*N01 Solenoid Water Valves Physical Data

MODEL NUMBER	DIAMETER (in.)	FLOW COEFFICIENT
23B0040N01	1 1/4	18.7
23B0041N01	1 1/2	46.8
23B0042N01	2	73.7

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.

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:

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

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

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

KEY:
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:

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

The resulting flow rate (GPM) is 9.6 or about 2.5 GPM per ton (see Table 22).

Table 22 — 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 Autoflow 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 autoflow regulator. An autoflow 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.

Autoflow regulators are utilized at each WSHP (each WSHP will have its own autoflow regulator) and the autoflow 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 autoflow 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 autoflow 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 autoflow 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 autoflow regulators and solenoid valves. The autoflow 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 mentioned above 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 the figures above, 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 autoflow 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.

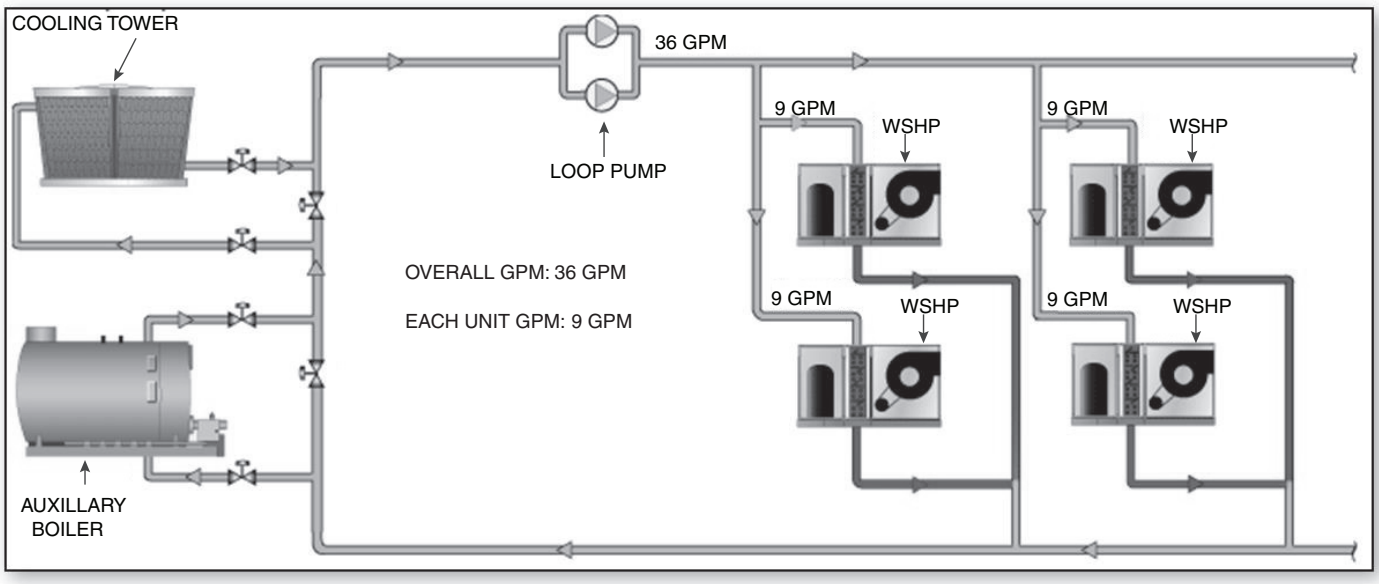


Fig. 12 — Standard Closed Water Loop System with Boiler and Cooling Tower

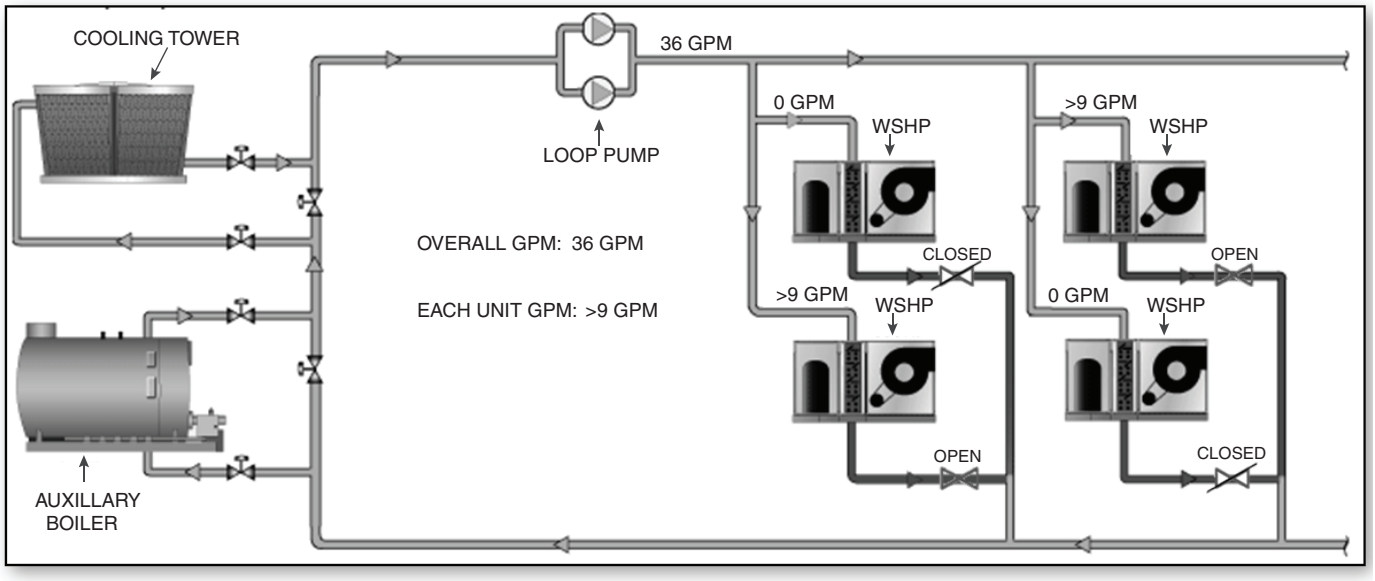


Fig. 13 — Water Loop System with Isolation Valves

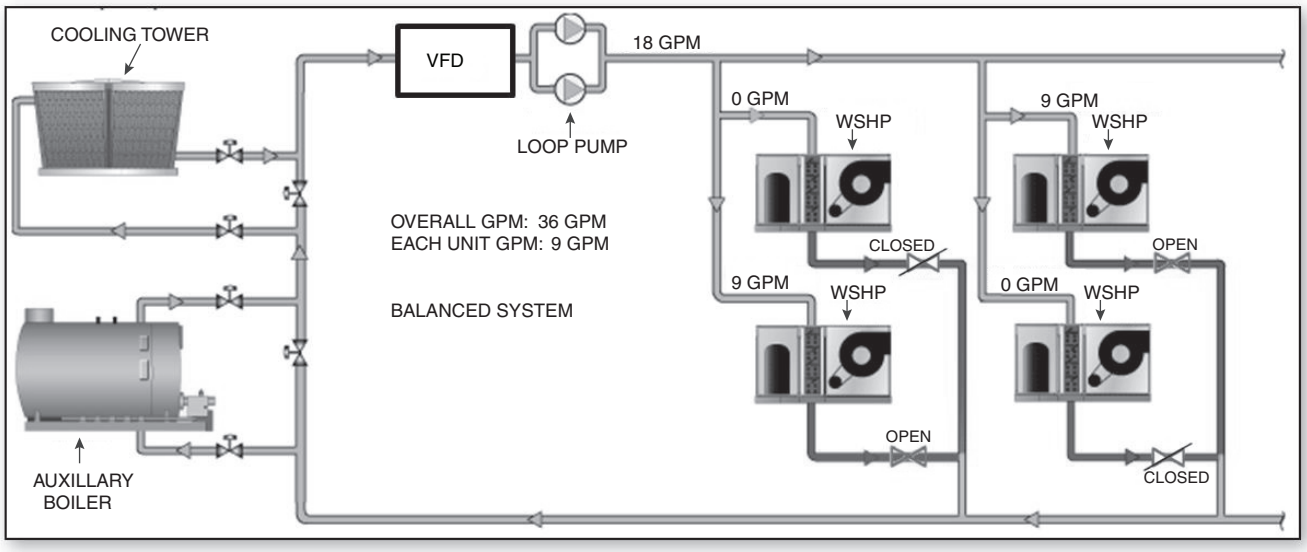


Fig. 14 — Water Loop System With Autoflow Regulator and Solenoid Valve

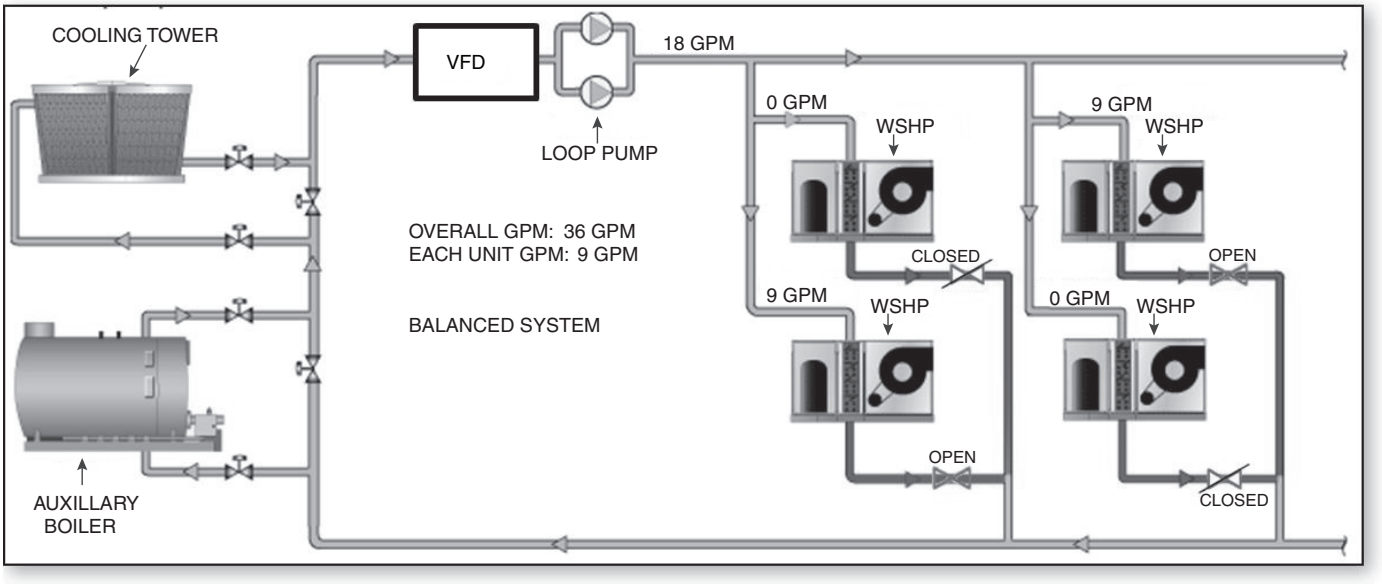


Fig. 15 — Water Loop System with Variable Frequency Drive

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:

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

KEY:

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

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.

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

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