SPACE PAK HYDRONICS

LAHP2-1119
45W30-WG0773

MODEL LAHP48 INSTALLATION, OPERATION & MAINTENANCE MANUAL

Low Ambient Air-to-Water Reverse Cycle Heat Pump

Intertek

SECTION 1: READ BEFORE PROCEEDING
Model LAHP Overview 2
SECTION 2: LAHP FIELD ADJUSTABLE PARAMETERS ... 3-7
SECTION 3: SPECIFICATIONS AND RATINGS 8-10
SECTION 4: DIMENSIONS 11
SECTION 5: LOCATION & MOUNTING
Prepare the Unit 12
Location 12
Hoisting 12
Mounting Pad 12
Indoor Installation 13
SECTION 6: RECOMMENDED PIPING 13
SECTION 7: GLYCOL/WATER SYSTEM
Glycol/Water System Design/ Installation 14-15
SECTION 8: START-UP AND TEST
Preparing for Start-Up 15
BEFORE Starting the Unit 16
Start the SpacePak Low Ambient Heat Pump 16
Anti-freeze Cycle 16
24-Hour follow-up 16
SECTION 9: ELECTRICAL DIAGRAMS
Pictorial Diagram 17
Ladder Diagram 18
Field Connections 19-20
SECTION 10: TROUBLESHOOTING/FAULT CODES 21-22
SECTION 11: MAINTENANCE
Annual Inspection 23
Preparing the LAHP for Shut Down 23
To Restart After Shutdown 23
SECTION 12: REPLACEMENT PARTS 24
SECTION 13: LIMITED WARRANTY 25

IN UNITED STATES: 260 NORTH ELM ST. WESTFIELD, MA 01085 800-465-8558 / FAX (413) 564-5815
IN CANADA: 7555 TRANMERE DRIVE, MISSISSAUGA, ONTARIO, L5S 1L4 (905) 670-5888 / FAX (905) 670-5782

⚠WARNING **Qualified installer only** —
This product must be installed only by a qualified service technician. The installation must be done using recognized industry practices, and in compliance with this manual and all applicable codes. Failure to comply could result in death, serious injury or substantial property damage.

NOTICE **For information not included in this manual, see the following:** This manual includes only basic information for installation, operation and maintenance of SpacePak air to water heat pumps. For more advanced applications and information not shown in this manual, contact SpacePak for assistance and supplemental instructions. Call 413-564-5530 in Westfield, MA or visit our website at www.spacepak.com to send an email or review technical literature.

Section 1: READ BEFORE PROCEEDING

Hazard Definitions

The following terms are used throughout this manual to bring attention to the presence of potential hazards or to important information concerning the product.

⚠DANGER Indicates an imminently hazardous situation, which if not avoided, WILL result in death, serious injury or substantial property damage.

⚠WARNING Indicates an imminently hazardous situation, which if not avoided, COULD result in death, serious injury or substantial property damage.

⚠CAUTION Indicates an imminently hazardous situation, which if not avoided, MAY result in minor injury or property damage.

NOTICE Used to notify of special instructions on installation, operation or maintenance, which are important to equipment, but not related to personal injury hazards.

Model LAHP Overview

The SpacePak Model LAHP48 Low Ambient Heat Pump is a self-contained reverse cycle heat pump that provides a continuous supply of heated or chilled water for various purposes, such as: residential or small commercial building heating and cooling; and specialty applications, such as computer room cooling or industrial/agricultural conditioning and dehumidification.

The Major Components of the LAHP48 are:

Model LAHP Heat Pumps are specifically configured to provide water at 80-140°F (45-60°C) at ambient temperatures as low as -8°F (-22°C) for medium temperature hydronic heating in moderate to cold winter climates. Additionally, cooling capacity of 3.3 tons is available in summer at water temperatures from 42-60°F conditions up to 95°F (35°C) outdoor ambient.

- A hermetically sealed, Enhanced Vapor Injected scroll refrigeration compressor & motor. The Enhanced Vapor Injection system draws heat from the liquid refrigerant, subcooling the charge for maximum heat capacity under extreme cold conditions, and uses that heat energy to increase the compression, and therefore usable heat, produced by the compressor.
- A generously sized outside coil to absorb heat (in heating mode) from the surrounding ambient air, or reject heat (in cooling mode).
- Two variable-speed motorized fans to force air through the outside coil.
- A brazed-plate refrigerant-to-water heat exchanger to supply heat (in heating) to the delivered water flow, or absorb heat (in cooling).
- A dedicated thermal expansion valve to throttle the refrigerant flow in heating and an electronically controlled expansion valve to manage Vapor Injection operation, responding to varying load on the system.
- Additionally, the system contains a reversing valve (to select between heating and cooling operation) and sensors and safety circuits to monitor and protect the equipment from potentially damaging or dangerous operating conditions.

The water circuit passes through the internal brazed-plate heat exchangers, and contains sensors to measure entering and leaving water temperatures. A mechanical flow switch safety ensures continuous water flow while the refrigerant system is operating.

All components are contained within a supporting structure and enclosure sufficient to allow stand-alone outdoor installation in all temperate climates.

All operation and protections are managed by a microprocessor controller which operates the individual systems, determines all operating parameters, and monitors the condition of each system. A simple interface communicates with the indoor air handler, heat exchanger, or other load.

Codes and Electrical Requirements

- This product must be installed in accordance with all applicable codes. Where instructions in this manual differ from specific local requirements, defer to the local codes.
- The electrical installation must also comply with the latest edition of: in the U.S. — National Electrical Code ANSI/NFPA No. 70; in Canada — CSA C22.1 Canadian Electrical Code Part 1. Wiring must be N.E.C. Class 1. Use only copper wire, rated for 90°C (194°F) and sized for the load listed in this manual.
- Electrical shock hazard — Disconnect all electrical power before servicing the unit. Also, the unit must be grounded in accordance with the Electrical Code listed above.

Refrigerant

- The refrigeration system is factory charged with R410A refrigerant, and requires no additional service during installation. Any repair, diagnosis or maintenance service to the refrigeration system must be performed by a qualified technician. No alternate refrigerants, lubricants or additives are approved for this unit. Any use of alternate or non-approved materials in the refrigeration system may result in personal injury or equipment damage, and will void the manufacturer's warranty.

Section 2: LAHP Field Adjustable Parameters

Figure 1 LAHP Controller

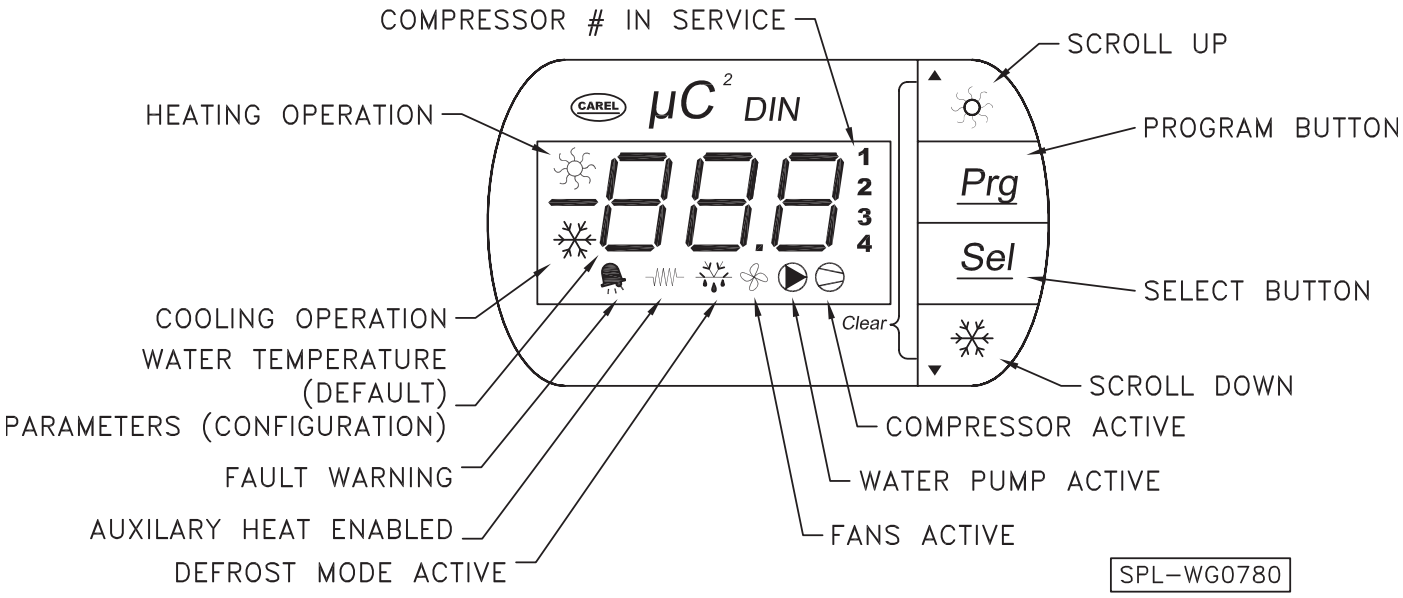
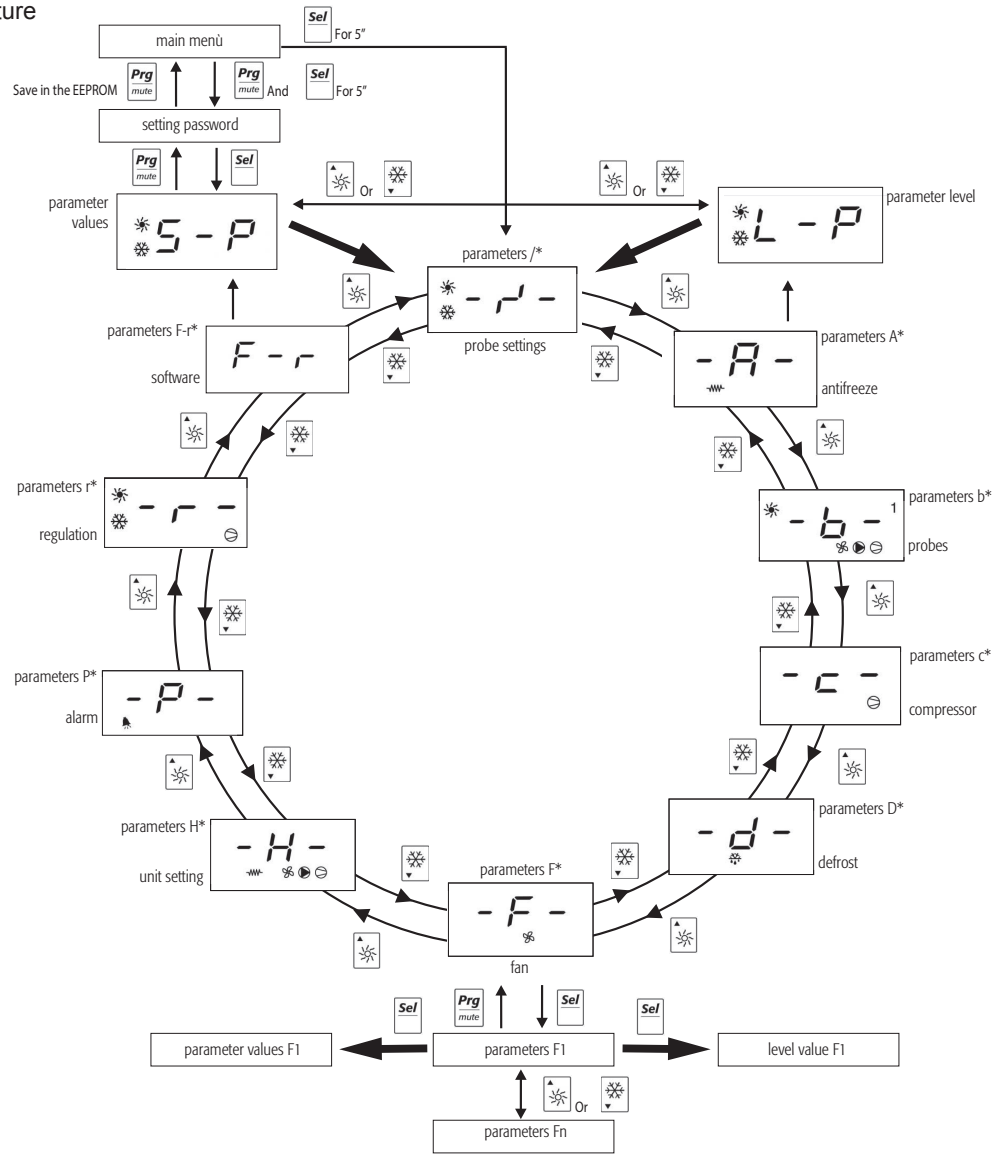


Figure 2 Menu Structure



Programming and Saving the Parameters

1. Press "**Prg**" and "**sel**" for 5 seconds;

2. the heating and cooling symbol and the figure "00" are displayed;

3. use "❄" and "❄" to set the password and confirm by pressing "**sel**";

4. use "❄" and "❄" to select the parameter menu (S-P) or levels (L-P) and then press "**sel**";

5. use "❄" and "❄" to select the parameter group and then press "**sel**";

6. use "❄" and "❄" to select the parameter and then press "**sel**";

7. after making the changes to the parameter, press "**sel**" to confirm or "**Prg**" to cancel the changes;

8. press "**Prg**" to return to the previous menu;

9. to save the modifications, press "**Prg**" repeatedly until reaching the main menu.

Note:
a. The parameters that have been modified without being confirmed using the "**sel**" button return to the previous value.
b. If no operations are performed on the keypad for 60 seconds, the controller exits the parameter modification menu by timeout and the changes are cancelled.

Keypad
The keypad is used to set the unit operating values (see Parameters/alarms – Keypad combinations).

LAHP Controller

The LAHP controller allows the adjustment of heating & cooling setpoints, differentials, and defrosting parameters.

The following chart depicts the factory default values for the most commonly adjusted parameters.

Certain read only parameters are available to evaluate performance or troubleshoot faults. These are accessed through the same parameter menu and are listed below.

DISPLAY	DESCRIPTION	MIN	MAX	UOM	DEFAULT	MEANING	PASSWORD
A01	Low Temp Alarm	A07	A04	°F	32.0	Water temperature below which the Low Temp alarm A1 will activate	22
A02	Alarm differential	0.3	122.0	°F	4.0	Alarm A1 turns off at A01 + A02	22
A04	Aux heater setpoint	A01	r16	°F	34.0	Water temperature below which the pump and electric heater, if present, engage.	22
A05	Differential for aux heater	0.3	50.0	°F	4.0	Pump and heater turns off at A04+A05	22
A07	Antifreeze alarm set point limit	-40.0	176.0	°F	32.0	Minimum temperature that A01 can be set to	66
A08	Auxiliary heater set point in heating mode	A01	r15	°F	90.0	Water temperature below which the electric heater, if present, engages in heating mode	22
A09	Auxiliary heater differential in heating mode	0.3	50.0	°F	5.0	Electric heater turns off at A08 + A09 in heating.	22
b00	Default display value	0	10	Flag	01	b00 = 0 Displays return water temperature b00 = 01 displays supply water temperature	22
b01	Probe B1 reading	-	-	°F	-	Read only, real time return water temperature	00
b02	Probe B2 reading	-	-	°F	-	Read only, real time supply water temperature	00
b03	Probe B3 reading	-	-	°F	-	Read only, real time OS coil surface temperature	00
b04	Probe B4 reading	-	-	Bar	-	Read only, real time OS coil refrigerant pressure, in bar (1 bar=14.5 PSI)	00
b08	Probe B8 reading	-	-	°F	-	Read only, real time ambient air temperature	00
c10	Accumulated compressor hours	-	-	hrs x 100	-	Value x 100 is the accumulated compressor run time in hours	00
C15	Accumulated pump hours	-	-	hrs x 100	-	Value x 100 is the accumulated pump run time in hours	00
d01	Defrost cycle	0	1	Flag	1	Defrost feature enabled	22
d02	Defrost logic	0	2	Flag	2	Start on pressure, end on temperature	22
d03	Start defrosting pressure	0.0	d04	Bar	3.2	Suction pressure below which Defrost initiates (1 bar = 14.5 PSIG)	22
d04	End defrosting temperature	0.0	176.0	°F	45	End defrost temperature, coil surface	22
d06	Min. duration of a defrosting cycle	0	150	Second	60	Minimum defrost duration even if all conditions are satisfied.	22
d07	Max. duration of a defrosting cycle	1	150	Minute	7	Maximum allowable defrost duration. Will display dF1 error code if exceeded	22
d08	Delay between 2 defrost cycles	10	150	Minute	45	Minimum time betgween two successive defrost cycles even if conditions call for it	22
d16	Forced ventilation time at the end of the defrosting	0	360	Second	45	Duration of fan operation at full speed to clear water from coil	66
d17	Defrost with compressors OFF	0	80.0	°F	55.0	Temperature above which defrost occurs with fans only.	66
F02	Fan operating logic	0	2	Flag	03	0 = Fans on full speed whenever unit is on 1 = Fans on when compressor is running 3 = Fans modulating according to F03 through F10	66
F03	Min. voltage threshold for Triac	0	F04	%	10	Establishes low end of fan modulation signal (See Fig 3 & Fig 6)	66
F04	Max. voltage threshold for Triac	F03	100	%	100	Establishes high end of fan modulation signal (See Fig 3 & Fig 6)	66
F05	Pressure value for min. speed Cooling	0.0	42.0	Bar	20.0	Discharge pressure, bar, below which fans remain on at minimum speed (1 Bar =14.5 PSIG) (See Fig 3)	22
F06	Pressure differential for max. speed Cooling	0.0	42.0	Bar	6.0	Fans reach max speed at F05 + F06 (See Fig 3)	22
F07	Pressure differential for fan shut-down in Cooling mode	0.0	F5	Bar	2.0	Fans shut down at F05 - F07 (See Fig 3)	22
F08	Pressure value for min speed in Heating mode	0.0	42.0	Bar	10.0	Discharge pressure, bar, above which fans operate at minimum speed (See Fig 4)	22
F09	Pressure differential for max speed in Heating	0.0	F08	bar	5.5	Fans reach maximum speed at F08 - F09 (See Fig 4)	22
F10	Pressure differential for fan shut-down in Cooling mode	0	F08	Bar	1.0	Fans shut down at F08 + F10 (See Fig 4)	22
F11	Fan starting time	0	120	Second	15	Fans start at maximum speed and remain for this duration before modulating	22
r01	Cooling set point	r13	r14	°F	47.0	Primary cooling setpoint (See Fig 5)	00
r02	Cooling differential	0.3	50.0	°F	8.0	Cooling differential/hysteresis	00
r03	Heating set point	r15	r16	°F	120.0	Primary heating setpoint (See Fig 6)	00
r04	Heating differential	0.3	50.0	°F	8.0	Heating differential/hysteresis	00
r06	Compressor control logic	0	4	Flag	00	00 = Proportional control on return water temperature 02 = Proportional control on supply water temperature	66
r13	Min. Cooling set point	-40.0	r14	°F	42	Minimum allowable cooling setpoint	22
r14	Max. Cooling set point	r13	176.0	°F	65	Maximum allowable cooling setpoint	22
r15	Min. Heating set point	-40	r16	°F	80.0	Minimum allowable Heating setpoint	22
r16	Max. Heating set point	r15	176.0	°F	140.0	Maximum allowable Heating setpoint	22
r17	Cooling compensation constant	-5.0	+5.0	°F	0.0	Slope of Outdoor reset curve, Deg water temp/Deg ambient temp. Cooling mode (See Fig 5)	22
r18	Maximum distance from the set point	0.3	20.0	°F	8.0	Maximum deviation from setpoint that can be achieved by outdoor reset (See Fig 5 & Fig 6)	22
r19	Start compensation temperature in cooling mode	-40.0	176.0	°F	85.0	Ambient air temp above which Outdoor Reset is active in Cooling (See Fig 5)	22
r20	Start compensation temperature in heating mode	-40.0	176.0	°F	30.0	Ambient air temp below which Outdoor Reset is active in Heating (See Fig 6)	22
r31	Heating compensation constant	-5.0	+5.0	°F	0	Slope of Outdoor reset curve, Deg water temp/Deg ambient temp. Heating mode (See Fig 6)	22

Figure 3 Solstice Extreme Fan Speed Control, Cooling

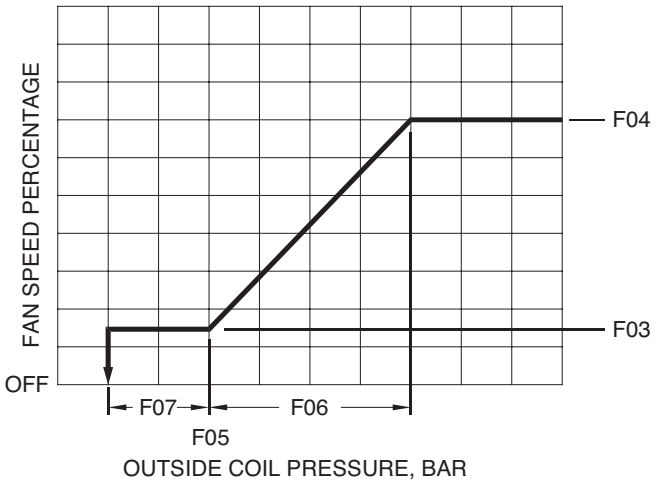


Figure 4 Solstice Extreme Fan Speed Control, Heating

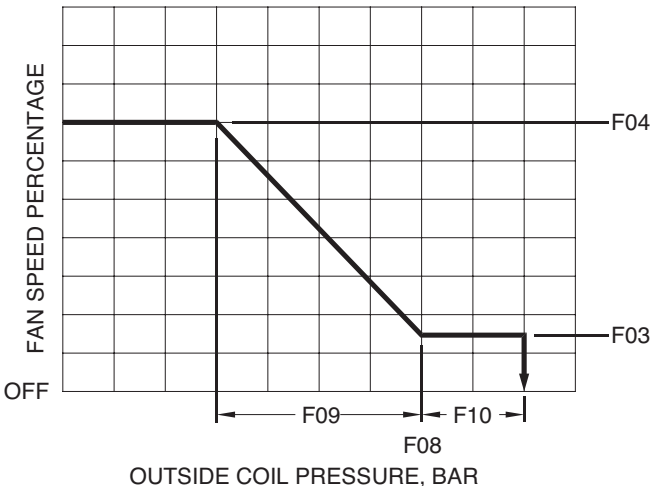


Figure 5 Solstice Outdoor Reset, Cooling

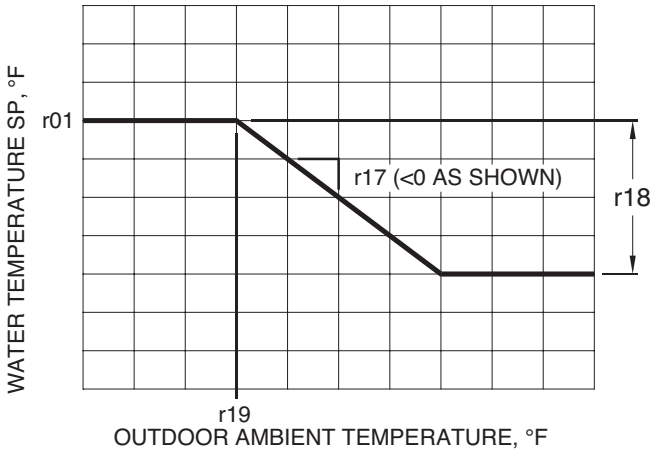
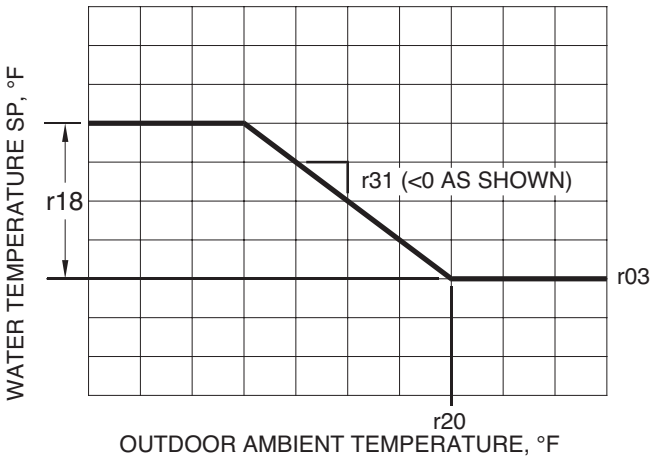


Figure 6 Solstice Outdoor Reset, Heating



Liquid Side

⚠CAUTION The fluid in the liquid side of the Model LAHP must be an anti-freeze/water mix. Only Ethylene Glycol or Propylene Glycol anti-freeze mixtures specifically formulated for boiler or hydronic system use are allowed.

The use of automotive glycol anti-freeze, or any alternative such as methanol or glycerin, will immediately void the manufacturer's warranty.

- The antifreeze percentage must be at least 30% by volume. This will ensure a free flowing coolant loop down to and below the minimum operating envelop, as well as burst protection to at least -60°F (-51°C). Therefore, a higher concentration is not generally recommended. However, if it is absolutely necessary to be able to "cold start" (after power has been removed and all components have cooled to ambient temperature) the coolant loop in extreme conditions, it is allowable to use up to a 50% glycol solution, for free flow down to -40°F (-40°C). However it should be noted that the heat transfer capacity of this higher concentration is lower, and the viscosity (system pressure drop) is significantly higher, so the unit performance will be diminished accordingly, and the circulator choice must be appropriate for these conditions.

Thoroughly flush the system before filling.

- The system must be supplied with a pump sized to provide the minimum flow rates specified in this manual. Pump selection must consider the pressure loss through the system and its components plus the pressure loss through the LAHP's heat exchanger and internal components. The pump must be rated for use with chilled water/glycol mixture.
- Install a y-strainer at the liquid input of the heat pump as shown in this manual to prevent damage to the heat exchanger from sediment.
- DO NOT use for potable water heating. The single-wall heat exchanger is not suitable for the application.

Ambient Operating Limits

- The LAHP48 is designed to deliver optimal performance in ambient temperatures ranging from -8°F (-22°C) to 105°F (40°C). Operation outside of these limits is not prohibited, as internal protective circuits will prevent dangerous or destructive conditions. However operation outside of this range will result in significantly diminished performance and may result in spontaneous shut down of the heat pump if the protective safety features are engaged.

Contact SpacePak Technical Support for assistance if more advanced configuration is desired, 1-800-465-8558.

Standard Equipment

- Heat pump, including a refrigeration system, factory-programmed controller, fans and all required internal components
- Powder-coated enclosure
- Pump and piping by others

Additional Components Required

- Expansion tank, properly sized for system volume.
- Buffer Tank (properly sized).

Recommended Accessories

- SpacePak heat pump interface module
- SSIC
- Multi-Chiller controller (for multiple heat pump installations)

Section 3: Specifications & Ratings

Model	LAHP48	COP
Heating Capacity (47°F/8°C Ambient temp. 120°F/50°C Supply Water)	66,480 BTU/h (18.9kW)	3.26
Heating Capacity (17°F/-8°C Ambient temp. 120°F/50°C Supply Water)	46,440 BTU/h (13.6kW)	2.35
Heating Capacity (5°F/-15°C Ambient temp. 120°F/50°C Supply Water)	42,240 BTU/h (12.4kW)	2.12
Cooling Capacity (95°F/35°C Ambient temp. 44°F/6.7°C Supply Water)	40,000 BTU/h (11.7kW)	2.43
Volts	230V/1ph/60Hz	
Minimum water supply temperature*	42°F (5.5°C)	
Maximum water supply temperature*	140°F (60°C)	
Minimum operating ambient temperature	-8°F (-22°C)	
Maximum operating ambient temperature	105°F (40°C)	
Minimum water flow	10 GPM (37.9 l/min)	
Recommended water flow	11 GPM (41.6 l/min)	
Pressure drop at recommended flow	17.1 ft/7.4 PSI (35.8 kPa)	
Heating current	31A	
Cooling Current	23.5A	
Noise level at max fan speed (Heating or Cooling)	62 dB (A)	
Compressor	EVI Scroll	
Installed weight	386 lbs (175 kg)	

*Refer to section 2 for default (factory set) control setpoints.

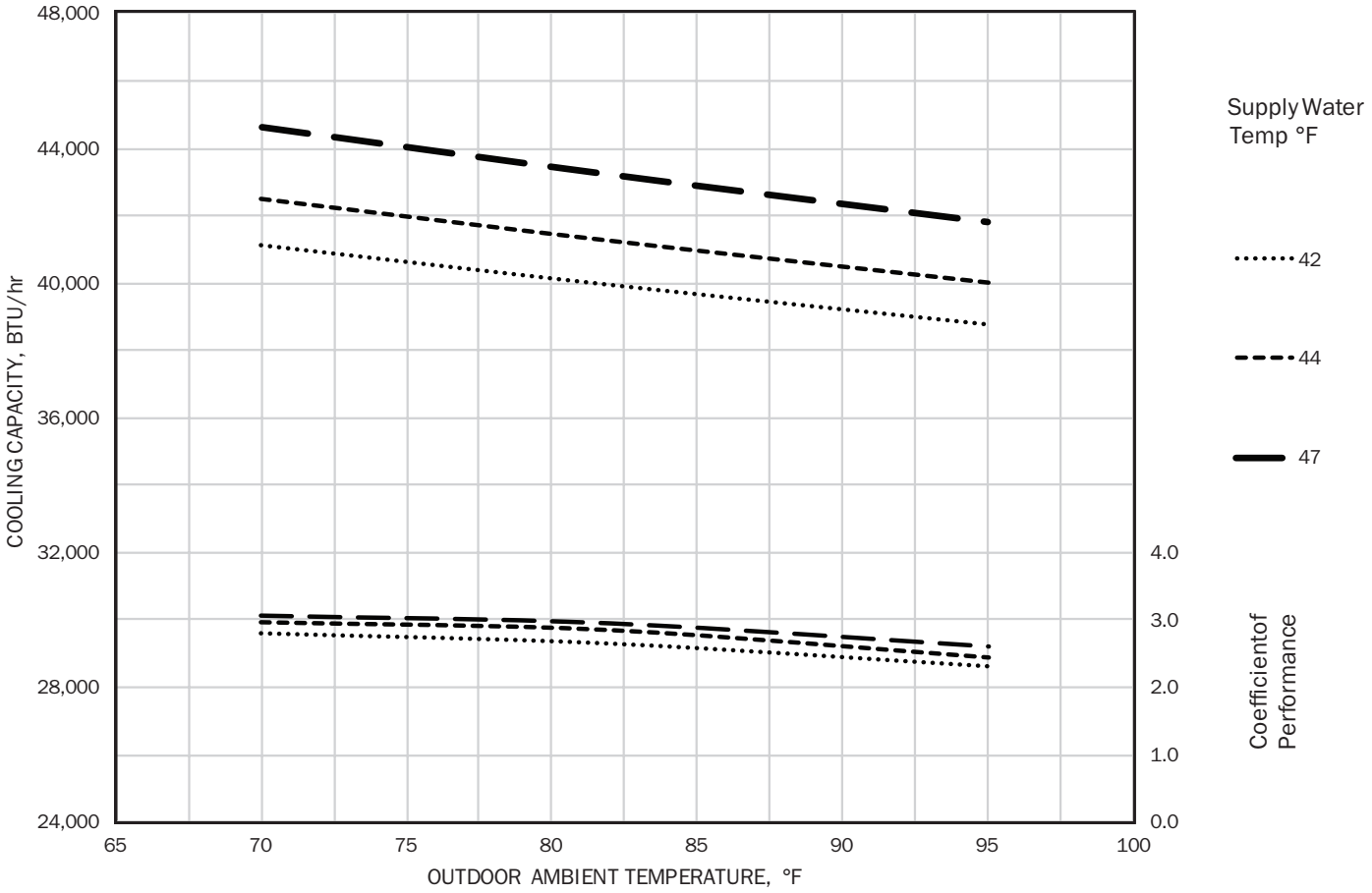
LAHP48

Heating						Cooling					
Water Temp °F	Ambient Temp °F	Capacity BTU/hr	Water DP ft WC	Watts	COP	Water Temp °F	Ambient Temp °F	Capacity BTU/hr	Water DP ft WC	Watts	COP
110	-5	37,500	17.1	3,880	2.30	42	70	41,100	17.1	4,298	2.80
	17	44,800	17.1	3,970	2.70		82	39,950	17.1	4,414	2.65
	47	60,580	17.1	4,263	3.75		95	38,800	17.1	4,897	2.32
120	-5	38,500	17.1	4,513	2.00	44	70	42,500	17.1	4,190	2.97
	17	46,440	17.1	5,790	2.35		82	41,250	17.1	4,238	2.85
	47	66,480	17.1	5,963	3.26		95	40,000	17.1	4,820	2.43
130	-5	40,425	17.1	5,249	1.86	47	70	44,600	17.1	4,240	3.08
	17	48,762	17.1	5,371	2.18		82	43,200	17.1	4,274	2.96
	47	69,804	17.1	5,768	3.04		95	41,800	17.1	4,708	2.60

All data based upon pure water @ 11.0 GPM

LAHP48 Cooling Performance

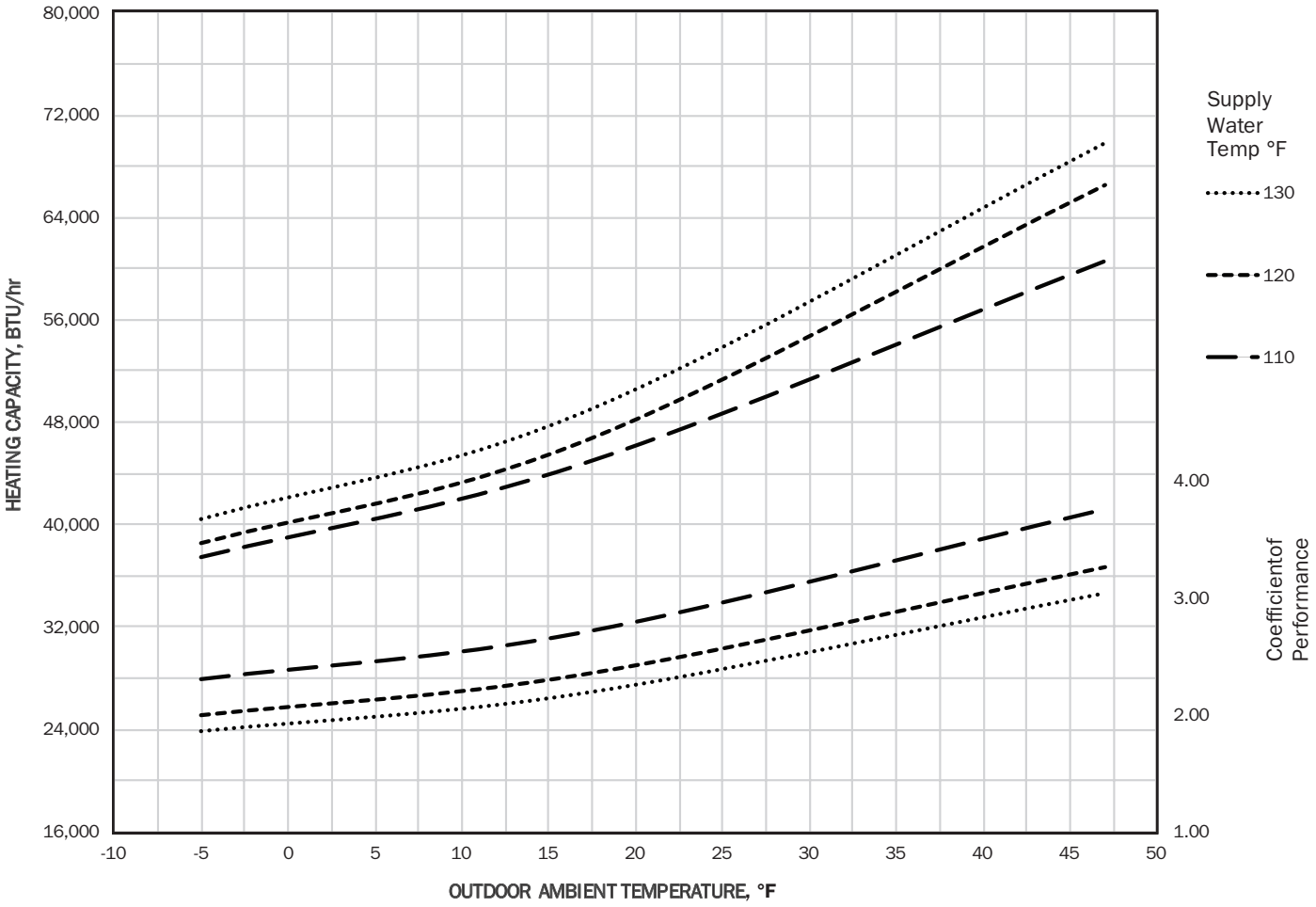
Figure 7



All data based upon pure water @11.0 GPM

LAHP48 Heating Performance

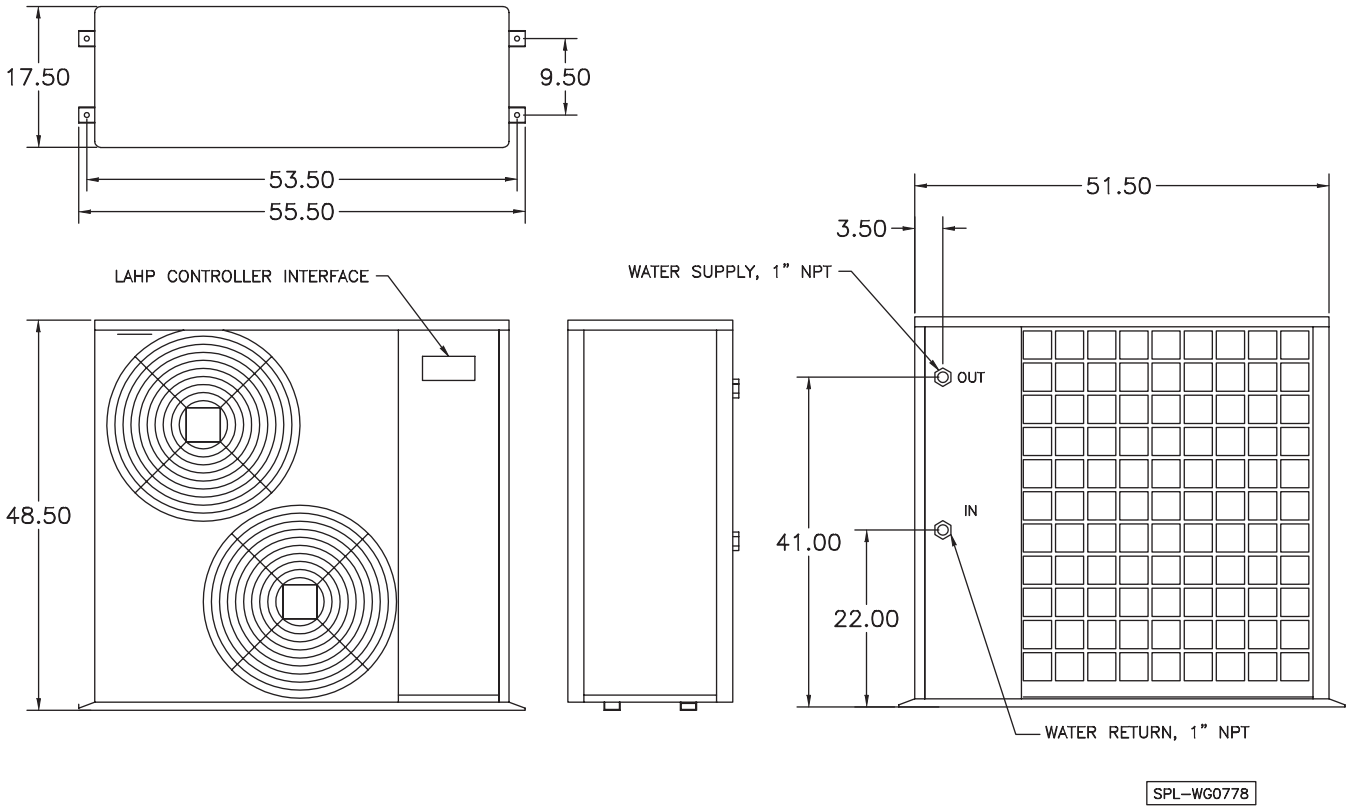
Figure 8



All data based upon pure water @11.0 GPM

Section 4: Dimensions

Figure 9 Model LAHP Dimensions (all dimensions in inches)



Section 5: Location & Mounting

⚠WARNING Failure to comply with all of the guidelines IN THE FOLLOWING could result in death, serious injury or substantial property damage.

The installation must comply with all applicable local codes.

Prepare The Unit

Inspect the unit for shipping damage. DO NOT use if there is a risk that the damage could affect unit operation.

Make sure all required components are available.

Install optional immersion heater, if used. See instructions provided with the heater.

Location

- DO NOT locate where the unit could be sprayed by sprinklers.
- DO NOT locate near swimming pools, spas or any location that could cause chlorine or other contaminant to enter the unit.
- DO NOT locate where water run-off from adjacent structures could impinge on the unit.
- Maintain the clearances shown in Figure 11.

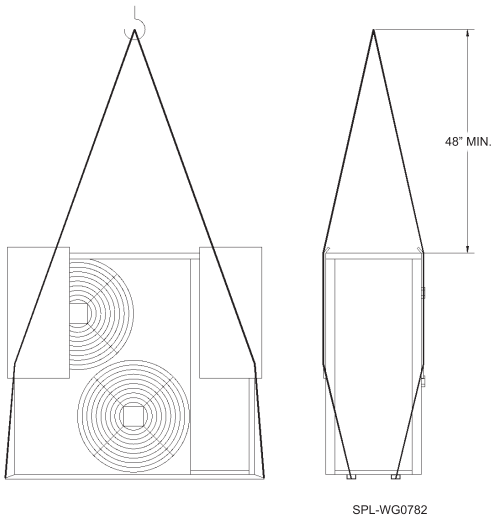
Hoisting (refer to Figure 10)

Using four equal length straps or cables, route them from the mounting feet, in front of and behind the cabinet, and join them together no less than 48" above the top of the unit.

This is ideally done in the original packaging, but if the unit has been unpacked, ensure the cabinet is protected where the cables cross, with sufficient padding such as multiple layers or corrugated cardboard.

Use caution when handling. The unit is heavy and could cause severe injury or damage if dropped or handled incorrectly.

Figure 10 Hoisting



Mounting Pad

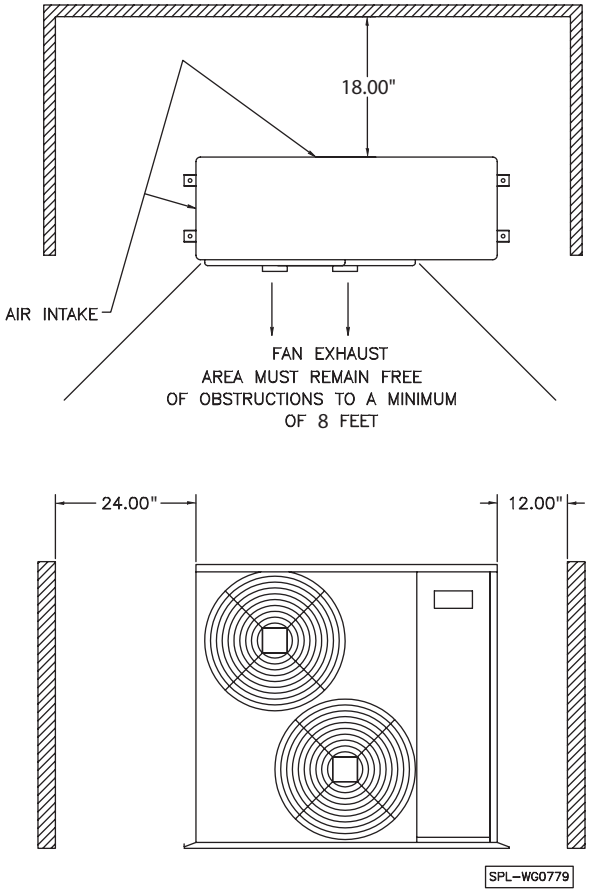
The SpacePak heat pump must be mounted on a level corrosion and weather-resistant mounting surface, preferably concrete. The structural support must be suitable for the operating weight of the unit and attached components, its mounting pad, snow loading and any other expected loads.

There must be sufficient clearance all around the LAHP for proper performance. Refer to Figure 11 for clearance dimensions.

The mounting pad must not be attached directly to a structure where noise transmission would be objectionable.

Vibration isolators supplied with the chiller may be installed when desired to reduce transmitted vibration.

Figure 11 Maintain Clearances Shown Above



The unit **must** be bolted securely to the pad. Where required by local jurisdiction, the mounting must also be analyzed for seismic loading capability.

The mounting must ensure that there will be no debris accumulation which might block air flow through the enclosure openings. The lower edge of the lower fan opening must be above the typical snow line, including allowance for drifting.

There must be no accumulation of water that could reach the bottom of the unit's enclosure.

Section 5: Location & Mounting (continued)

Corrosive Environments

Do **NOT** install the unit in an area subject to sea air or other potential corrosive contaminants.

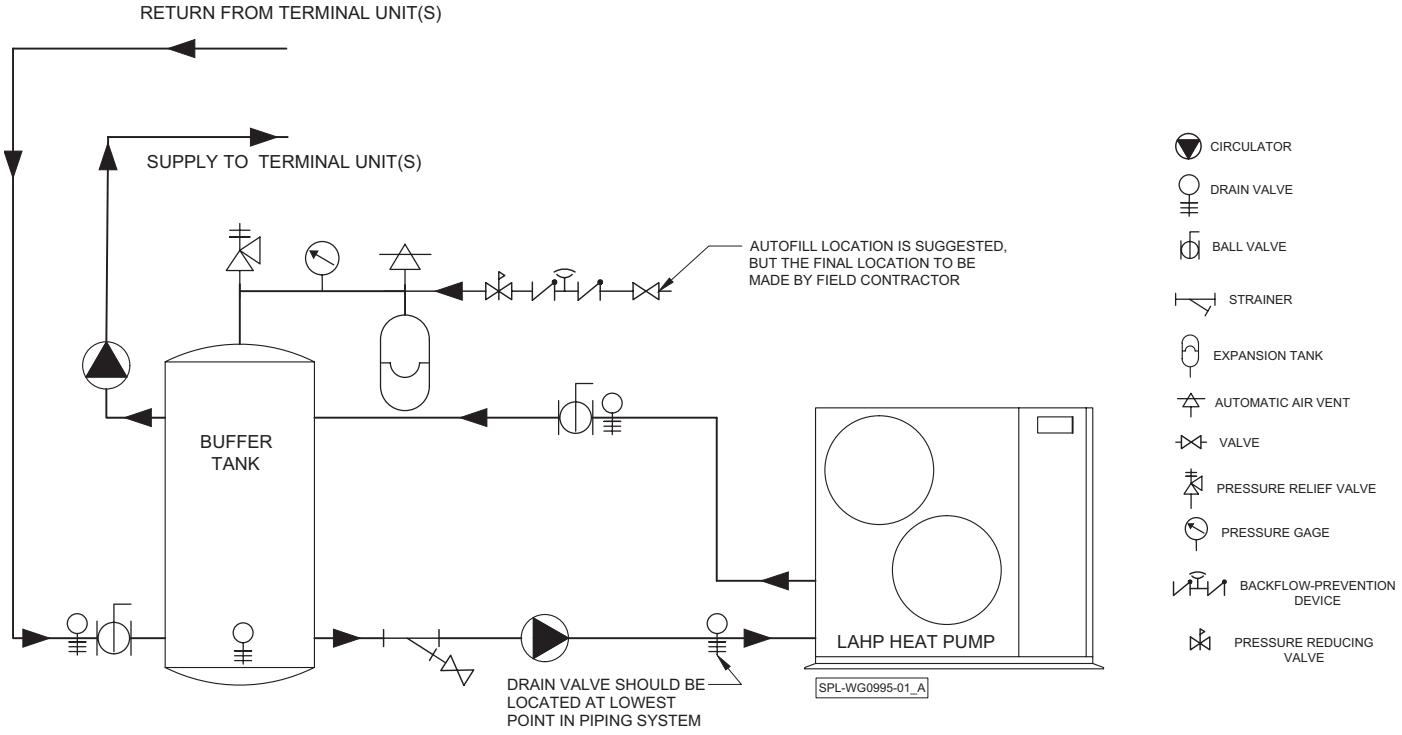
Indoor Installation

If the unit is installed inside a building, the building must be equipped with air openings sufficient to ensure free discharge of heated (or cooled) air generated by the heat pump. All clearances must be maintained to ensure free air flow into and out of the enclosure. Make sure no other equipment located in the space will be affected by the units air flow.

All clearances must be maintained to ensure free air flow into and out of the enclosure. Make sure no other equipment located in the space will be affected by the unit's airflow.

Section 6: Recommended Piping Diagram

Figure 12



Section 7: Glycol/Water System

Figure 13 LAHP Glycol Concentrations (30% Minimum, 50% Maximum)

Ethylene Glycol %	30	40	50
Min. Ambient Temp for Operation	2°F/-17°C	-13°F/-25°C	-36°F/-38°C
SpacePak Capacity Multiplier	0.93	0.91	0.89
Pressure Drop Multiplier (Cooling)	1.16	1.25	1.36
Pressure Drop Multiplier (Heating)	1.16	1.22	1.28
Minimum Expansion Volume / System Volume			
Heating and Cooling (Gallons)	1 gallon expansion per 15 gallons system volume		
Heating only, HP only (Gallons)	1 gallon expansion per 20 gallons system volume		
Heating Only, with Boiler (Gallons)	1 gallon expansion per 15 gallons system volume		
Propylene Glycol %	30	40	50
Min. Ambient Temp for Operation	8°F/-13°C	-7°F/-22°C	-29°F/-34°C
SpacePak Capacity Multiplier	0.96	0.93	0.88
Pressure Drop Multiplier (Cooling)	1.34	1.5	1.65
Pressure Drop Multiplier (Heating)	1.34	1.46	1.5
Minimum Expansion Volume / System Volume			
Heating and Cooling	1 gallon expansion per 15 gallons system volume		
Heating only, HP only	1 gallon expansion per 20 gallons system volume		
Heating only, with Boiler	1 gallon expansion per 15 gallons system volume		

Figure 14

Piping Pressure Losses*

	Pressure Drop, Ft water/100Ft			
Flow rate GPM	**1"**	**1-1/4"**	**1-1/2"**	**2"**
Pex Pipe				
10	13.4	5.2	2.4	0.6
11	15.9	6.2	2.8	0.7
12	18.5	7.2	3.2	0.9
14	24.4	9.4	4.2	1.2
Copper Pipe (Type L)				
10	7.1	2.6	1.1	0.3
11	8.4	3.1	1.3	0.3
12	9.9	3.6	1.5	0.4
14	13.2	4.8	2	0.5

*Remember to check the CV rating of your fittings and valves to make sure your getting the correct flow through the equipment.

Glycol/Water System Design

Size the Piping and Select the System Pump

Each LAHP48 has a recommended flow of 11 GPM. The pressure drop at 11 GPM is 8 PSI or 17 ft/head (based on pure water, see Figure 13 for pressure drop correction for glycol mix), size the system piping (see Figure 14 for piping pressure losses) and size pump accordingly. Adjust the pressure drop through piping and heat pump using the glycol correction multipliers in Figure 13.

System Volume and Expansion Volume

To ensure smooth temperature control and minimize cycling of refrigeration system, all installations must have total circulating volumes equal to or greater than 7-1/2 gallons per nominal ton of the unit performance (The greater of either heating or cooling produced). In other words, in the case of a four ton heat pump the minimum total system volume is 4x7-1/2=30 gallons. Multiple heat pump installations that are operating in a staged configuration follow the same rule, so that only a single heat pump tonnage needs to be considered. Additionally, the system requires an expansion volume (air) to compensate for the change in volume of the glycol mixture as it heats and cools, see Figure 13 for expansion volume.

A typical multiple heat pump installation may actually have a volume far greater than the minimum required, and it is this entire volume that must be considered when sizing the expansion tank. Note that the nominal expansion tank volume is not the same as the expansion volume. If the actual air volume is not published, consider it to be no more than half the nominal volume.

As an example, a four ton nominal heat pump, used for both heating and cooling, requires a minimum of thirty gallons of circulated system volume. A 40 gallon buffer tank is selected for best operation. When the system installation is complete, the total liquid volume of plumbing, air handlers, and heat pump is 45 gallons. (Note the expansion tank, no matter how large, is not considered circulated volume) This requires an ***acceptance volume*** of 3 gallons. If the acceptance volume is not specified, assume it is 50% of the total volume. Therefore, this system would require an expansion tank of 3 gallons acceptance volume, or six gallons nominal full volume.

Air Separator

Locate at least one high efficiency air separator as shown in the piping to remove any air from the system.

Glycol / Water Mixture

⚠WARNING The water system must contain a mixture of inhibited glycol and water with thermal protection sufficient for the coldest expected temperature for the installation. The inhibitor level can degrade over time, and may need to be adjusted periodically. The inhibitor is essential to prevent the glycol from accelerating corrosion of metal components in the system. The glycol and inhibitor levels must be checked regularly (no less than once annually).

⚠CAUTION The minimum allowable concentration of glycol is 30% by volume in all installations.

⚠CAUTION Automotive glycol is not suitable for use in the LAHP system. Over time it may leave deposits which will degrade the performance and damage pumps or other devices in the system. Use only ethylene glycol or propylene glycol mixtures specifically labeled for boiler or HVAC use.

Section 7: Glycol/Water System (continued)

Glycol/Water System Installation

Obtain all components specified in Figure 12. Make sure all components and piping comply with applicable local codes.

DO NOT use galvanized pipe anywhere in the system. Galvanizing will react with the glycol and can cause glycol degradation and sludge in the system.

- Confirm charge of expansion tank is 12-15 PSIG (with no water or pressure in the system).
- Install the system piping. DO NOT connect the SpacePak unit to the system piping until the system has been cleaned as required below.

The LAHP must NOT be connected to the system during this process.

1. Connect a hose from a fresh water supply to the system fill hose bib. Note the drain port can be used for this purpose. The hose bib purge/drain valve should be located low in the system and close to the LAHP48 return connection.
2. Open the high point purge valve, (not shown in illustration, as it may be inside the air handler) while slowly filling the system. Close the valve when air is removed from the system and water begins to flow out of the valve.
3. Fill the system with fresh water and run water until the system has been thoroughly flushed clean.

Automatic Fill – When an automatic fill system is installed, the cooling fluid (Glycol/water) must be inspected at least every 3 months, or whenever a leak is detected to ensure the proper glycol concentration is maintained.

Pressure Test The System

1. Add water to the system as needed to raise the pressure to 25 PSIG (verify that all system components are suitable for this pressure). Verify that the pressure remains constant for at least one hour. Locate and correct any leaks.
2. After successfully testing, drain the system and remove the fresh water hose.

Insulate The Piping

1. After testing and draining the system, apply pipe insulation. Fill system with glycol/water mixture. Calculate the system volume.
2. See Figure 13, for required glycol concentration for the minimum expected outside temperature.
3. Obtain the required volume inhibited glycol/water solution premixed or mix in a clean container. (The glycol must contain an inhibitor to prevent metal corrosion.)
4. Pump the glycol/water solution into the system, allowing air to escape through the purge valve(s).
5. After filling the system, sample the system fluid and verify glycol and inhibitor percentages, following instructions provided with the glycol.

The electrical loads given in Figure 1, allow for a pump load of no more than 5 amps at 110 VAC (2.5 amps at 230 VAC). If the pump load exceeds this, provide a separate power source to the pump. DO NOT feed power to the pump from the SpacePak air handler panel.

- Provide a separate power source and overcurrent protection for the immersion heater. Refer to the Figures 15 and 17 of this manual for detailed wiring.

LAHP Control Wiring Connection

The SpacePak LAHP requires a dry contact (relay) signal to enable and select between heating and cooling modes. They will not operate on the 24V signals from typical thermostats or air handlers. Connecting 24V to either of these points will result in erratic operation and may cause significant component damage.

- Connect single zone systems to Heat Pump as shown in Figure 17.
- Connect multiple zone system to Heat Pump using SpacePak SSIC Control Module and instructions included with it. See Figure 18.
- See Figure 16, for chiller electrical ladder diagram. Section 9: Electrical Diagrams.

Figure 17 SpacePak Heat Pump field wiring — SINGLE air handler

- Refer to manual supplied with SSIC Control Module for connection and operational details.

Section 8: Start-up And Test

Preparing For Start-Up

1. With the heat pump isolated and dry, charge the “system” and remove as much air as possible through the air separator.
2. Apply a static pressure to the system, with all pumps off, of 15-25 PSI.
3. Allow the water to continue to fill the heat pump, displacing air. This should go very slowly, and could take a minute or more.
4. When all the air has been displaced, unit can be operated.

Section 8: Start-up And Test (continued)

BEFORE Starting The Unit

⚠WARNING **Electrical shock hazard** — Disconnect all electrical power before proceeding with the following. Verify that the system and all components have been installed in accordance with this manual and all applicable codes and instructions. Inspect the SpacePak heat pump and all other system components. All components should be in good condition and operational. Inspect the water piping for any signs of leakage.

Repair all system leaks. Leakage will cause pressure to drop, preventing the heat pump from operating. Leaks also allow introduction of excess make-up water, whether filled automatically or manually. Check system pressure, the pressure should be at least 12-15 PSIG with heat pump/chiller not in operation. Check all wiring connections to ensure terminal connections are tight and all wiring is in place.

Starting The SpacePak LAHP

Start In Heating Mode

1. When the pump has stopped, change the thermostat to Heating and raise the set point above current room temperature.
2. This initiates a call in heating mode. The pump symbol will begin flashing.
3. After 1 to 2 minutes, the pump symbol will change to constant display, and the pump will begin circulating.
4. Assuming the water is outside of the heating temperature range (below 120^{0}F) the refrigeration system will initiate and the 1, or 3, or both numerals will begin flashing.
5. After 1 to 2 minutes, the 1, or 3, or both numerals will change to constant, the compressor symbol will turn on and one or both compressors will start.
6. Observe for any alarms, errors, or faulty operation (noises, vibration, etc).

Start In Cooling Mode (If Applicable)

1. Apply power to the unit.
2. The display (Figure 1) should show the start sequence — uC2, then 2.0, then the current water temperature. No other symbol should appear.
3. When the display shows only temperature, lower the thermostat setpoint below the current room temperature.
4. This begins a call for cooling, and the pump symbol will begin to flash.
5. After 1 to 2 minutes, the pump symbol will change to constant display, and the pump will begin circulating.
6. Assuming the water is outside of the cooling temperature range (above r01 setpoint) the refrigeration system will initiate and the numeral 1 will begin flashing on display.
7. After 1 to 2 minutes, the 1 numeral will change to constant, the compressor symbol will turn on and the compressor will start.
8. Observe for any alarms, errors, or faulty operation (noises, vibration, etc.).
9. When operation is deemed satisfactory, raise the thermostat set-point or turn it off.
10. The pump will run for approximately two minutes after the compressor shutdown.

Anti-freeze Cycle

Should the water temperature drop to 34°F* during periods of non-use, the pump will start and the anti-freeze heater (if connected) will energize and continue to operate until the temperature reaches 39°F*.

If the water temperature continues to fall and reaches 32°F*, the Alarm symbol and Fault Code AL will be displayed, and the unit will automatically start in heating mode. It will continue to run until the water temperature reaches 37°F*.

NOTICE This provides the maximum level of protection in all cases, but may use energy unnecessarily when a suitable concentration of glycol anti-freeze is installed. When freeze protection is sufficient, these values can be adjusted to lower temperatures. Contact technical support for guidance (Section 2) in reconfiguring, however it must be understood that the installer is responsible for ensuring sufficient freeze protection to the lowest temperature allowed.

24-Hour Follow-up

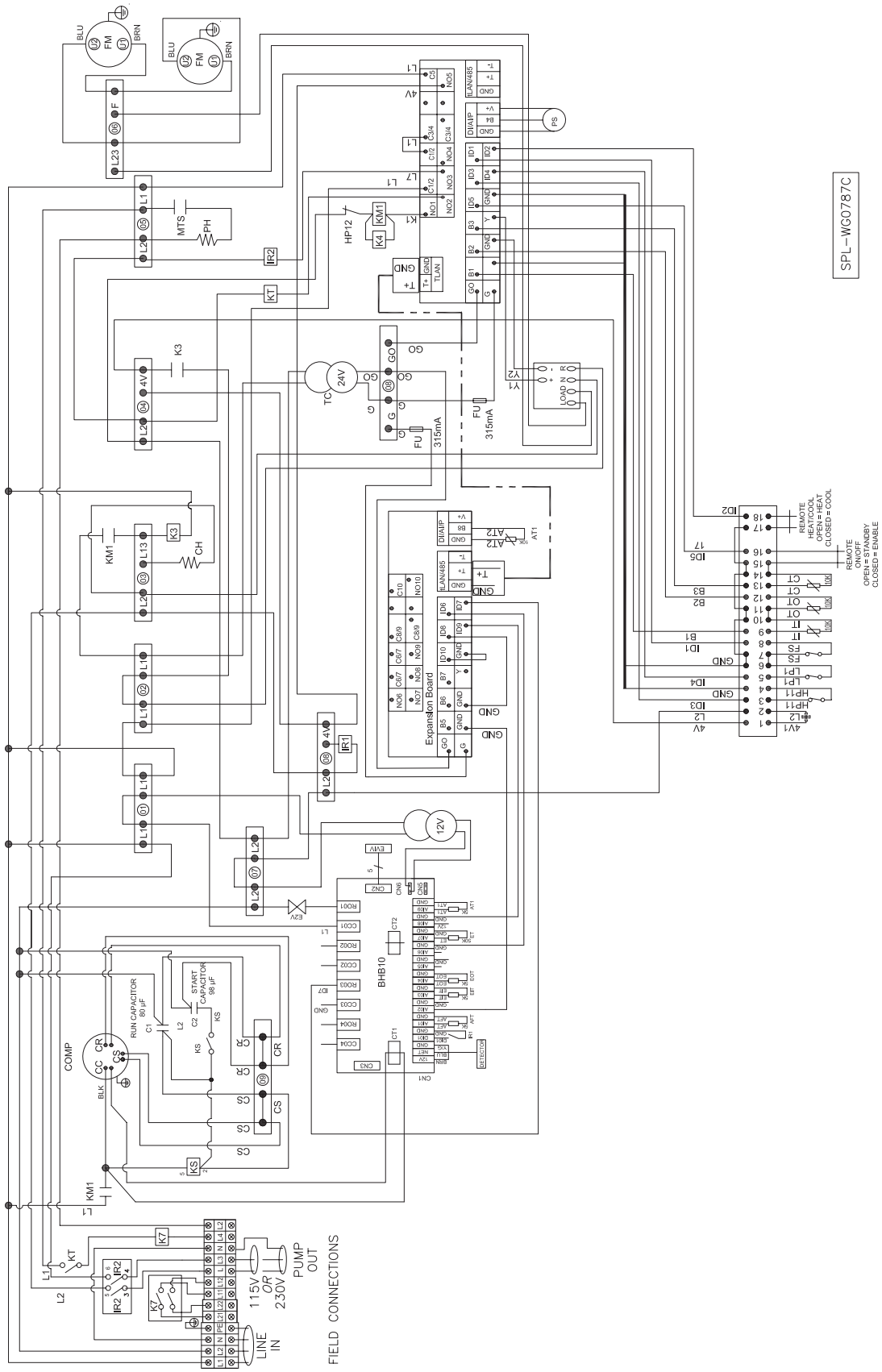
Approximately 24 hours after start-up and testing, return to the installation to verify proper operation. Perform the following checks.

- Check system pressure. Add additional glycol/water mixture if needed to restore pressure. (Pressure can drop as air is removed from the system by the air vents.)
- Sample the glycol/water mixture in the system. Verify inhibitor and glycol levels. Inspect the piping and components to ensure there are no leaks. Repair any leaks immediately.
- Close the isolation valves on either side of the y-strainer at the SpacePak heat pump return connection. Remove the screen and inspect for sediment. Clean if necessary.
- If the strainer has become clogged with sediment, determine whether the system needs to be drained, cleaned and re-filled. Excessive sediment accumulation in the strainer will reduce flow and cause the unit to shut down.
- Cycle the system on heating and cooling. Verify that all components operate correctly.

***These are factory default setpoints. Please see Section 2 to adjust in the field.**

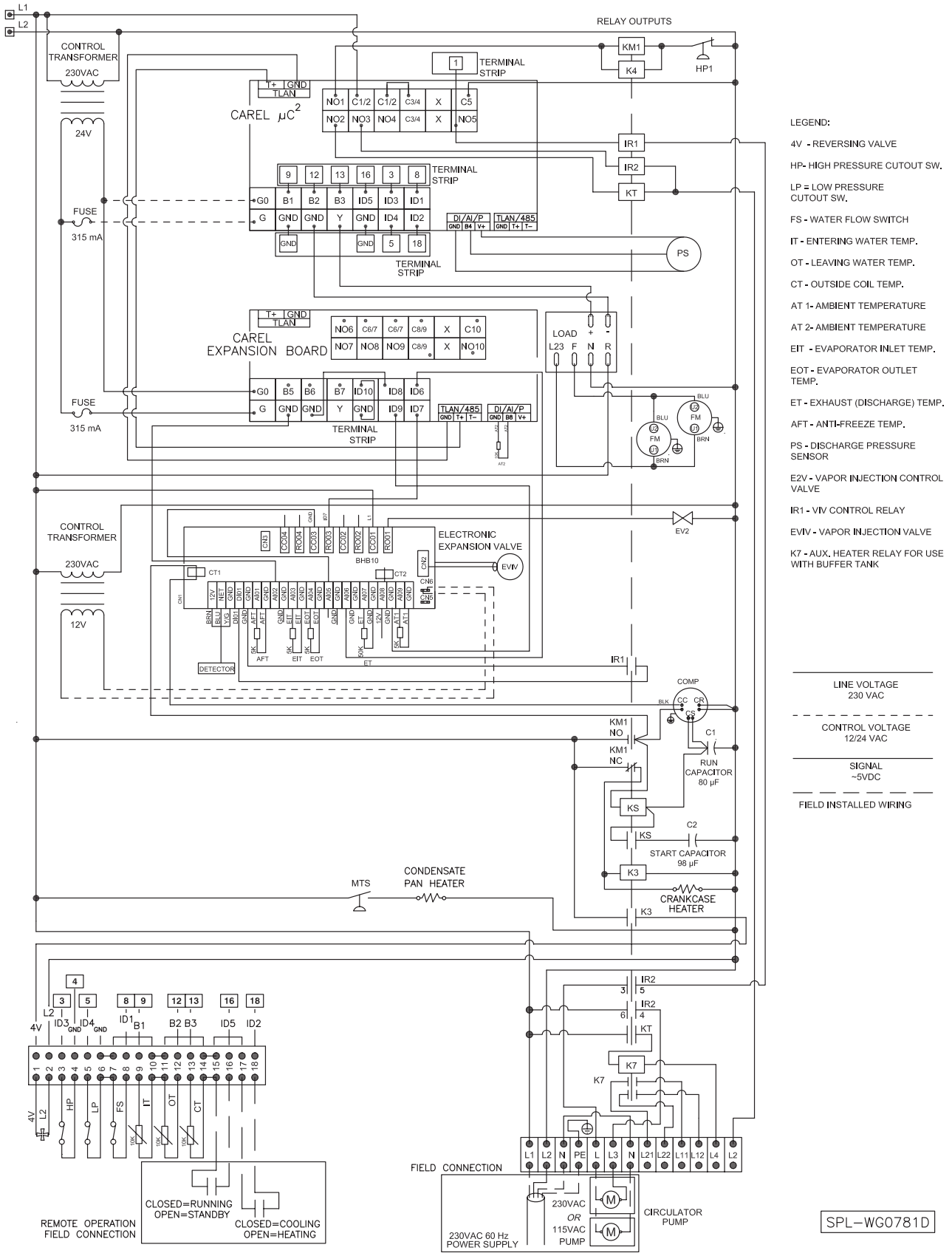
Section 9: Electrical Diagrams

Figure 15 SpacePak LAHP - Pictorial Wiring Diagram



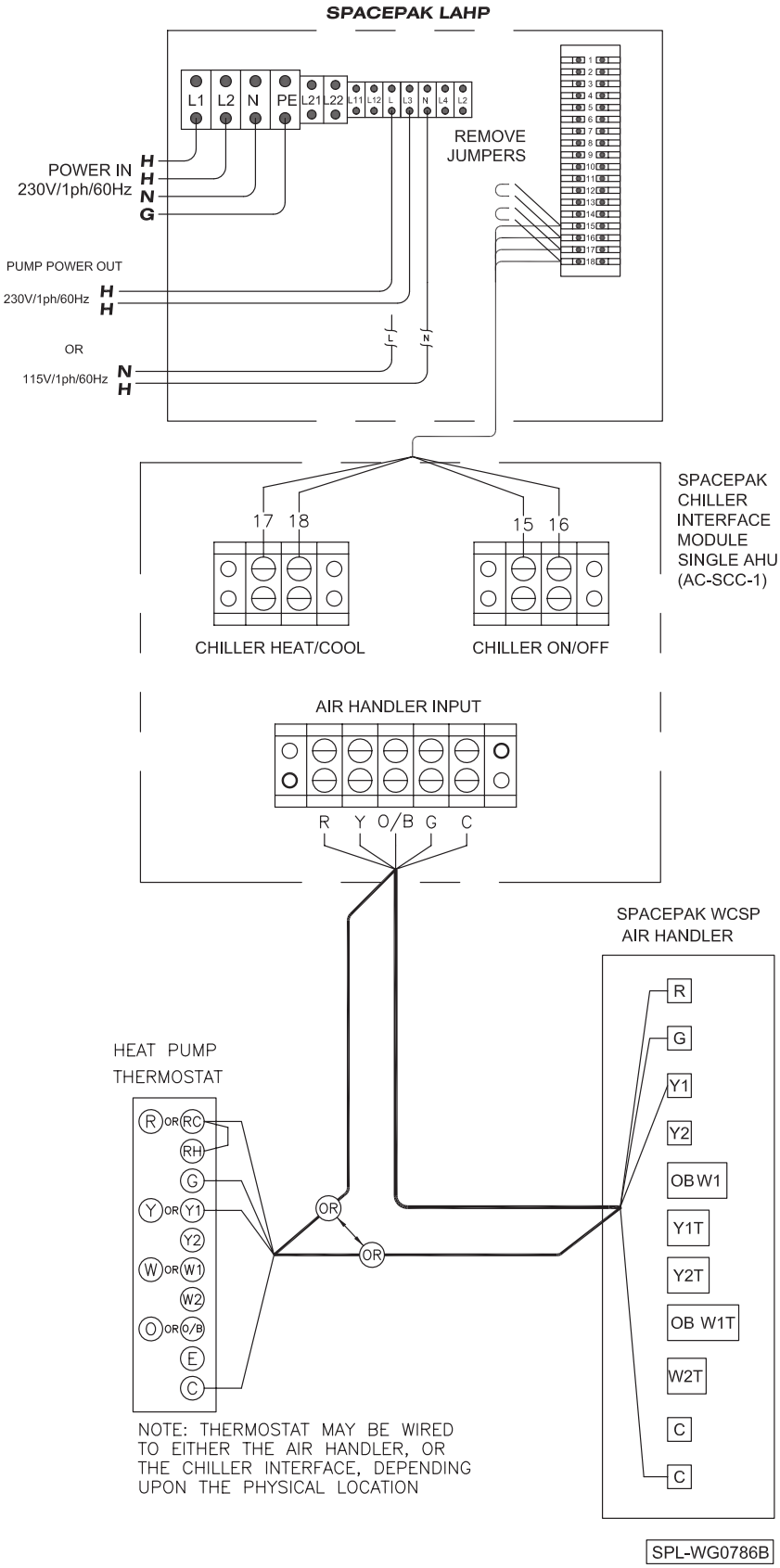
Section 9: Electrical Diagrams (continued)

Figure 16 SpacePak LAHP Electrical Ladder Diagram



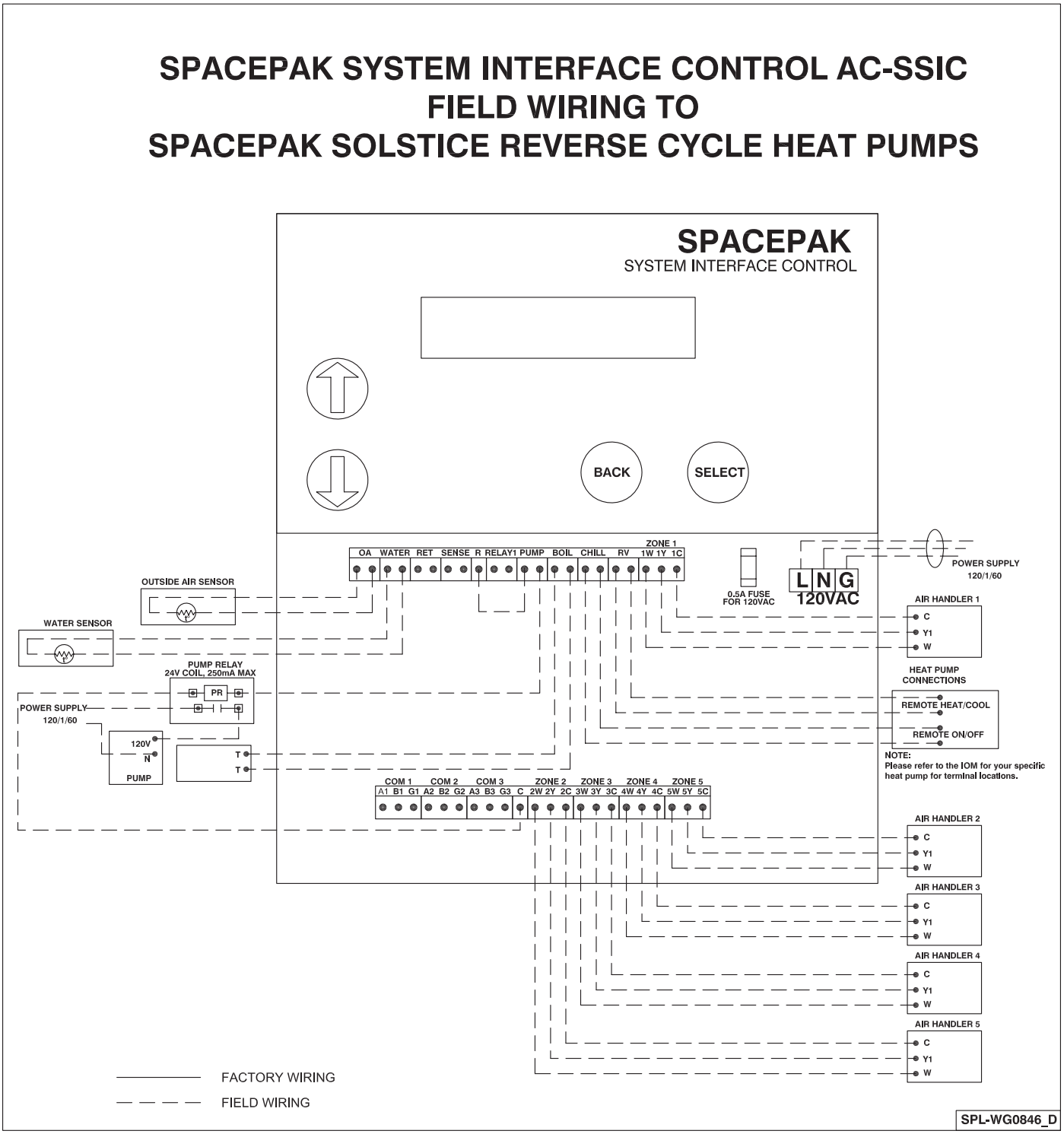
Section 9: Electrical Diagrams (continued)

Figure 17 Field Connections



Section 9: Electrical Diagrams (continued)

Figure 18 Wiring Diagram



Section 10: Fault Codes

Figure 19 Fault Codes

Alarm Display	Alarm type	Reset Logic	Compressor Response	Pump Response	Fans Response	Heater Response
A1	Freeze error	Automatic	Stop	None	Stop	Enable
Aht	High water temp at startup	Automatic	Stop	None	Stop	None
dF1	Defrost error, cycle time exceeded	Automatic	None	None	None	None
E1	Return water temp sensor fail	Automatic	Stop	None	Stop	Stop
E2	Supply water temp sensor fail	Automatic	Stop	None	Stop	Stop
E3	OS coil temp sensor fail	Automatic	None	None	None	None
E4	Refrigerant pressure sensor fail	Automatic	Stop	None	Stop	None
E8	Ambient temp sensor fail	Automatic	None	None	None	None
ESP	Lost com. with expansion module	Automatic	Stop	Stop	Stop	Stop
FL	Water system low flow	Automatic	Stop	Stop	Stop	Stop
Hc1	Service hours notification	Automatic	None	None	None	None
HP1	Refrigerant High Pressure fault	Auto x3, then Manual	Stop	None	Run 60 sec	None
Ht	High water temp	Automatic	None	None	None	None
LHt	Low Water temp at startup	Automatic	Stop	None	Stop	None
LP1	Refrigerant Low Pressure fault	Auto x3, then Manual	Stop	None	Run 60 sec	None
tC1	Compressor over current or delivered water too cold	Automatic	Stop	Stop	Stop	Stop

Section 10: Troubleshooting

Figure 20 Troubleshooting Suggestions

Condition	Possible Causes	Verification	Solution
Unit will not start	Incorrect power supply	Check power supply	Supply correct power, 220-240 60Hz
	Loose or broken wires	Check wiring	Repair or replace wiring
	Circuit breaker interrupted	Check for short	
Compressor running - insufficient cooling/heating	Insufficient pipe insulation	Check insulation	Add/repair insulation
	Dirty coil	Check coil	Clean coil
	Low water flow	Look for alarm symbol and FL fault code	Clean strainer screen
			Clear blockage
			Remove air in piping
			Verify operation/condition of water pump
High compressor discharge pressure in cooling	Dirty coil	Check coil	Clean Coil
High compressor discharge pressure in heating	Low water flow	Measure water flow through heat exchanger	Flow should be a minimum of 10 GPM
Low compressor suction pressure in cooling	Insufficient / no water flow	Look for alarm symbol and FL fault code	Clean strainer screen
			Clear blockage
			Remove air in piping
			Verify operation/condition of water pump
	Cooling operation in low Ambient	Confirm outdoor ambient is lower than typical for cooling operation, i.e. <55°F	If low ambient cooling is desired, contact Technical Support for procedure to modify fan operating parameters.
Compressor will not run	Power supply failure		Supply correct power, 220-240 60Hz
	Failed compressor contactor		Replace contactor
	Loose power cable	Check power cable	Tighten power cable
	Incorrect return water temperature setting	Check return water temperature setting	Adjust return water temperature setting
	Low glycol/water flow	Look for alarm symbol and FL fault code	Clean strainer screen
			Clear blockage
			Remove air in piping
Fan will not run	Fan controller failure		Replace fan controller
	Fan motor failure		Replace fan motor
Compressor runs - no heating/cooling	No refrigerant charge	Check for leaks	Add appropriate refrigerant
	Damaged heat exchange	Check for glycol/water leaks and/or refrigerant leaks	Replace heat exchanger
Low outlet glycol/water temperature in cooling	Improper temperature control setting	Check cooling temperature setpoint and differential	Contact Technical Support for instructions to reset cooling setpoints
	No load/rapid temperature drop	Ensure compressors are allowed to run a minimum of three minutes before reaching desired temperature	Verify cooling function when there is sufficient heat load to allow continuous operation.
			Ensure system volume is at least 40 Gallons

Section 11: Annual Maintenance

Perform Annual Inspection

Check Glycol/Water Mixture

1. At least once annually, sample the system fluid to verify that the glycol concentrations meet the minimum value given in Figure 13. Also test the inhibitor concentration. Add glycol and inhibitor as needed to return the system to the correct concentrations.
2. Perform any and all other tests as recommended by the anti-freeze manufacturer's instructions in order to ensure optimal performance and maintain warranty protection on all installed components.

Check Operating Pressure

1. Check the glycol/water system pressure. Operating pressure should be between 15 and 25 PSIG. Adjust fluid volume if needed to restore pressure.

2. If pressure is low, check system for evidence of leaks. Repair all leaks immediately. Perform annual inspection

⚠WARNING **Electrical shock hazard** — Disconnect all electrical power before proceeding with the following.

Inspection of System

At least once annually, perform a complete inspection of the system, including at least the following:

- Inspect the LAHP for signs of dirt or debris accumulation. Remove any debris and notify the building owner that the unit must be kept clean and unobstructed.
- Inspect glycol/water system piping and components. Repair or replace any defective components. Repair all leaks immediately.
- Close the isolation valves on either side of the y-strainer at the SpacePak heat pump return connection. Remove the screen and inspect for sediment. Clean if necessary.

NOTE: If the strainer has become clogged with sediment, determine whether the system needs to be drained, cleaned and re-filled. Excessive sediment accumulation in the strainer will reduce flow and cause the unit to shut down.

- Inspect all wiring and wiring connections. Tighten connections if needed. Correct any problems found.
- Check the fuses or breakers to ensure they are correctly sized and properly installed.
- Clean the LAHP heat exchangers and air openings.
- Cycle the system on heating and cooling. Verify that all components operate correctly.

Preparing The LAHP For Shut Down

DO NOT turn off power to the LAHP in the winter or any time when there is a possibility of freezing. Power must be ON for the automatic anti-freeze operation to occur. See information below for preparing the unit for shut down.

1. When the water temperature drops below 34°F during periods of non-use, the pump will start and the anti-freeze heater (optional, when installed) will energize and continue to operate until the temperature reaches 38°F.
2. If the LAHP must be turned off or left idle during periods when freezing is possible, one of the following must be done:

   a. Verify that sufficient glycol solution is present to protect against most extreme anticipate conditions

   b. — OR — Drain heat pump and external piping completely.

To restart after shutdown

1. If unit was drained, refill.
2. Follow start up procedure in Section 8.

Section 12: Replacement Parts

Figure 20 Replacement Parts LAHP48

Item	Part Number	Description
1	45460-WG1047-01	Programmed Controller
2	45R20000-370007	Transformer 12V 41x26.5F
3	45R2000-3223	Sensor 150-503-96115 (5k)
4	45R20000-430031	EEV Control Module
5	45R2000-3220	Sensor (5k)
6	45R20000-350004	Compressor Run Capacitor
7	45R2000-3524	Compressor Start Capacitor
8	45R20000-360035	Start Relay
9	45R2001-3630	Intermediate Relay
10	45R20000-360007	Single Phase AC Contactor
11	45R2000-3214	Compressor Cable Heater 40W
12	45R2000-3619	Relay HF
13	45R2000-3215	Bottom Plate Cable Heater 70W
14	45R2001-3674	Mechanical Thermostat
15	45R2000-3635	Timer Relay
16	45R20000-430048	Fan Speed Controller
17	45R2000-3202	Sensor (5k)
18	45R20000-120100	Plate Heat Exchanger EVI
19	45R20000-140027	Filter
20	45R20000-140194	EVI Solenoid Valve
21	45R20000-140234	Electronic Expansion Valve
22	45R20000-360059	Pressure Switch 3.2MPa/4.0MPa
23	45R20000-360082	Pressure Switch 0.1MPa Off / 0.2MPa On
24	45R2001-1491	4-Way Reversing Valve
25	45R2001-1497	Check Valve CV-8
26	45R2001-3605	Pressure Switch 3.2MPa/4.4MPa
27	45R2002-1494	Thermal Expansion Valve
28	45R20000-330110	Fan Motor
29	45R35019-120011	Condensor Coil
30	45R35019-120008	Plate Heat Exchanger Refrigerant to Water
31	45R20000-120029	Suction Accumulator Tank
32	45R3500-1401	Liquid Gas Separator
33	45R2000-3606	Water Flow Switch
34	45W55-WG0784	Compressor
35	45R2000-3137	Carel Expansion Board
36	W14RWG0061-01	Transformer, 24V

Section 13: Limited Warranty

LIMITED WARRANTY
Air to Water Reverse Cycle Heat Pump

The "Manufacturer" warrants to the original owner at the original installation site that the Air to Water Reverse Cycle Heat Pump (the "Product") will be free from defects in material or workmanship for a period not to exceed one (1) year (parts) or two (2) years (compressor) from the startup. If upon examination by the Manufacturer the Product is shown to have a defect in material or workmanship during the warranty period, the Manufacturer will repair or replace, at its option, that part of the Product which is shown to be defective.

This limited warranty does not apply:

a) If the Product has been subjected to misuse or neglect, has been accidentally or intentionally damaged, has not been installed, maintained or operated in accordance with the furnished written instructions, or has been altered or modified in any way.
b) To any expenses, including labor or material, incurred during removal or reinstallation of the defective Product or parts thereof.
c) To any workmanship of the installer of the Product.

This limited warranty is conditional upon:

a) Shipment, to the Manufacturer, of that part of the Product thought to be defective. Goods can only be returned with prior written approval from the Manufacturer. All returns must be freight prepaid.
b) Determination, in the reasonable opinion of the Manufacturer, that there exists a defect in material or workmanship.

Repair or replacement of any part under this Limited Warranty shall not extend the duration of the warranty with respect to such repaired or replaced part beyond the stated warranty period.

THIS LIMITED WARRANTY IS IN LIEU OF ALL OTHER WARRANTIES, EITHER EXPRESS OR IMPLIED, AND ALL SUCH OTHER WARRANTIES, INCLUDING WITHOUT LIMITATION IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE, ARE HEREBY DISCLAIMED AND EXCLUDED FROM THIS LIMITED WARRANTY. IN NO EVENT SHALL THE MANUFACTURER BE LIABLE IN ANY WAY FOR ANY CONSEQUENTIAL, SPECIAL, OR INCIDENTAL DAMAGES OF ANY NATURE WHATSOEVER, OR FOR ANY AMOUNTS IN EXCESS OF THE SELLING PRICE OF THE PRODUCT OR ANY PARTS THEREOF FOUND TO BE DEFECTIVE. THIS LIMITED WARRANTY GIVES THE ORIGINAL OWNER OF THE PRODUCT SPECIFIC LEGAL RIGHTS. YOU MAY ALSO HAVE OTHER RIGHTS WHICH MAY VARY BY EACH JURISDICTION.

SPACE PAK HYDRONICS

SPACE PAK CENTRAL AIR ANYWHERE®

HYDRONICS

IN UNITED STATES: 260 NORTH ELM ST. WESTFIELD, MA 01085 800-465-8558 / FAX (413) 564-5815
IN CANADA: 7555 TRANMERE DRIVE, MISSISSAUGA, ONTARIO, L5S 1L4 (905) 670-5888 / FAX (905) 670-5782