Carrier

Turn to the experts

Product Data

Aquazone™
Water Source Heat Pumps
Console Unit

$^{3}/_{4}$ to $1^{1}/_{2}$ Nominal Tons

AQUAZONE™

50PEC 09-18
Water Source Heat Pumps Console Unit
with Puron® Refrigerant (R-410A)

Features/Benefits

Carrier's Aquazone console water source heat pumps are a flexible, attractive alternative for all finished interior space, under-window style installations.

Single-package console water source heat pump with available thermostat control, WSHP Open DDC control, or unit mounted control.

- Suitable for either geothermal or boiler/tower applications with operating temperature range from 25°F to 110°F
- Available unit mounted controller eliminates the need for remote thermostat (not thermostat compatible)
- Optional Complete C or Deluxe D control package (for remote thermostat).
- Optional WSHP Open controller can use BACnet[1], Modbus[2], N2, and LonWorks[3] protocols for integrating energy efficiency and more precise unit control
- Thermostatic expansion valve (TXV)
- Double isolated compressors for quiet operation
- Sloped top cabinet
- Right or left hand piping connection
- Selectable cabinet and sub-base configurations
- Environmentally balanced Puron refrigerant (R-410A)

Operating efficiency

Aquazone water source heat pump (WSHP) units are designed for quality and performance excellence over their lifetime. Units offer standard cooling EERs (energy efficiency ratios) up to 13.5 for boiler/tower systems and as high as 22.1 for geothermal applications. Heating COPs (coefficients of performance) are as high as 5.1.

Quiet operation

The Carrier console WSHP provides quiet operation for maximum comfort.

Design flexibility

Aquazone™ console WSHP units are offered in 4 capacity sizes to meet individual zone needs efficiently and effectively. Extended operating range units are standard to suit a variety of application requirements.

1. BACnet is trademark of ASHRAE.
2. Modbus is a registered trademark of Schneider Electric.
3. LonWorks is a registered trademark of Echelon Corporation.

Safe, reliable operation

Standard safety features include: high and low pressure monitoring and field selectable water and air coil freeze protection sensing. All safety controls may be reset at the thermostat. Each unit is tested and run at the factory to ensure proper operation of all components and safety switches.

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

The water-to-refrigerant heat exchanger has copper inner and steel outer tubing which is painted on the outside to provide corrosion resistance protection. Cupronickel heat exchangers are available and should be used on all open loop applications.

Units are rated and certified in accordance with AHRI (Air-Conditioning, Heating, and Refrigeration Institute)/ISO (International Organization for Standardization)/ASHRAE (American Society of Heating, Refrigerating and Air-Conditioning Engineers) 13256-1 performance standard, and are CSA (Canadian Standards Association)/NRTL (Nationally Recognized Testing Lab) listed.

Installation ease

The unit is packaged for simple, low cost handling, with minimal time required for installation. The console unit arrives at the jobsite fully assembled to minimize installation time and reduce installation cost. All units are pre-wired and factory charged with Puron® refrigerant (R-410A).

Water connections are available in a variety of configurations direct from the factory. The standard configuration is $^{5}/_{8}$ in. OD sweat connections for maximum flexibility in the field.

The standard electrical connections are made quickly and directly to a power distribution terminal block. A factory installed non-fused disconnect is available to further improve installation simplicity.

A $^{5}/_{8}$ in. ID vinyl condensate connection is provided for connection to the field-installed condensate line.

The standard cabinet dimensions are 12 in. deep, 48 in. wide and 24 in. tall. An optional 63 in. cabinet is also available. For flexibility, the controls can be mounted on the top right or left side. Additionally, the sloped top design discourages the use of the unit as a shelf, preventing air blockage and any spills from damaging the unit.

No-fuss maintenance and serviceability

Large service access panels enable quick inspection for problem solving and the control box swings down for easy access to the controls.

Fan motor sleeve bearings are permanently lubricated. If the unit requires service, an easily removable cabinet and slide-out fan section make access simple.

Units are equipped with easily accessible service access ports on both the suction and the discharge refrigerant lines for on-site testing and refrigerant recovery. Filter racks provide easy filter access for cleaning.

Maximum control flexibility

Aquazone water source heat pumps provide maximum control flexibility, with options for self contained control (unit mounted controller), remote thermostat control (Complete C or Deluxe D control package), or factory installed DDC control with network communication (WSHP Open).

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Features/Benefits (cont)

Aquazone units with Complete C, Deluxe D, or WSHP Open also include a solid state unit protection module (UPM). The UPM helps to ensure safe and reliable operation, is flexible for different types of installations, and simplifies unit troubleshooting.

Units with Complete C, Deluxe D, or WSHP Open are also available with the following:

40-va transformer

Assists in accommodating accessory loads.

Anti-short cycle timer

The timer provides a minimum off time to prevent the unit from short cycling. The 5-minute timer energizes when the compressor is de-energized, resulting in a 5-minute delay before the unit can be restarted. Thus, it prevents short cycling of the compressor.

Random start relay

The random start relay provides a random delay in energizing each different WSHP unit. This option minimizes peak electrical demand during start-up from different operating modes or after building power outages. The control features a 5 to 80 second random start upon start-up.

High and low pressure refrigerant protection

Safeguards against unreliable unit operation and prevents refrigerant from leaking.

Condensate overflow sensor

Electronic sensor mounted to the drain pan. When condensate pan liquid reaches an unacceptable level, the unit is automatically deactivated and placed in a lockout condition. The sensor recognizes 30 continuous seconds of overflow as a fault condition.

High and low voltage protection

Safety protection for excessive or low voltage conditions.

Automatic intelligent reset

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

Water coil freeze protection (selectable for water or antifreeze)

Field selectable switch for water and water/glycol solution systems initiates a fault when temperatures exceed the selected limit for 30 continuous seconds.

Outside Air Damper

Optional factory-installed motorized outside air damper is available for the unit to provide fresh air to the space. When the supply fan is on, the outside air damper opens. When the supply fan is off, the outside air damper will close.

Alarm relay setting

Selectable 24-v or pilot duty dry contact provides remote alarm activation.

Service Test mode with diagnostic LED (light-emitting diode)

Test mode allows service personnel to check the operation of the WSHP and control system efficiently. Upon entering Test mode, time delays speed up, and the Status LED flashes a code indicating the last fault. This mode provides an easy fault diagnosis, based on the fault code that the status LED flashes. Carrier-provided troubleshooting tables provide an easy reference to typical problems.

LED visual output

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

Puron® refrigerant (R-410A)

Puron refrigerant (R-410A) is an environmentally balanced refrigerant that does not contain chlorine, which damages the ozone layer. Puron refrigerant characteristics, compared to R-22, have:

- Binary and near azeotropic mixture of 50% R-32 and 50% R-125.
- Virtually no glide. Unlike other alternative refrigerants, the two components in Puron refrigerant have virtually the same leak rates.

Model number nomenclature

50PEC 12 X A U E 3 D 1 A 1

Model Series
50PEC – Aquazone R-410A High-Efficiency Water Source Heat Pump Console Unit

Size – Nominal Tons
09 – 3/4
12 – 1
15 – 1 1/4
18 – 1 1/2

Water Circuit Options
A – Right Hand Water Connection, 5/8 in. Sweat Connection
H – Right Hand Water Connection with 1/2 in. FPT Fittings
T – Left Hand Water Connection with 1/2 in. FPT Fittings
X – Left Hand Water Connection, 5/8 in. Sweat Connection

Cabinet and Sub-base Options
A – 63 in. Cabinet and Sub-base
T – No Cabinet and Standard Sub-base
W – No Cabinet and No Sub-base
X – Standard 48 in. Cabinet and Sub-base

Control
L – Complete C Package with Remote Mounted Thermostat
R – Deluxe D Package with Remote Mounted Thermostat
U – Unit Mounted Controller
W – WSHP Open with C Microprocessor Control

Refrigerant Circuit Options
E – Cu, Coated Evap (Epoxy)
J – CuNi, Coated Evap (Epoxy)

Voltage
0 – 115 V - 1 Ph - 60 Hz
3 – 208/230 V - 1 Ph - 60 Hz
4 – 265 V - 1 Ph - 60 Hz
B – 115 V - 1 Ph - 60 Hz with Disconnect
C – 208/230 V - 1 Ph - 60 Hz with Disconnect
D – 265 V - 1 Ph - 60 Hz with Disconnect

Revision Code
E – Revision E
F – Revision F (09 Size Only)

Packaging
1 – Single Pack, Domestic

Operating Range
A – Extended Range

Factory Installed Options
1 - Cleanable Mesh Filter
A - OA Damper and Cleanable Mesh Filter

LEGEND
Cu — Copper
CuNi — Cupronickel
OA — Outdoor Air

AHRI/ISO capacity ratings

50PEC UNIT SIZE	FLUID FLOW RATE gpm	WATER LOOP				GROUND WATER				GROUND LOOP			
		Cooling Capacity (Btu/hr)	EER	Heating Capacity (Btu/hr)	COP	Cooling Capacity (Btu/hr)	EER	Heating Capacity (Btu/hr)	COP	Cooling Capacity (Btu/hr)	EER	Heating Capacity (Btu/hr)	COP
09 115V	**2.0**	8,300	12.7	10,600	4.55	9,800	20.1	8,500	3.9	8,750	14.5	6,700	3.25
09 265V	**2.0**	8,200	12.2	10,600	4.7	9,800	19.55	8,700	3.95	8,800	14.35	6,900	3.25
09 208/230V	**2.0**	8,500	13.5	10,500	5.1	10,000	22.1	8,600	4.25	9,000	15.8	6,600	3.4
12	**3.0**	11,700	12.7	12,600	4.3	13,700	19.8	11,000	3.8	12,200	15.0	8,500	3.2
15	**4.0**	14,000	12.3	17,000	4.6	16,400	20.2	14,500	4.0	14,600	14.4	11,300	3.3
18	**4.5**	16,400	12.2	21,100	4.3	19,500	18.0	17,400	3.8	17,200	14.1	13,900	3.2

LEGEND

AHRI — Air-Conditioning, Heating and Refrigeration Institute
COP — Coefficient of Performance
db — Dry Bulb Temperature
EER — Energy Efficiency Ratio
ISO — International Organization for Standardization
wb — Wet Bulb Temperature

NOTES:

1. Certified in accordance with AHRI/ISO 13256-1.
2. Cooling capacities based upon 80.6°F db, 66.2°F wb entering air temperature.
3. Heating capacities based upon 68°F db, 59°F wb entering air temperature.

AHRI CERTIFIED™
www.ahridirectory.org
Water Source HP
ANSI/AHRI/ASHRAE/ISO13256-1

Physical data

50PEC UNIT	09	12	15	18
COMPRESSOR (qty 1)	Rotary	Rotary	Rotary	Rotary
Maximum Water Working Pressure (psig/kPa)	400/3100	400/3100	400/3100	400/3100
STANDARD FAN MOTOR AND BLOWER				
Fan Motor Type	PSC	PSC	PSC	PSC
Fan Motor (hp)	1/10	1/4	1/4	1/4
Blower Wheel Size (Dia x W) (in.) (qty)	5.5 x 8.0 (X 2)	5.5 x 8.0 (X 2)	5.5 x 8.0 (X 2)	5.5 x 8.0 (X 2)
WATER CONNECTION SIZE (in.)	5/8 in. Sweat (Optional 1/2 in. FPT)			
Coaxial Coil Volume (gal)	0.08	0.11	0.11	0.11
Condensate Connection in.	5/8	5/8	5/8	5/8
VERTICAL CABINET				
Refrigeration Charge (oz)	24 (208/230V) 23 (115/265V)	25	31	26
Air Coil Dimensions (H x L)	10 x 27	10 x 27	10 x 27	10 x 27
Standard Filter - 1/2 in. Washable Aluminum (H x L)	7 x 31 1/4 x 3/8	7 x 31 1/4 x 3/8	7 x 31 1/4 x 3/8	7 x 31 1/4 x 3/8
Weight - Operating (lb)	131	138	144	144
Weight - Shipping (lb)	151	158	164	164

LEGEND

FPT — Female Pipe Thread
PSC — Permanent Split Capacitor

Options and accessories

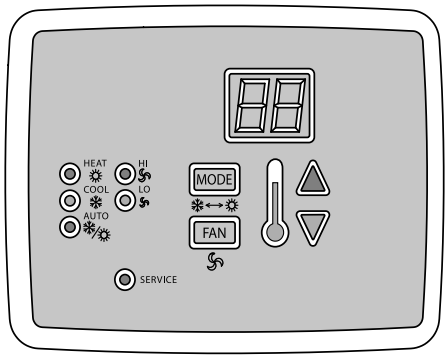
ITEM	FACTORY-INSTALLED OPTION	FIELD-INSTALLED ACCESSORY
Unit Mounted Controller	X	
Cupronickel Heat Exchangers	X	
Piping Connections	X	
Complete C Control Package	X	
Deluxe D Control Package	X	
WSHP Open Multi-Protocol Controller	X	
WSHP Open Equipment Touch™ Device		X
WSHP Open System Touch™ Device		X
WSHP Open ZS Sensor		X
Supply and Return Water Hose Kits		X
Edge Pro® 7-Day Programmable Thermostat		X

Factory-installed options

Unit mounted controller

The unit mounted controller is a factory-wired option that eliminates the need for a remote mounted thermostat. The standard unit mounted controller provides a tactile touchpad for temperature, fan and mode adjustment as shown. Temperature is read in a digital display, with an LED display indicating unit operating mode, as well as fan speed and fault indication for high or low pressure lockout. Temperature set points are adjustable from 60°F to 80°F, with an adjustable temperature differential between 1°F and 6°F. Selectable options include manual or automatic changeover, high or low fan speed as well as constant fan operation or fan operation to cycle with the compressor. Additional features include a 5-minute anti short cycling delay, random start, 90-second low pressure bypass timer and intelligent reset to allow the unit to automatically restart after 5 minutes if a fault is no longer active. The unit mounted controller is not compatible with thermostat or DDC controls.

UNIT MOUNTED CONTROL



Cupronickel heat exchangers

Cupronickel heat exchangers are available for higher corrosion protection for applications such as open tower, geothermal, etc. Consult the water quality guidelines for proper application and selection of this option.

Piping connections

Piping connections can be provided on either the right or left hand side of the unit, for easy installation. Orientation is determined by facing the unit from the front side.

Deluxe D package

Deluxe D package provides all of the options on the standard Complete C package in addition to the following:

- Energy Management Switch - Enables a 24 vac external signal to control the operation of the WSHP.
- Pump-Valve Relay - provides a signal between an isolation valve and a secondary pump.

COMPLETE C AND DELUXE D PACKAGE CAPABILITIES

CAPABILITY	COMPLETE C PACKAGE	DELUXE D PACKAGE
High and Low Refrigerant Pressure Switches	X	X
Fluid Temperature (Freeze) Protection	X	X
Condensate Overflow Protection Sensor	X	X
Air Temperature (Freeze) Protection	X	X
Anti-short Cycle Timer	X	X
Random Start Relay	X	X
Low Pressure Bypass Timer	X	X
Surge Protection	X	X
Intelligent Reset	X	X
Lockout Reset	X	X
Malfunction (Alarm) Output	X	X
Test Service Mode with LED Fault Indication	X	X
Field-Installed DDC Compatibility	X	X
Energy Management Switch		X
Pump-Valve Relay		X

Options and accessories (cont)

WSHP Open multi-protocol controller

An integrated component of a Carrier water source heat pump. The WSHP Open controller continuously monitors and regulates water source heat pump operation with reliability and precision. This advanced controller features a sophisticated, factory-engineered control program that provides optimum performance and energy efficiency.

The WSHP Open controller is factory installed and programmed to control all factory-installed standard options.

The WSHP Open controller is programmed to communicate with different protocols including BACnet, N2, Modus and LonWorks. While the controller is programmed to operate on Carrier's i-Vu® building automation system (BAS), the WSHP Open controller can easily be integrated into a third party BAS.

Independent fan speed control

Provides one of the most efficient methods of WSHP operation. All WSHP Open controllers come programmed from the factory with independent fan speed control. Using the space temperature input, the WSHP Open controller will automatically operate the fan at the lowest of the available fan speeds to maintain space temperature while providing increased latent heat removal, reduced sound and the lowest fan energy consumption.

Intuitive fault detection

Allows prolonged operation of the WSHP. The pre-programmed WSHP Open controller logic monitors and preemptively shuts down a WSHP as an alarming condition approaches instead of causing a hard lock out of the WSHP. This way, the WSHP can automatically restart if the fault condition clears within a set amount of time and a local reset of the WSHP is not required.

Learning Adaptive Optimal Start

Transitions the WSHP from unoccupied set points to occupied set points in the most efficient means possible. Over time, the WSHP will learn and determine the best adjustment rates of the set points to provide an efficient means of shifting the WSHP to an occupied mode.

Field-installed accessories

WSHP Open Equipment Touch™ and System Touch™

Touchscreen devices have a color LCD display that allows easy connection to the controllers to view or change the controller's property values including set points, schedule equipment, view trends and alarms and more. The Equipment Touch device provides easy connection to one controller while the System Touch device can access up to 60 controllers when wired together as a network. For more details about the Equipment Touch and System Touch devices, see either the Equipment Touch or System Touch Installation and Setup Guide.

WSHP Open - ZS sensors

ZS sensors are the preferred method of monitoring space temperature, humidity and CO_2 levels when using the WSHP Open controller.

NOTE: The ZS sensor is required for space temperature with all WSHP Open controllers. Only a ZS sensor can provide the necessary space temperature input for the WSHP Open controller.

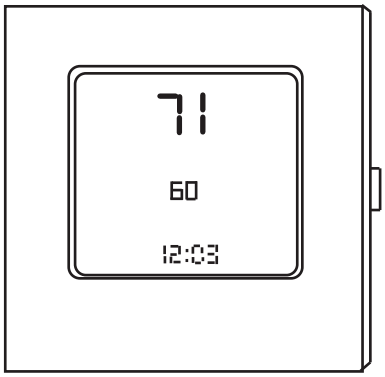
Supply and return water hose kits

Available as accessories. Hose kits are recommended for connection between the unit and the water loop piping. Hose kits are 24 inches in length, flexible stainless steel and have options for manual isolation valves with and without auto flow regulators and Y-strainers.

Edge® Pro 7-day programmable thermostat

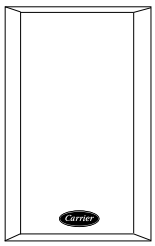
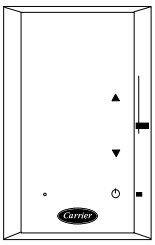
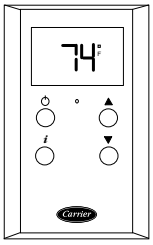
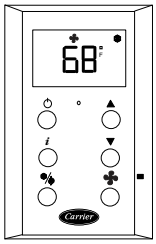
The Edge Pro is available for connecting a unit directly to a wall mounted thermostat. The Edge Pro thermostat offers 2-stage heat, 2-stage cool, remote sensor capability, preoccupancy purge, soft start, manual/auto changeover, 4 settings per day, 24 vac, backlit LCD, keypad lockout, no batteries required, 5-minute compressor protection, never lost memory, 3 security levels, and temperature display in degrees F or C.

EDGE PRO® THERMOSTAT



Options and accessories (cont)

ZS SENSOR FEATURES

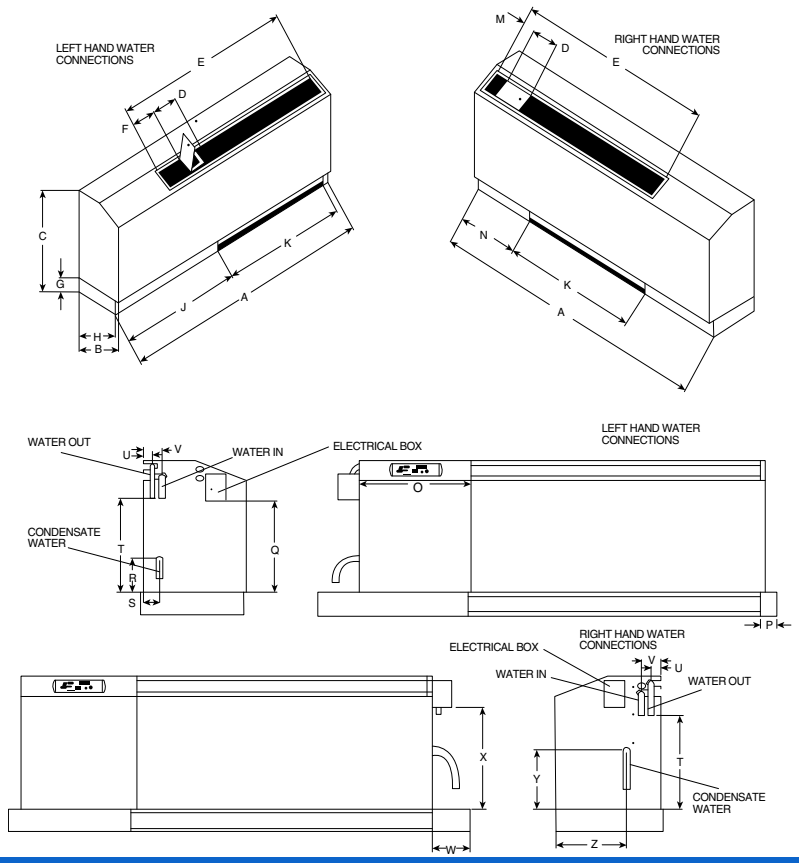
FEATURES	 ZS STANDARD	 ZS PLUS	 ZS PRO	 ZS PRO-F
Temp, CO_2, Humidity	X	X	X	X
Neutral Color	X	X	X	X
Addressable/Supports Daisy-Chaining	X	X	X	X
Hidden Communication Port	X	X	X	X
Mounts on a Standard 2-in. X 4-in. Electrical Box	X	X	X	X
Occupancy Status Indicator		X	X	X
Push-Button Occupancy Override		X	X	X
Set Point Adjust		X	X	X
Large, Easy-to-Read LCD			X	X
Alarm Indicator			X	X
Fan Speed Control			X	X
Cooling/Heating/Fan Only - Mode Control				X
F to C Conversion Button				X

ZS SENSOR OPTIONS

OPTIONS	ZS STANDARD	ZS PLUS	ZS PRO	ZS PRO-F
	PART NUMBER			
Temperature Only	ZS2-CAR	ZS2PL-CAR	ZS2P-CAR	ZS2PF-CAR
Temperature with CO_2	ZS2-C-CAR	ZS2PL-C-CAR	ZS2P-C-CAR	ZS2PF-C-CAR
Temperature with Humidity	ZS2-H-CAR	ZS2PL-H-CAR	ZS2P-H-CAR	ZS2PF-H-CAR
Temperature with Humidity and CO_2	ZS2-HC-CAR	ZS2PL-HC-CAR	ZS2P-HC-CAR	ZS2PF-HC-CAR

Dimensions

50PEC09-18 UNIT DIMENSIONS



UNIT SIZE	A	B	C	D	E	F	G	H	J	K
50PEC09-18	Width	Depth	Height	Control Door Width	Discharge Grille Width	Grilled Edge to Door, Left Hand	Clearance to Unit Bottom	Sub-base Depth	Cabinet End to Return Air, Left Hand	Return Air Width
Standard	48.00	12.00	23.88	6.00	45.00	6.12	3.37	11.00	12.87	30.75
Extended Width	63.00								30.87	

UNIT SIZE	M	N	O	P	Q	R	S	T	U	V
50PEC09-18	Grille Edge to Door, Right Hand	Cabinet End to Return Air, Right Hand	Control Panel Width	Return Air to Chassis End, Left Hand	Power Switch Height From Sub-base, Left Hand	Condensate Height from Sub-base, Left Hand	Condensate Depth From Rear, Left Hand	Water Connection Height From Sub-base	Water Out Depth from Rear	Water In Depth from Rear
Standard	2.87	12.87	12.00	1.63	13.50	5.00	1.75	13.75	1.00	2.00
Extended Width										

UNIT SIZE	W	X	Y	Z		
50PEC09-18	Return Air to Chassis End, Right Hand	Power Switch Height From Sub-base, Right Hand	Condensate Height From Sub-base, Right Hand	Condensate Depth From Front, Right Hand	Condensate Water Connections	Permanent Washable Filter Size
Standard	4.00	15.00	8.69	7.31	$^{5}/_{8}$ tube	30.12 x 7 x 0.37
Extended Width						

NOTE: All dimensions are in inches unless otherwise noted. All dimensions within ±0.125 inch. Specifications subject to change without notice.

Please see WSHP Builder for cooling and heating performance data.

Performance data

SOUND DATA — SOUND POWER LEVEL, CASING RADIATED

50PEC UNIT	LOAD	OCTAVE BAND SOUND POWER LEVELS dB, RE 10-12 WATTS CENTER FREQUENCY - Hz							Overall	A WEIGHTED
		125	250	500	1000	2000	4000	8000		AHRI-260 (100hz-10kHz)
09	Cooling Full	65	59	47	43	34	30	28	66	54
12	Cooling Full	65	58	52	44	37	33	28	66	55
15	Cooling Full	62	61	54	50	43	40	35	65	56
18	Cooling Full	70	62	55	51	45	40	34	70	59

NOTE: Tested according to AHRI-350 standard for “Sound Rating of Non-Ducted Indoor Air Conditioning Equipment.” Overall calculated using 125-8000 Hz octave bands.

Electrical data

50PEC UNIT SIZE	VOLTAGE V-PH-Hz	COMPRESSOR			BLOWER			MIN CIRCUIT AMPS	MAX FUSE/ HACR
		QTY	RLA	LRA	QTY	FLA	HP		
09	115-1-60	1	7.0	45.6	1	2.1	0.10	10.9	15
	208/230-1-60	1	3.4	22.2	1	0.9	0.10	5.2	15
	265-1-60	1	2.9	18.8	1	0.7	0.10	4.3	15
12	115-1-60	1	9.6	58.4	1	1.3	0.25	13.3	20
	208/230-1-60	1	4.6	27.9	1	0.8	0.25	6.6	15
	265-1-60	1	3.8	22.2	1	0.8	0.25	5.6	15
15	208/230-1-60	1	5.6	29.0	1	0.8	0.25	7.8	15
	265-1-60	1	4.6	20.0	1	0.8	0.25	6.6	15
18	208/230-1-60	1	7.4	33.0	1	0.8	0.25	10.1	15
	265-1-60	1	6.0	28.0	1	0.8	0.25	8.3	15

LEGEND

FLA — Full Load Amps
HACR — Heating, Air Conditioning and Refrigeration
LRA — Locked Rotor Amps
RLA — Rated Load Amps

Application data

Aquazone™ water source heat pump products are available in a flexible, efficient array of models, which can be used in all types of water loop, ground water, and ground loop type systems. Use Aquazone products to provide optimal energy efficient solutions and adapt to the most challenging design requirements.

AQUAZONE PRODUCT GUIDE

50 SERIES	TYPE SIZE (tons)	APPLICATION
50HQP,VQP	Large Capacity 6-20 (HQP) 6-30 (VQP)	Environmentally balanced unit with Puron® refrigerant (R-410A) designed to handle large zoned areas for all geothermal and boiler/tower applications.
50PC	Compact $^1/_2$-6	Compact WSHP with Puron refrigerant (R-410A) for boiler/tower, ground water, or ground loop systems.
50PS	Premium Efficiency $^1/_2$-6	Premium, ultra efficient unit with Puron refrigerant (R-410A) for new boiler/tower, ground water, or ground loop systems.
50PEC	High Efficiency Console $^3/_4$-1$^1/_2$	Efficient console unit with Puron refrigerant (R-410A) and attractive design for finished interior, under-window installations.
50PT	Premium Efficiency 2-6	Premium, ultra efficient 2-stage unit with Puron refrigerant (R-410A) for new boiler/tower, ground water, or ground loop systems.
50PSW	Water-to-Water 2-35	Efficient unit with Puron refrigerant (R-410A) serves as an alternative to pre-heat or cool air. Unit can be used as a stand-alone or supplemental boiler/chiller in most hydronic heating applications. Also conditions process fluids, lubricants, and refrigerants.

Water loop system

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

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

- Horizontal, vertical, console, rooftop and water-to-water product applications.
- Ventilation methods and system design, including energy recovery.
- Acoustical considerations for different product types.
- Addressing IAQ issues such as condensate removal, humidity control.
- Air distribution design, including diffuser selection/layout and ductwork design.
- Hydronic system design, including pipe sizing/layout and boiler/tower sizing.
- Control configurations such as stand alone, DDC, DCV (demand controlled ventilation), and VVT® (variable volume and temperature).
- WSHP efficiency/operational cost comparison chart.
- System variations such as a system without a boiler, variable pumping, and VAV for interior use.

Ground water systems

To use Aquazone units in ground water applications, the extended range should be specified. This will provide factory-installed coaxial coil insulation to prevent condensate from dripping when entering water temperatures are below 55°F. In addition, the copper coaxial coil installed on the Aquazone units may not be suitable for all water conditions. Refer to the Water Conditioning section for proper coaxial coil material selection.

Surface water system

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

Open loop system

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

Aquazone units are rated to extremely low temperatures to self-adjust the refrigeration circuit. Open loop systems may require water regulating valves.

Ground loop systems

There are many commonly specified designs for ground loop applications. Typical designs include vertical loops and horizontal loops. In some applications, water is piped from the ground or lake directly to the water source heat pump. This system only requires piping to get the water from the source to the unit.

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

Horizontal ground loop

Use this system when adequate space is available and trenching can be easily accomplished. A series of parallel pipes are laid out in trenches 3 to 6 feet below the ground surface, and then back-filled. Often, multiple pipes are used to maximize each trench's heat transfer capability. Ground conditions, heating and cooling requirements, and system design determine piping requirements and ground loop field size.

Vertical ground loop

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

Application data (cont)

Hybrid systems

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

Condensate drainage

Connect the console unit condensate drain to the building condensate drain with a flexible, non-pressure rated plastic hose. Be sure to avoid kinks in this hose to ensure an unobstructed flow of condensate from the unit to the drain. The condensate hose's horizontal run is usually too short to pose any drainage problems; however, make sure this line is pitched at least 1 in. for every 10 ft of run (in the direction of the flow) to avoid drainage problems. Avoid low points and unpitched piping since dirt collects in these areas and may cause stoppage and overflow.

Water conditioning

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

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

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

Acoustical design

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

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

It is important to know how to convert the unit ratings from sound power (Lw) to sound pressure (Lp). This conversion depends on the specifics of the installation's acoustical environment. Assessing an area's acoustical design requires that you compare the sound pressure (Lp) with the NC curve for the selected area.

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

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

- Type of acoustical ceiling
- Use of metal or flex duct
- Absorption in the occupied space
- Location in the occupied space
- Open or closed layout plan
- Use of open or ducted returns
- Orientation of unit to occupant
- Use of lined or unlined duct

Application data (cont)

WATER QUALITY GUIDELINES

CONDITION	HX MATERIAL*	CLOSED RECIRCULATING†	OPEN LOOP AND RECIRCULATING WELL**
Scaling Potential — Primary Measurement Above the given limits, scaling is likely to occur. Scaling indexes should be calculated using the limits below.			
pH/Calcium Hardness Method	All	N/A	**pH < 7.5 and Ca Hardness, <100 ppm**
Index Limits for Probable Scaling Situations (Operation outside these limits is not recommended.)			
Scaling indexes should be calculated at 150°F for direct use and HWG applications, and at 90°F for indirect HX use. A monitoring plan should be implemented.			
Ryznar Stability Index	All	N/A	6.0 - 7.5 If >7.5 minimize steel pipe use.
Langelier Saturation Index	All	N/A	–0.5 to +0.5 If <–0.5 minimize steel pipe use. Based upon 150°F HWG and direct well, 85°F indirect well HX.
Iron Fouling			
Iron Fe^{2+} (Ferrous) (Bacterial Iron Potential)	All	N/A	<0.2 ppm (Ferrous) If Fe^{2+} (ferrous) >0.2 ppm with pH 6 - 8, O_2<5 ppm check for iron bacteria.
Iron Fouling	All	N/A	<0.5 ppm of Oxygen Above this level deposition will occur.
Corrosion Prevention††			
pH	All	6 - 8.5 Monitor/treat as needed.	6 - 8.5 Minimize steel pipe below 7 and no open tanks with pH <8.
Hydrogen Sulfide (H_2S)	All	N/A	<0.5 ppm At H_2S>0.2 ppm, avoid use of copper and cupronickel piping or HXs. Rotten egg smell appears at 0.5 ppm level. Copper alloy (bronze or brass) cast components are okay to <0.5 ppm.
Ammonia Ion as Hydroxide, Chloride, Nitrate and Sulfate Compounds	All	N/A	<0.5 ppm
Maximum Chloride Levels			Maximum allowable at maximum water temperature.
			50°F (10°C) / 75°F (24°C) / 100°F (38°C)
	Copper	N/A	<20 ppm / NR / NR
	Cupronickel	N/A	<150 ppm / NR / NR
	304 SS	N/A	<400 ppm / <250 ppm / <150 ppm
	316 SS	N/A	<1000 ppm / <550 ppm / <375 ppm
	Titanium	N/A	>1000 ppm / >550 ppm / >375 ppm
Erosion and Clogging			
Particulate Size and Erosion	All	<10 ppm of particles and a maximum velocity of 6 fps. Filtered for maximum 800 micron size.	<10 ppm (<1 ppm “sandfree” for reinjection) of particles and a maximum velocity of 6 fps. Filtered for maximum 800 micron size. Any particulate that is not removed can potentially clog components.
Brackish	All	N/A	Use cupronickel heat exchanger when concentrations of calcium or sodium chloride are greater than 125 ppm are present. (Seawater is approximately 25,000 ppm.)

LEGEND

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

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

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

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

††If the concentration of these corrosives exceeds the maximum allowable level, then the potential for serious corrosion problems exists. Sulfides in the water quickly oxidize when exposed to air, requiring that no agitation occur as the sample is taken. Unless tested immediately at the site, the sample will require stabilization with a few drops of one Molar zinc acetate solution, allowing accurate sulfide determination up to 24 hours after sampling. A low pH and high alkalinity can cause system problems, even when both values are within ranges shown. The term pH refers to the acidity, basicity, or neutrality of the water supply. Below 7.0, the water is considered to be acidic. Above 7.0, water is considered to be basic. Neutral water registers a pH of 7.0.
To convert ppm to grains per gallon, divide by 17. Hardness in mg/l is equivalent to ppm.

Application data (cont)

WSHP sound control

Analyzing the projected sound level in the conditioned space caused by a WSHP unit is quite involved. The key is to have good sound power ratings (Lw) in dB on the equipment to determine the ductwork, ceiling and room sound attenuation effect.

Console units

With console units, the fan and compressor are located within the space, and only the casing design attenuates the transmission of sound sources into the space. The designer should carefully review the manufacturer's acoustical data when selecting console units and use lower fan speeds to minimize space noise.

Operating limits

Environment

This equipment is designed for indoor installation ONLY.

Power supply

A voltage variation of ± 10% of nameplate utilization voltage is acceptable.

Starting conditions

The 50PEC unit will start and operate in an ambient temperature of 50°F, with entering-air temperature at 50°F with both air and water at the flow rates used in the AHRI/ISO Standard 13256-1 rating test, for initial start-up in winter.

NOTE: These are not normal or continuous operating conditions. Such a start-up should be used to bring the building space up to occupancy temperature.

AIR AND WATER LIMITS

50PEC UNIT	Cooling (F)	Heating (F)
Min Entering Air	68/57	50
Rated Entering Air, db/wb	80/67	68
Max Entering Air, db/wb	95/85	80
Min Entering Water	40	20
Rated Entering Water	86	68
Max Entering Water	110	110

LEGEND

db — Dry Bulb
wb — Wet Bulb

Freeze protection

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

- Equipment and performance may suffer with high concentrations of glycol and other antifreeze solutions
- Loss of piping pressure may increase greatly, resulting in higher pumping costs
- Higher mixture viscosity may cause excess corrosion and wear on the entire system
- The water's acidity may be greatly increased, promoting corrosion

Glycol promotes galvanic corrosion in systems of dissimilar metals. The result is corrosion of one metal by the other, causing leaks.

Controls sequence of operation

The WSHP Open multi-protocol controller will control mechanical cooling and heating outputs based on its own space temperature input and set points. An optional CO_2 IAQ (indoor air quality) sensor mounted in the space can maximize the occupant comfort. The WSHP Open controller has its own hardware clock that is automatically set when the heat pump software is downloaded to the board. Occupancy types are described in the scheduling section below. The following sections describe the functionality of the WSHP Open multi-protocol controller. All point objects that are referred to in this sequence of operation will be referenced to the objects as viewed in the BACview6 handheld user interface.

Scheduling

Scheduling is used to start/stop the unit based upon a time period to control the space temperature to specified occupied heating and cooing set points. The controller is defaulted to control by occupied set points all the time, until either a Time Schedule is configured with the Equipment Touch™ interface, i-Vu® Open, or a third party control system Enables/Disables the BAS On/Off point. Your local time and date must be set for these functions to operate properly. The occupancy source can be changed to one of the following:

Occupancy schedules

The controller will be occupied 24/7 until a Time schedule has been configured using either i-Vu Open, Equipment Touch or a third party control system Enables/Disables the BAS On/Off point. This can be disabled by going to Config>Unit>Occupancy Schedules and changing the point from Enable to Disable.

NOTE: This point must be Enabled in order for i-Vu Open or Bacview6 to assign a Time schedule to the controller.

Schedule_Schedule

The unit will operate according to the schedule configured and stored in the unit. The schedule is accessible via the Equipment Touch user interface, i-Vu Open, or Field Assistant. The daily schedule consists of a start/stop time (standard or 24 hour mode) and seven days of the week, starting with Monday and ending on Sunday.

Occupancy input contact (option)

If configured for remote occupancy control (default), the WSHP Open controller has the capability to use an external dry contact closure to determine the occupancy status of the unit. You will need to disable the Occupancy Schedules in order to utilize the Occupancy Contact Input. The control will cause the unit to go into an occupied mode whenever the abnormal input is sensed. After the input returns to its normal state, the unit will stay in the occupied mode for the configured Occupancy Override Delay period (15 minutes default).

NOTE: Scheduling can only be controlled from one source.

BAS (building automation system) on/off

For use with a Building Automation System that supports network scheduling, you will need to disable the Occupancy Schedules so the BAS system can control the unit through a network communication and the BAS scheduling function.

NOTE: Scheduling can only be controlled from one source.

Global occupancy scheduling

The WSHP Open controller has the capability to read the occupancy status from another unit so that a group of WSHPs can be controlled from a single occupancy schedule. The local Occupancy Schedules must be disabled in order to utilize the global occupancy input.

NOTE: Scheduling can only be controlled from one source.

BACnet network occupancy input

The WSHP Open controller has the capability to accept an external BACnet Binary Network Input for occupancy control. This function is only compatible with units used in BACnet systems. You will need to configure the "System Occupancy" BACnet network input point to locate the device and point name where the external occupancy point information resides. Also Occupancy Schedules must be disabled in order to utilize this input.

NOTE: Scheduling can only be controlled from one source.

Fire/smoke detector (FSD) input (field optional)

The WSHP Open controller has the capability to read the status of a normally closed FSD contact input to determine if a fire or smoke detector alarm is present. If the controller determines an alarm condition is present, all heating, cooling and the fan are disabled. The normal state of the switch is factory set to Normally Closed and cannot be changed.

Shutdown input

The WSHP Open controller has a shutdown input (software) which when set to its Active mode will cause the WSHP to safely shut down in a controlled fashion. Heating and cooling will be disabled after any minimum runtime conditions expire and the fan will be disabled after the fan off timer expires. All alarms are reset but any active alarm will remain active. After the shutdown input transitions from Active mode to Inactive mode, the WSHP Open controller will restart after the configured power fail restart delay expires.

Indoor fan

The indoor fan will operate in any one of three modes depending upon the user configuration selected. Fan mode can be defined/selected as Auto, Continuous, or Always On. In Auto mode the fan is in intermittent operation during both occupied and unoccupied periods. Continuous fan is intermittent during unoccupied periods and continuous during occupied periods. Always On operates the fan continuously during both occupied and unoccupied periods. In the default mode, Continuous, the fan will be turned on whenever any one of the following is true:

- It is in occupied mode. Determined by its occupancy status.
- Whenever there is a demand for cooling or heating in the unoccupied mode.
- When there is a call for dehumidification (optional).

When power is reapplied after a power outage, there will be a configured time delay of 5 to 600 seconds before starting the fan. There are also configured fan delays for Fan On and Fan Off. The fan on delay defines the delay time (0 to 30 seconds; default 10) before the fan begins to operate after heating or cooling is started while the fan off delay defines the delay time (0 to 180 seconds; default 45) the fan will continue to operate after heating or cooling is stopped. The fan will continue to run as long as the compressors, heating

stages, or the dehumidification relays are on. If the SPT failure alarm or condensate overflow alarm is active; the fan will be shut down immediately regardless of occupancy state or demand.

Automatic independent fan speed control

With the 50PEC units, the WSHP Open controller is capable of controlling up to two fan speeds. The motor will operate at the lowest speed possible to provide quiet and efficient fan operation with the best latent capability. The motor will increase speed if additional cooling or heating is required to obtain the desired space temperature set point. The control increases the motor's speed as the space temperature rises above the cooling or below the heating set point. The amount of space temperature increase above or below the set point required to increase the fan speed is user configurable in the set point. Also, the control will increase the fan speed as the supply-air temperature approaches the configured minimum or maximum limits.

Fan speed control - during heating

Whenever heat is required and active, the control continuously monitors the supply air temperature to verify it does not rise above the configured Maximum Heating SAT Limit (110°F default). As the SAT approaches this value, the control will increase the fan speed as required to ensure the SAT will remain 5°F below the limit. This feature provides the most quiet and efficient operation by operating the fan at the lowest speed possible.

Fan speed control - during cooling

Whenever mechanical cooling is required and active, the control continuously monitors the supply-air temperature to verify it does not fall below the configured Minimum Cooling SAT Limit (50°F default). As the SAT approaches this value, the control will increase the fan speed as required to ensure the SAT will remain 5°F above the limit. Fan will operate at lowest speed to maximize latent capacity during cooling.

Fan status (option)

An optional input can be configured as either an occupancy input contact or a fan status input. If configured as fan status, the controller will compare the status of the fan to the desired commanded state. Whenever the fan is commanded to run (ON), the fan status will be checked and verified to match the commanded state. If the fan status is not on, then a fan status alarm will be generated after 1 minute and the equipment's compressor(s) and auxiliary heat will be disabled and the optional OA damper will close (if equipped).

Cooling

The WSHP Open controller will operate one or two stages of compression to maintain the desired cooling set point. The compressor outputs are controlled by the PI (proportional-integral) cooling loop and cooling stages capacity algorithm. They will be used to calculate the desired number of stages needed to satisfy the space by comparing the space temperature (SPT) to the appropriate cooling set point. The waterside economizer, if applicable, will be used for first stage cooling in addition to the compressor(s). The following conditions must be true in order for the cooling algorithm to run:

- Cooling is set to Enable.
- The Fire/Smoke Input and Shutdown modes are inactive.
- Heat mode is not active and the compressor time guard(s) have expired.
- Condensate Overflow input is Normal.
- Fan Status is true (if option is enabled).
- If occupied, the SPT is greater than the occupied cooling set point.
- Space temperature reading is valid.
- If unoccupied, the SPT is greater than the unoccupied cooling set point.
- If economizer cooling is available and active and the economizer alone is insufficient to provide enough cooling.
- OAT is greater than the cooling lockout temperature if OAT is available.
- Condenser water pump is on (if condenser water linkage active).

If all the above conditions are met, the compressors will be energized as required, otherwise they will be de-energized. If cooling is active and should the SAT approach the minimum SAT limit, the fan will be indexed to the next higher speed. Should this be insufficient and if the SAT falls further (equal to the minimum SAT limit), the fan will be indexed to the maximum speed. If the SAT still continues to fall 5°F below the minimum SAT limit, all cooling stages will be disabled.

During Cooling, the reversing valve output will be held in the cooling position (either B or O type as configured) even after the compressor is stopped. The valve will not switch position until the heating mode is required.

The configuration screens contain the Min SAT parameter as well as cooling lockout based on outdoor air temperature (OAT), both can be adjusted to meet various specifications.

There is a 5-minute off time for the compressor as well as a 5-minute time delay when staging up to allow the SAT to achieve a stable temperature before energizing a second stage of capacity. Likewise, a 45-second delay is used when staging down.

After a compressor is staged off, it may be restarted again after a normal time-guard period of 5 minutes and if the supply air temperature has increased above the minimum supply air temperature limit.

The WSHP Open controller provides a status input to monitor the compressor operation. The status is monitored to determine if the compressor status matches the commanded state. This input is used to determine if a refrigerant safety switch or other safety device has tripped and caused the compressor to stop operating normally. If this should occur, an alarm will be generated to indicate the faulted compressor condition.

Reverse cycle heating

The WSHP Open controller will operate one or two stages of compression to maintain the desired heating set point. The compressor outputs are controlled by the heating PI (proportional-integral) loop and heating stages capacity algorithm. They will be used to calculate the desired number of stages needed to satisfy the space by comparing the space temperature (SPT) to the appropriate heating set point. The following conditions must be true in order for the heating algorithm to run:

- Heating is set to Enable
- The Fire/Smoke Input and Shutdown modes are inactive
- Cool mode is not active and the compressor time guard has expired
- Condensate Overflow input is Normal

- Fan Status is true (if option is enabled).
- If occupied, the SPT is less than the occupied heating set point.
- Space temperature reading is valid.
- If unoccupied, the SPT is less than the unoccupied heating set point.
- OAT is less than the heating lockout temperature if OAT is available.
- Condenser water pump is on (if condenser water linkage active).

If all the above conditions are met, the heating outputs will be energized as required, otherwise they will be de-energized. If the heating is active and should the SAT approach the maximum SAT limit, the fan will be indexed to the next higher speed. Should this be insufficient, then if the SAT rises further and reaches the maximum heating SAT limit, the fan will be indexed to the maximum speed. If the SAT still continues to rise 5°F above the maximum limit, all heating stages will be disabled.

During heating, the reversing valve output will be held in the heating position (either B or O type as configured) even after the compressor is stopped. The valve will not switch position until the cooling mode is required.

The configuration screens contain the Max SAT parameter as well as heating lockout based on outdoor air temperature (OAT), both can be adjusted to meet various specifications.

There is a 5-minute off time for the compressor as well as a 5-minute time delay when staging up to allow the SAT to achieve a stable temperature before energizing a second stage of capacity. Likewise, a 45-second delay is used when staging down.

After a compressor is staged off, it may be restarted again after a normal time-guard period of 5 minutes and if the supply air temperature has fallen below the maximum supply air temperature limit.

The WSHP Open controller provides a status input to monitor the compressor operation. The status is monitored to determine if the compressor status matches the commanded state. This input is used to determine if a refrigerant safety switch or other safety device has tripped and caused the compressor to stop operating normally. If this should occur, an alarm will be generated to indicate the faulted compressor condition.

Indoor air quality (IAQ) and demand controlled ventilation (DCV)

If the optional indoor air quality sensor is installed or the network input point "System Space AQ" is utilized, the WSHP Open controller can maintain indoor air quality, with a field-installed modulating OA damper providing demand controlled ventilation. The control operates the modulating OA damper during occupied periods. The control monitors the CO_2 level and compares it to the configured set points and adjusts the ventilation rate as required. The control provides proportional ventilation to meet the requirements of ASHRAE specifications by providing a base ventilation rate and then increasing the rate as the CO_2 level increases. The control will begin to proportionally increase ventilation when the CO_2 level rises above the start ventilation set point and will reach the full ventilation rate when the CO_2 level is at or above the maximum set point. A user configurable minimum damper position ensures that proper base ventilation is delivered when occupants are not present. The IAQ configurations can be accessed through the configuration screen. The following conditions must be true in order for this algorithm to run:

- Damper control is configured for DCV.
- The Fire/Smoke Input and Shutdown modes are inactive.
- Fan Status is true (if option is enabled).
- The unit is in an occupied mode.
- IAQ sensor reading is greater than the DCV Start Control set point.

The control has four user adjustable set points: DCV start control set point, DCV Maximum Control set point, Minimum damper position and the DCV Maximum damper position.

NOTE: In order for the damper to maintain proper base ventilation, the fan must be configured to operate in either the Continuous or Always On mode.

Two-position OA damper

The control can be configured to operate as a ventilation damper in a 2-position ventilation mode to provide the minimum ventilation requirements during occupied periods. This control operation still utilizes the modulating damper actuator.

Demand limit

The WSHP Open controller has the ability to accept three levels of demand limit from the BACnet network. In response to a demand limit, the unit will decrease its heating set point and increase its cooling set point to widen the range in order to immediately lower the electrical demand. The amount of temperature adjustment in response is user adjustable for both heating and cooling and for each demand level. The response to a particular demand level may also be set to zero.

Power failure restart delay

The control provides a user configurable delay when recovering from a power failure or SHUTDOWN mode or when transitioning from unoccupied to occupied mode in order to prevent excessive demand when many units start simultaneously. Each unit can be user configured for a unique delay between 5 and 600 seconds. The factory programmed default delay is 180 seconds.

Fire/smoke detector alarm

The control monitors the voltage input to J1-9 to detect if a smoke detector or fire detector Normally Closed contact has opened, indicating an alarm condition. The control will verify the presence of 24 vac on this input. If the input should open at any time, an alarm will be generated after 3 seconds and the equipment (fan, compressor, auxiliary heat and damper) will immediately return to an OFF or closed state.

Space temperature alarms

The control provides the ability to generate an alarm whenever the space temperature exceeds the alarm set point. A separate occupied hysteresis and fixed unoccupied high and low alarm set points are provided. The control provides a 5-minute alarm delay during unoccupied periods. During occupied periods, the control uses the occupied temperature set points and applies the hysteresis value to determine the alarm set points. Whenever an occupancy transition from unoccupied to occupied occurs or the occupied temperature set points are changed causing an alarm condition to occur, the control will automatically calculate an alarm delay (equivalent to the configured

delay time in minutes per degree F times the temperature error that occurred plus 15 minutes). This will prevent nuisance alarms whenever an occupancy change occurs and allows time for the unit to correct an alarming temperature condition.

Condenser water temperature alarm

The control has 4 configurable alarm limits for condenser water temperature. The control will verify that the water temperature is within operating range (between high and low limits) for the specific operating mode (heating or cooling) before energizing the compressor. Once the compressor is started, the condenser water temperature is further monitored to verify that it is within limits to ensure sufficient water is flowing through the coil. Should the leaving water temperature rise above or fall below the appropriate limits, an alarm is generated and the compressor will be shut down if the condition occurs for more than 15 seconds.

Supply air temperature alarm

The control has 2 configurable alarm limits for supply air temperature. The control will verify that the supply air temperature is within operating range (between high and low limits) whenever the compressor or auxiliary heat is operating. Should the air temperature rise above or fall below the appropriate limit, an alarm is generated if the condition occurs for more than 1 minute.

High condensate/overflow alarm

The control will monitor a discrete input to determine the state of a condensate level switch. The input can be configured to alarm on either an open or closed switch condition. Should this input be in an alarm state, the control will start a timer and after the timer exceeds a configurable Condensate Overflow Alarm Delay limit (10-second default), the control will generate an alarm and the unit will disable the compressor and fan outputs.

Fan status alarm (optional)

The control generates a fan status alarm should the fan status input detect the fan is OFF after any fan speed output has been enabled. A 30-second alarm delay is used to allow the fan sufficient time to start operating before an alarm condition is detected. The control monitors the fan output and if the fan is operating at any speed, the fan status must detect the fan is operating.

Compressor status alarm

The control generates a compressor failure alarm should the compressor status input detect the compressor is OFF after the compressor output has been energized. A 6-minute alarm delay is used to allow the compressor to start (prevents alarms due to time guard operation) before an alarm condition is detected. The control monitors the compressor output and if the compressor output is energized, the compressor status input must detect the compressor operation.

Filter status alarm

The control provides the ability to generate a dirty filter alarm after the number of fan run hours exceeds a configurable filter alarm timer limit. The control monitors the fan output and if the fan is operating at any speed, it accumulates run time. Should the fan run time hours exceed the configurable limit, an alarm is generated. To reset the alarm timer after the alarm has been generated, a Reset Filter Alarm input is provided. The filter alarm can be disabled by setting the Filter Alarm Timer Delay to zero (factory default).

Indoor air quality alarm

The control provides the ability to generate a high CO_2 level alarm during occupied periods whenever the CO_2 sensor value exceeds the user adjustable limit. Whenever an occupancy transition from unoccupied to occupied occurs, or the occupied alarm limit is changed to a value that causes an alarm condition to occur, the control will automatically calculate an alarm delay:

$$\frac{\text{the configured delay time in minutes}}{\text{ppm times the error that occurred}} + 15 \text{ minutes}$$

This prevents nuisance alarms from occurring when occupancy changes or the set point is changed. The IAQ alarm can be disabled by setting Occupied High IAQ Alarm Limit to zero.

Relative humidity alarm

The control provides the ability to generate an alarm whenever the space relative humidity exceeds the alarm set point. Separate occupied and unoccupied high humidity alarm set points are provided. The control provides a 5-minute alarm delay during unoccupied periods. During occupied periods, the controller uses the occupied high RH alarm limit. Whenever an occupancy transition from unoccupied to occupied occurs, or the occupied high alarm limit is lowered causing an alarm condition to occur, the control will automatically calculate an alarm delay:

$$\frac{\text{the configured delay time in minutes}}{\text{\% RH times the humidity error condition that occurred}} + 15 \text{ minutes}$$

This will prevent nuisance alarms whenever an occupancy change occurs and allows time for the unit to correct an alarming humidity condition.

Condenser water linkage failure alarm (if condenser water linkage was active)

The control generates a condenser water linkage failure alarm should linkage fail after once being active. The linkage status is monitored and should it fail to be updated from the loop controller, then a Condenser Water Linkage alarm is generated. A 6-minute alarm delay is provided to prevent false alarms from occurring.

NOTE: This alarm can only be reset by re-establishing linkage and correcting the condition that caused the linkage failure to occur or by setting the SHUTDOWN point to Active momentarily.

Airside linkage failure alarm (if airside linkage was active)

The control generates an airside linkage failure alarm should linkage fail after once being active. The linkage status is monitored and should it fail to be updated from the Master Zone Controller, then an airside linkage alarm is generated. A 6-minute alarm delay is provided to prevent false alarms from occurring.

NOTE: This alarm can only be reset by re-establishing linkage and correcting the condition that caused the linkage failure to occur or by setting the SHUTDOWN point to Active momentarily.

Controls sequence of operation (cont)

OAT sensor alarm (if network OA temperature was active)

The control generates an OAT sensor failure alarm should the value of OAT fail to be updated through the network after once being active. The update status is monitored and should it fail to be updated, then an OAT sensor alarm is generated. An alarm delay (approximately 1 hour) is provided to prevent false alarms from occurring while minimizing the required update rate for OAT.

NOTE: This alarm can be reset by setting the SHUTDOWN point to Active momentarily.

ZS sensor alarm (if ZS sensor was active)

The control generates a ZS sensor failure alarm should the ZS sensor fail to communicate with the control. The update status is monitored and should it fail to be updated, then the alarm is generated.

Console Water Source Heat Pumps

HVAC Guide Specifications

Size Range: **8,700 to 16,900 Btuh**
Cooling Capacity (Water Loop)
9,500 to 20,800 Btuh
Heating Capacity (Water Loop)
Carrier Model Number: **50PEC**

Part 1 — General

1.01 SYSTEM DESCRIPTION

A. Install water source heat pumps, as indicated on the plans with capacities and characteristics as listed in the schedule and the specifications that follow.

B. Units shall be individually packaged with wooden skid covered with protective corner posts and plastic stretch wrapping for maximum protection.

1.02 QUALITY ASSURANCE

A. All equipment shall be rated and certified in accordance with ANSI/AHRI/ASHRAE/ISO (American National Standards Institute/Air-Conditioning, Heating and Refrigeration Institute/American Society of Heating, Refrigerating, and Air-Conditioning Engineers/International Organization for Standardization) 13256-1, latest edition, and safety listed in accordance with NRTL (Nationally Recognized Testing Lab) or CSA (Canadian Standards Association). All units shall have AHRI/ISO and NRTL or CSA labels.

B. Units shall be factory tested to verify operation of critical components and verify functionality of control and safety devices.

Part 2 — Product

2.01 EQUIPMENT

A. Heat Pump Assembly:

Units shall be designed to operate throughout the range of entering fluid temperature of 40°F to 110°F in the cooling mode and 25°F to 80°F in the heating mode. The management system governing the manufacture of this product is ISO 9001 certified.

B. Unit Cabinet:

1. Cabinet work shall include two separate integral assemblies: cabinet and sub-base. Cabinet shall be factory fabricated from heavy gage galvanized steel, finished with powder coat paint. Cabinet dimensions are in accordance with drawings and are manufactured for left or right water discharge piping. Cabinet shall be single-piece construction. Removal of the cabinet shall give complete side and front access to unit for routine servicing. The cabinet is mounted onto the sub-base and secured with two screws for security. A wall mounting bracket secured to the sub-base shall be provided. Air flow is bottom intake-top discharge. Cabinets will be factory fabricated specifically for left hand or right hand connections as specified. Cabinet shall be slope top style, flat top cabinet is not acceptable.
2. An access door shall be provided to access the unit mounted controller (units with unit mounted controller only).
3. Factory mounted 3 $^{3}/_{8}$-in. sub-base is constructed of heavy gage painted steel. Cutouts are provided for floor connections and outside air. Includes integral filter mounts to support a bottom mount permanent, washable, aluminum mesh filter. Sub-base shall have integral wall bracket.

C. Chassis:

The unit shall be chassis only, chassis on sub-base, or chassis with sub-base and cabinet. The chassis is of compact design and of the same dimensions for all model sizes. Dimensions must match details on drawings. Chassis mounts directly on support structures provided by the sub-base and shall be removable from the sub-base without dismantling the sub-base. Both the compressor and coil compartment shall be thermally and acoustically insulated, and have removable steel cover plates giving double acoustical protection between the two compartments. Compressor is mounted to the bottom of chassis with a 2-piece basepan to reduce noise transmission and vibration. The compressor access panel shall have a closed cell foam insulation for extra quiet operation. Fiberglass insulation is not acceptable on compressor access panel. The stainless steel condensate drain pan shall be IAQ with positive double slope and be removable without disturbing the evaporator assembly for cleaning as needed.

D. Fan and Motor Assembly:

Unit blower has a high efficiency PSC motor with two speed settings. Motor is direct connected to two double width, double inlet forward curved oversized centrifugal blower wheels that are selected for quiet operation, and balanced to minimize vibration. Blower wheel access is through removable blower inlet rings. Motor and blower assembly shall be removable without removing the chassis.

E. Outside Air Damper (optional):

Unit shall have a factory installed, motorized, 2-position, outdoor air damper.

F. Refrigerant Components:

1. Units shall have a sealed refrigerant circuit including a rotary compressor, a refrigerant metering device, a finned tube refrigerant-to-air heat exchanger, a reversing valve, a coaxial (tube-in-tube) refrigerant-to-water heat exchanger, and safety controls including a high-pressure sensor, a loss-of-charge sensor to protect against loss of refrigerant, and low water temperature (freeze-stat) sensor.
2. Rotary compressors shall have thermal overload protection and shall be located in an insulated

compartment to minimize sound transmission. Units shall have the compressor mounted on isolators to reduce noise and vibration transmission.

3. Coils shall be coated using an electro coating process for protection against most airborne chemicals.
4. Refrigerant-to-water heat exchangers shall be of copper inner water tube and steel refrigerant outer tube design rated to withstand 600 psig working refrigerant pressure and 400 psig working waterside pressure.
5. Drain pan shall be constructed of stainless steel to resist corrosion.
6. Reversing valve shall be four-way solenoid-activated refrigerant valves which shall fail to heating operation. If the unit fails to cooling a low-temperature thermostat must be provided to prevent over-cooling of the room.
7. Optional coaxial water-to-refrigerant heat exchangers shall be cupronickel.

G. Controls and Safeties:

1. Electrical:

   A control box shall be located within the unit and shall contain controls for compressor, reversing valve and fan motor operation.
2. Piping:
   a. Copper tubes with a $^{5}/_{8}$-in. OD dimension shall be provided on the supply and return water connections for the purpose of forming a sweat connection to field-supplied distribution piping.
   b. Optional threaded connections: A $^{1}/_{2}$-in. female pipe threaded fitting shall be factory mounted on the supply and return water connections.
3. Unit Controls:

   Safety devices on all units shall include low-pressure sensor or loss-of-charge switch, high-pressure switch, low water temperature sensor, and condensate overflow switch.
4. The optional unit mounted controller shall provide a tactile touchpad for temperature, fan and mode adjustment and provide a digital display of temperature in either degrees Fahrenheit or Celsius. The unit mounted controller shall provide an LED display for indication of unit operating mode as well as fan speed and fault indication for high or low pressure lockout. Rotary dial electromechanical controls shall not be acceptable. Options and features shall include:
   a. Adjustable temperature set point from 60°F through 80°F (15.5°C through 26.7°C).
   b. Adjustable temperature differential between 1°F and 6°F (0.6°C and 3.3°C).
   c. Manual or automatic changeover.
   d. High and low fan speed control.
   e. Constant fan speed or fan speed cycling with compressor.
   f. A 5-minute anti-short cycling delay.
   g. Random start.
   h. A 90-second low pressure bypass timer.
   i. Intelligent reset to allow unit to automatically restart after 5 minutes if a fault is no longer active.
5. Units with Complete C control package shall include a factory installed Unit Protection Module (UPM) with terminal strip inputs for use with remote heat pump thermostat or DDC controller. The Unit Protection Module shall have the following features:
   a. Anti-short cycle time delay on compressor operation; time delay shall be 5 minutes minimum.
   b. Random start on power-up.
   c. Low voltage protection.
   d. High voltage protection.
   e. Condensate overflow shutdown.
   f. Unit shutdown on low refrigerant pressures.
   g. Unit shutdown on high or low water temperature (selectable for antifreeze solutions).
   h. Option to reset unit at thermostat or disconnect. Fault type shall be retained in memory if reset at thermostat.
   i. Automatic intelligent reset. Unit shall automatically restart 5 minutes after shutdown if the fault has cleared. Should a fault occur 3 times sequentially, then lockout will occur.
   j. Ability to defeat time delays for servicing.
   k. Light-emitting diode (LED) to indicate high pressure, low pressure, improper voltage, water coil freeze protection, air coil freeze protection, condensate overflow, and control status.
   l. Remote fault type indication at thermostat.
   m. Single harness connection for all safety devices.
   n. Selectable 24-v or pilot duty dry contact alarm output.
   o. 24-v output to cycle a motorized water valve with compressor contactor.
   p. The control box components shall be easily accessible with a swing out control compartment.

6. The optional Deluxe D package shall have all the features of the Complete C package, with the following additional features:
   a. Pump-valve relay.
   b. Energy Management Switch to enable remote operation of WSHP.
7. WSHP Open Multiple Protocol Control:
   a. Units shall have a factory installed WSHP Open DDC controller with UPM module. DDC controller shall be factory installed, wired, configured, and run tested. Field installed DDC controls or DDC controls that are not factory configured and run tested are not acceptable. DDC control shall be capable of stand alone operation or network operation via BACnet[1], Modbus[2], or N2. The DDC controller shall include the following control points:
      1) Space temperature.
      2) Leaving water temperature.
      3) Discharge air temperature.
      4) Command of space temperature set point.
      5) Cooling status.
      6) Heating status.
      7) Low temperature sensor alarm.
      8) High pressure switch alarm.
      9) Fan on/off position of space thermostat.
      10) Unoccupied/occupied command.
      11) Cooling demand.
      12) Heating demand.
      13) Fan "ON/AUTO" command.
      14) Fault prevention with auto reset.
      15) Fault code
   b. Additional DDC control requirements include:
      1) DDC control shall provide independent fan speed control based on space temperature input. Control shall provide a minimum of 2 fan speed operation. Compressor dependent fan speed operation is not acceptable.
      2) Two-position OA (outdoor air) damper
      3) Modulating OA damper with DCV (demand controlled ventilation).
      4) Power fail restart delay.
8. Multiple-protocol WSHP Open controller remote ZS sensors for DDC (direct digital controls) control options. Only Carrier ZS sensors can be used with the WSHP Open controller. Sensors are available as follows, and all sensors below offer monitoring of space temperature only, or space temperature and CO_2, or space temperature and humidity, or space temperature and CO_2 and humidity.
   a. ZS Standard sensor with a communication port.
   b. ZS Plus sensor with communication port, occupancy status indicator, local occupancy override and set point adjustment.
   c. ZS Pro sensor with communication port, occupancy status indicator, local occupancy override, set point adjustment, LCD (liquid crystal diode) display, alarm indicator and fan speed control.
   d. ZS Pro-F sensor with communication port, occupancy status indicator, local occupancy override, set point adjustment, LCD display, alarm indicator, fan speed control, cooling/heating/fan only mode control and F to C conversion.
9. Optional Controls:
   a. Outdoor air dampers shall be motorized with a spring return motor solenoid. The damper shall open when the damper switch is set to "ON" and a request for the compressor to run is provided by the system.

H. Electrical Requirements:
1. Unit shall include a wiring diagram permanently affixed to the inside of the cabinet.
2. Unit nameplate shall specify power feed minimum circuit ampacity (MCA) and maximum overcurrent protection (MOCP).
3. Unit shall have a 24VA control circuit.
4. Units shall be provided with a factory mounted 2 x 4 junction box with removable cover on the same side as the water connections (left or right) for direct wire connection. This cover may be supplied with a non-fused power disconnect switch for servicing the unit. The unit shall operate with specified voltages 115 volt, 208/230 volt or 265 volt, single phase, 60 Hz supply current. Units with power cord and plug are not acceptable.
5. All 50PEC console units are rated for 5kA SCCR.

1. BACnet is a trademark of ASHRAE.
2. Modbus is a trademark of Schneider Electric.

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