R.A.S.E.R.S System™

Installation Guide

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R.A.S.E.R.S System™ components

Unlike other heat pump systems, the R.A.S.E.R.S System from Eco Evolution Technologies® inherently supports multiple condensers and evaporators to provide a *total energy system* for your customers.

Specifications are subject to change without notice or obligation from Eco Evolution Technologies.

Required components for heating, cooling, and hot water

Provided

Component	Specification
R.A.S.E.R.S unit	
Compressor	
Water condenser	
Liquid refrigerant receiver	
Water circulating pump	
Accumulator	
Low-pressure safety switch	
High-temperature sensor	
Three-way solenoid valves (3)	
Solenoid coil	
Electrical control panel	
Check valves	
Muffler	
Balance line fixed piston assembly, connection, and orifice options (optional)	Orifice size depends on system design.
Outdoor evaporator	
Finned evaporator coil	
Thermal expansion valve	
Fan	
Fan power disconnect switch	
Balance line connections and orifice options	[Fixed piston assembly and connections]
Hot gas defrost check valve and connection	Includes check valve
Outdoor air-cooled condenser	
Power disconnect switch	

Not provided

The following accessories are not included but are required to complete the system. All can be purchased separately either from third parties or from Eco Evolution Technologies.

✓	Component	Specification
Thermostatic controls		
☐	Thermostat wire	Four-strand (for connecting thermostatic controller to R.A.S.E.R.S unit) Six-strand (if connecting to house thermostat)
☐	House thermostat	Multiple-stage cooling Multiple-stage heat Eco Evolution Technologies models recommended
☐	Thermostat controller with sensor	
Air handler		
☐	Fan	
	Indoor DX coil	
	Thermal expansion (TX) valve	
	Indoor hydronic heat coil	
Electrical system		
☐	Electrical service to the R.A.S.E.R.S System	Single-phase 208/240V 8 gauge or lower stranded wire
☐	Circuit breaker exclusively for the R.A.S.E.R.S unit's 208/240V electrical service	50A, 2-pole
☐	Service disconnect switch for R.A.S.E.R.S unit	Wired using 8 gauge (minimum), 3-wire plus ground, stranded or solid copper wire. Located between the main electrical service panel and the R.A.S.E.R.S unit, and located within sight of the R.A.S.E.R.S unit. • *Depending on applicable codes, the shutoff switch may not be needed if the R.A.S.E.R.S unit is within sight of the main electrical service panel.*
☐	Service disconnect switch for evaporator	
Water system		
☐	Water storage tank	Eco Evolution Technologies brand recommended 40 gallon minimum
☐	Water pipes for connecting R.A.S.E.R.S unit to water storage tank	1" copper tubing (insulated)
☐	Hydronic heating circulation pump	With internal check valve
☐	Hydronic heating water control valve	
☐	Water pipes for connecting hydronic heating coil to water storage tank	1" pex or 3/4" copper
☐	Finish water heating system	Tank or inline heater
☐	Water supply system check valve	
☐	Water shut-off valves (quantity depends on system configuration)	Full-port, 1" diameter brass
☐	Shutoff valves and hose bibs for heat exchanger descaling	Shutoff valves: 1/2" full-port Hose bibs: 1/2"
Refrigeration system		
☐	Refrigeration line to connect the suction side of evaporator panel to the R.A.S.E.R.S unit compressor	7/8" refrigeration copper line
☐	Refrigeration line to connect the high-pressure side of the R.A.S.E.R.S System	3/8" refrigeration copper line
☐	Liquid line from the outdoor condenser to R.A.S.E.R.S unit	1/2" ACR
☐	Line from the R.A.S.E.R.S unit to the outdoor condenser.	5/8" ACR

✓	Component	Specification
☐	Hot gas line from R.A.S.E.R.S unit to outside condenser	5/8" wrapped in 3/4" Insulflex® Aerostyle Pyrojacket® firesleeve insulation
☐	Liquid line drier filter	One for outdoor evaporator One for air handler DX coil

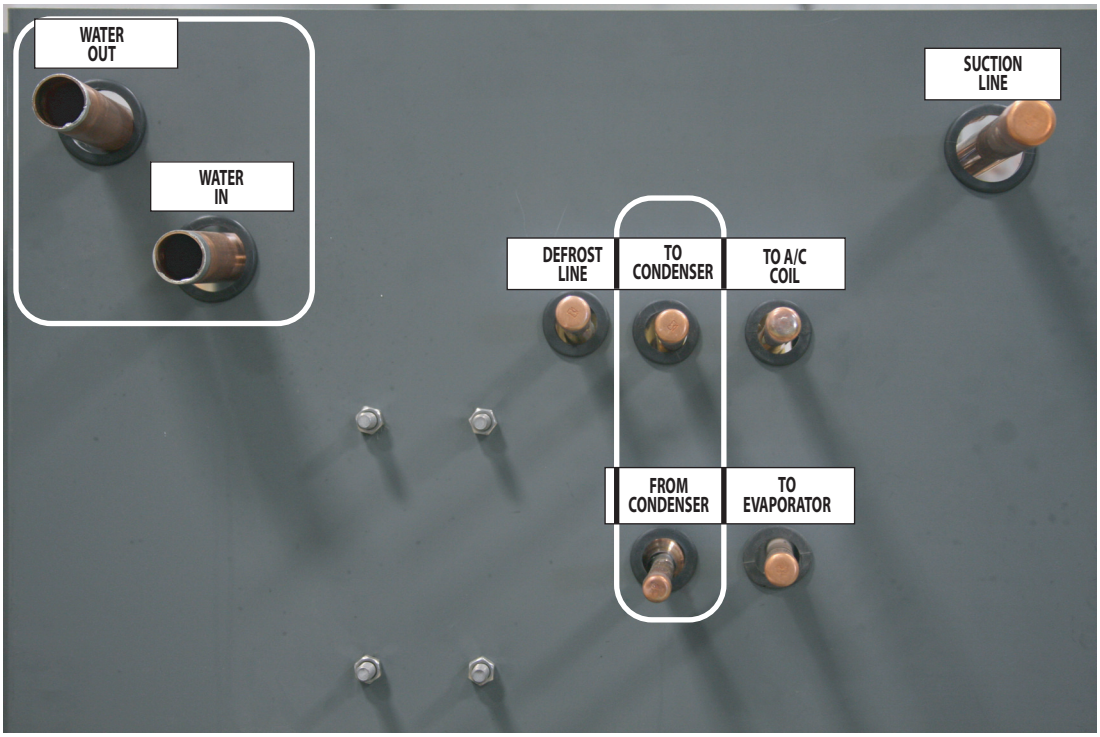
Optional components

✓	Component	Specification
☐	Emergency backup heat	
☐	Radiant flooring components	
☐	Pool warming components	
☐	Additional water storage tank	

R.A.S.E.R.S System snapshots

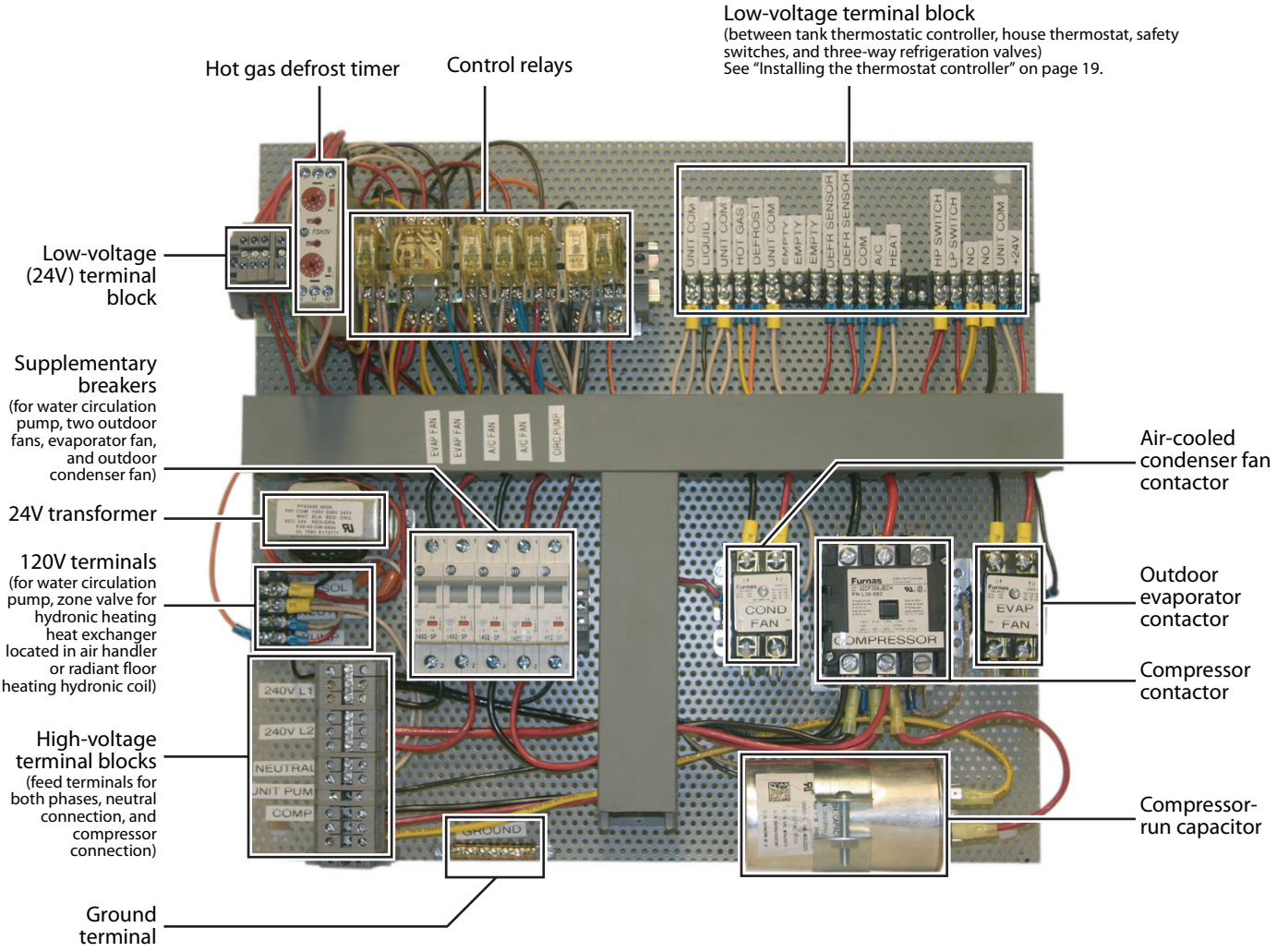
Pipe connections

Figure 1: Pipe connections



Electrical panel

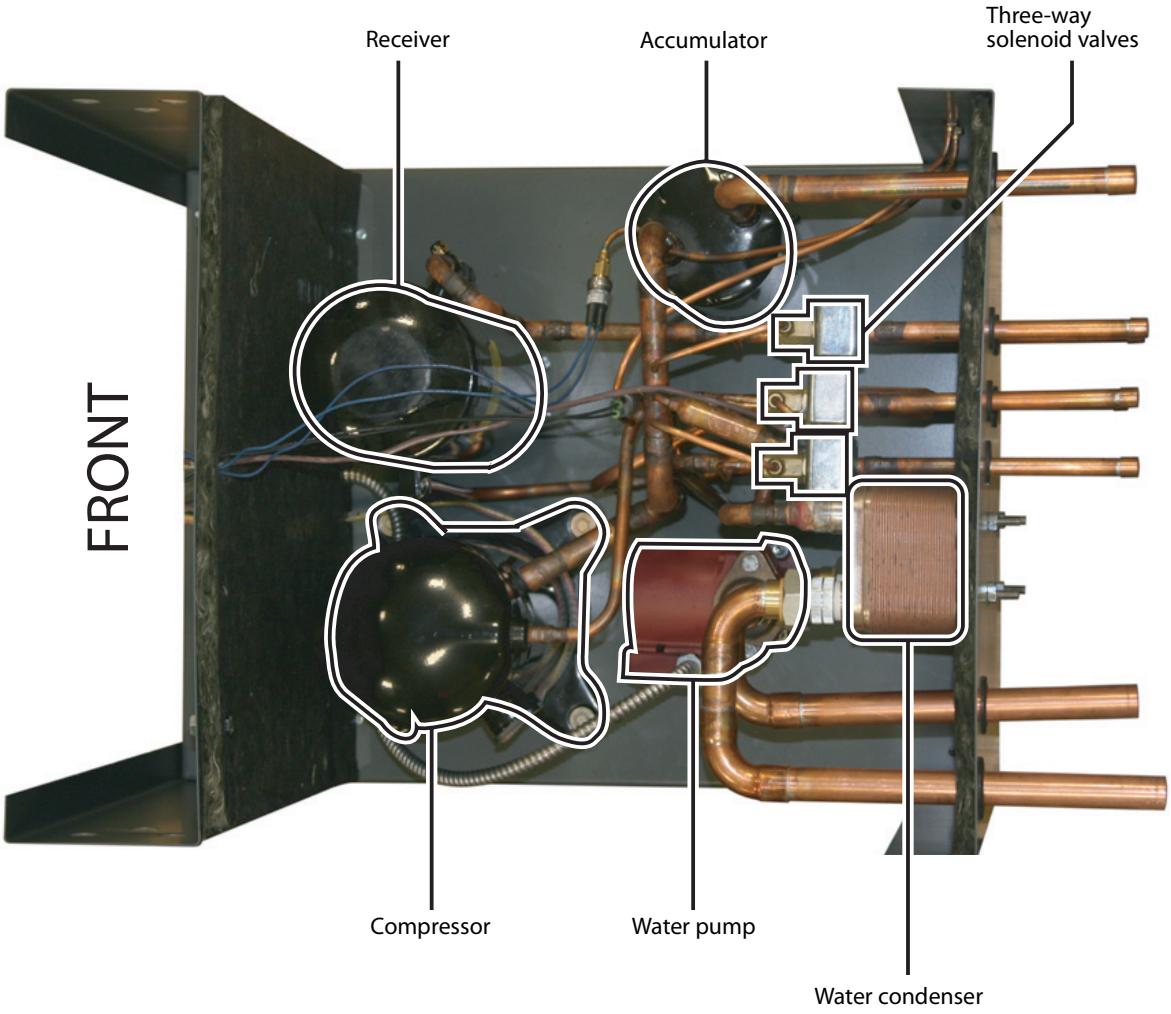
Figure 2: Electrical panel components



Internal components

- Receiver
- Accumulator
- Three-way solenoid valves
- Compressor
- Water pump
- Water condenser

Figure 3: Internal components



Installation overview

For a complete installation of a R.A.S.E.R.S System, you'll perform the following general tasks:

- Position the R.A.S.E.R.S unit
- Install external evaporator
- Install external condenser (optional)
- Install refrigerant lines between the R.A.S.E.R.S unit, evaporators, and condensers
- Install temperature sensor probe
- Install water service
- Install thermostat controller
- Connect electrical service
- Charge the system

When cutting any copper pipe to length, make sure that the ends are free from burrs and deformations.

Positioning the R.A.S.E.R.S unit

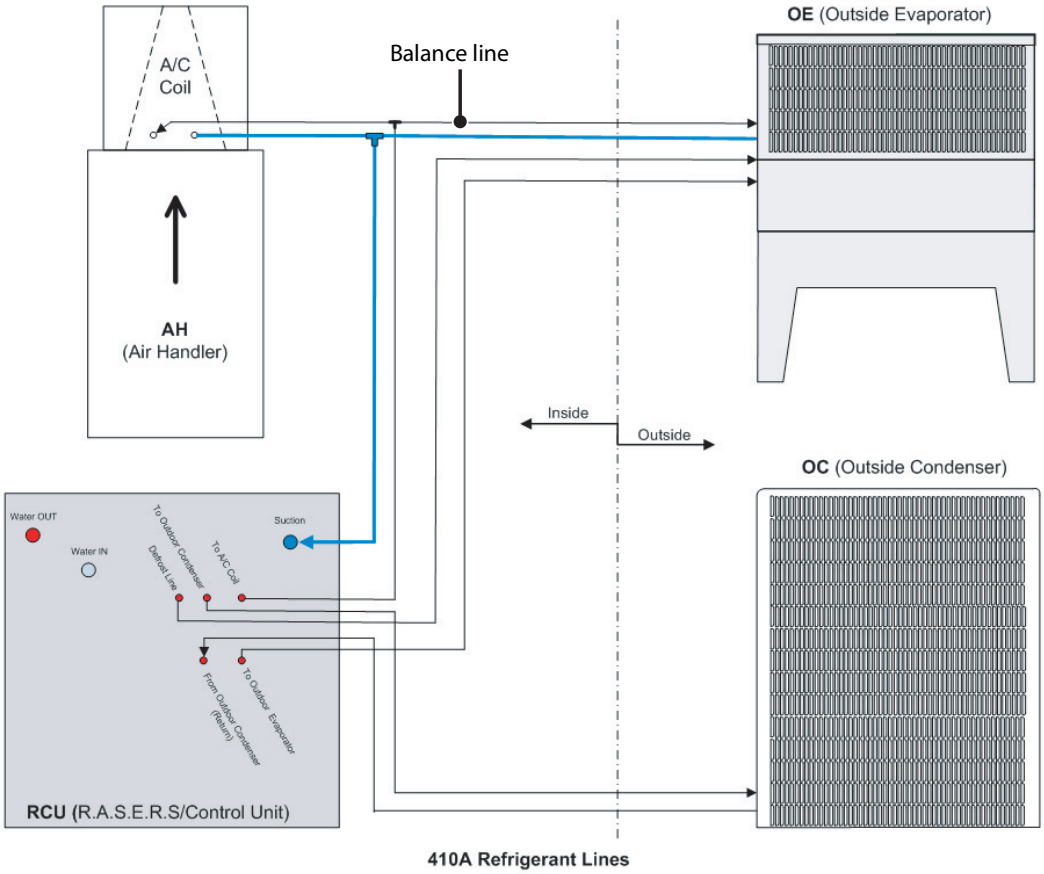
Situate the R.A.S.E.R.S unit according to the following criteria:

- On level, solid ground indoors
- Electrical panel (front) facing out
- Adequate clearance for pipe connections and maintenance (1 foot minimum clearance at back, 18"~24" ideal)

Installing the evaporator

The R.A.S.E.R.S unit is designed to connect with one or more evaporators. The evaporator should be sized to match the capacity of the R.A.S.E.R.S unit. If the R.A.S.E.R.S unit is a 5-ton unit, but your evaporator is smaller (1.5~4 ton), you must install a balance line. See “Installing a balance line” on page 11.

Figure 4: Refrigerant lines with evaporator and condenser



NOTE

Each R.A.S.E.R.S System installation is unique. Use this schematic as a general guide only.

Installing a R.A.S.E.R.S System evaporator

Eco Evolution Technologies manufactures evaporator panels for use in many types of applications. The size or surface area of the evaporators that should be used in an installation vary according to the nature of the heat source used, although the components (and manufacturing methods) used are the same:

- Heat collection surface (tubing)
- Thermal expansion valve
- Liquid connection
- Suction connection

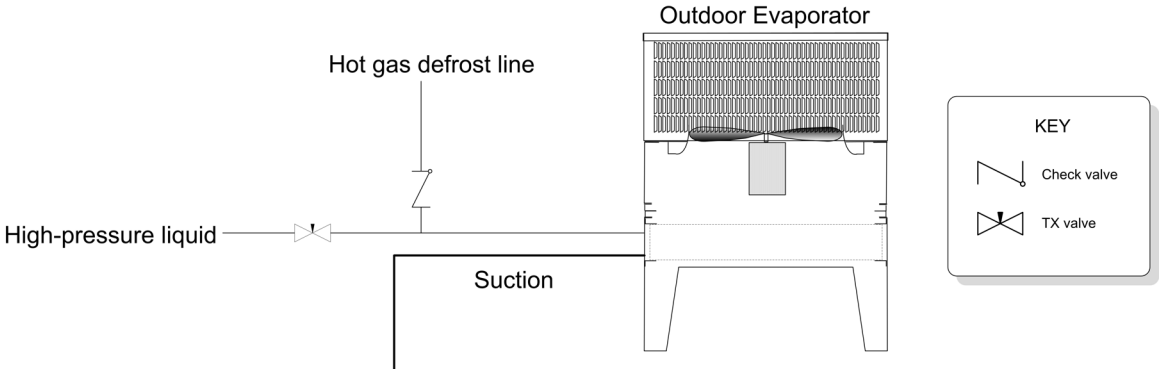
Each R.A.S.E.R.S System evaporator also has:

- 1/2" liquid connection downstream of the thermal expansion valve (capped)
- 7/8" suction connection (capped)
- Hot gas defrost line

To install a R.A.S.E.R.S System evaporator:

1. Determine the location to install the evaporator. The evaporator should be located in the waste heat environment at the same level or below the R.A.S.E.R.S unit.
2. Orient the evaporator panel so that the liquid connection side of the evaporator is on the top, and the suction side of the evaporator is on the bottom. This orientation allows the liquid refrigerant to boil and flow unrestricted to the top of the evaporator.

Figure 5: Evaporator connections



3. Install the 7/8" ACR return suction line with at least a slight slope back to the R.A.S.E.R.S unit.

CAUTION The slope is important to help convey oil back to the compressor.

4. Because of the nature of the refrigerant, you should install traps in the return suction line:
   - For a horizontal run, install a trap every 20-25 feet.
   - For a sloping or vertical run, install a trap every 8 to 10 feet in elevation back to the R.A.S.E.R.S unit.

5 Release the nitrogen gas from the evaporator by slowly opening the appropriate Schrader valves until the gas is fully released. Make sure that you replace the Schrader valve core before evacuating the refrigerant sytem.

The R.A.S.E.R.S unit and panel are pre-charged with nitrogen gas. **Before** removing caps from the R.A.S.E.R.S unit and panel, **make sure that nitrogen gas is released**.

6 Connect the R.A.S.E.R.S unit's hot gas defrost line to the evaporator's upper port (the 1/2" connection).

7 Connect the evaporator's lower port (the 7/8" connection) to the **SUCTION** port on the R.A.S.E.R.S unit.

8 Connect the evaporator's lower port (high-pressure fluid, smaller) to the **TO EVAPORATOR** port on the R.A.S.E.R.S unit.

The R.A.S.E.R.S unit contains two evaporator liquid supply ports:

- The lower port (**TO EVAPORATOR**) is generally used for connection to the evaporator.
- The upper port (**TO A/C COIL**) is generally used for connection to the air handler's A/C coil.

If the R.A.S.E.R.S System evaporator will be used as the primary heat source, then the lower liquid port on the unit should be connected with the liquid port on the evaporator using copper tubing with sweat connections.

The suction port on the unit should also be connected to the suction port on the evaporator using 7/8" ACR copper tubing with sweat connections. If the evaporator is within 70 feet of the R.A.S.E.R.S unit, then 1/2" ACR liquid line and 7/8" ACR suction line tubing can typically be used. Larger tubing sizes may be required for special applications or longer distances.

Contact Eco Evolution Technologies with any questions about tube sizing.

The suction line must be insulated between the evaporator and the R.A.S.E.R.S unit to avoid condensation issues and to protect the system from uncontrolled environmental heating or cooling of the refrigerant.

Installing non-R.A.S.E.R.S System evaporators

If an evaporator other than a R.A.S.E.R.S System vaporator (such as an DX coil in an air handler) is to be used, then the evaporator should be connected to the appropriate ports of the R.A.S.E.R.S unit according to the evaporator manufacturer's instructions and the guidelines described above for port selection.

Connecting multiple evaporators (optional)

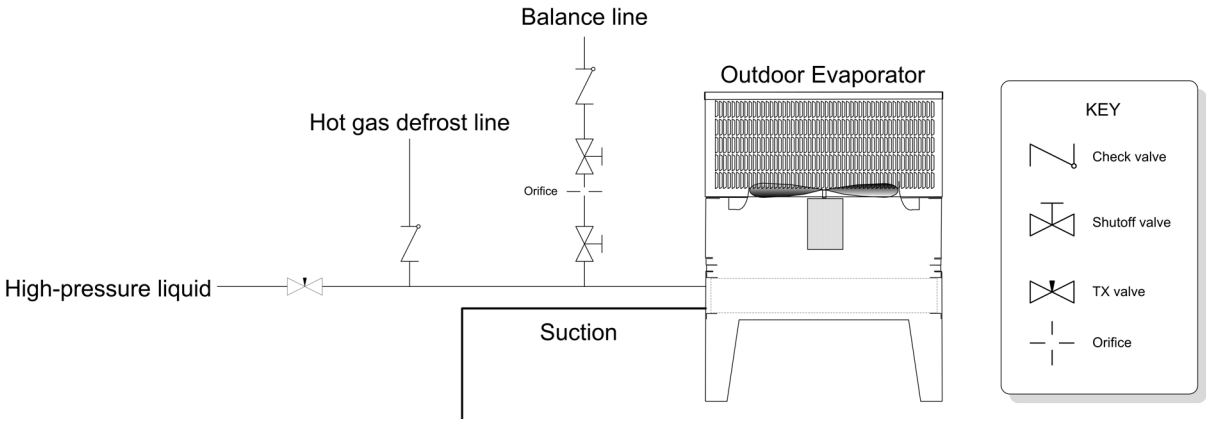
If more than one evaporator is to be connected to the R.A.S.E.R.S unit, the liquid connections should be made according to the port selection criteria described above. The suction connections require a 'T' fitting to accept the returning refrigerant vapor from both evaporators. Only one of the evaporators will function at a time. Figure 6 illustrates where a R.A.S.E.R.S System evaporator and an DX coil are connected to the R.A.S.E.R.S unit.

Figure 6: Connecting multiple evaporators [need schematic]

Installing a balance line

The air conditioner evaporator should be sized to match the capacity of the R.A.S.E.R.S unit. For example, if you are installing a 5-ton R.A.S.E.R.S unit into a structure sized for 36,000 BTU/hr (3-ton) heat gain, a 24,000 BTU/hr (2-ton) balance line must be installed to balance the system. Install the balance line onto the orifice assembly that's pre-installed on the evaporator.

Figure 7: Evaporator connections with balance line



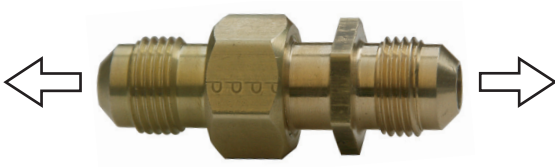
To install a balance line and configure the orifice assembly:

1. Install a balance line by using 1/4" pipe to connect the pre-installed orifice assembly to a T connector on the DX coil's liquid refrigerant line.

> **TIP** The DX coil's liquid refrigerant line is usually 3/8" (for 4-ton DX coils and smaller), so the T connector usually needs to be a 3/8" run with a 1/4" branch.

2. If you are sizing the balance line for a 2.0-ton balance (requiring an 0.060" orifice, which is pre-installed in the assembly), skip to Step 7.
3. If it is not already closed, close the shutoff valve upstream from the orifice assembly.
4. Separate the orifice assembly with a wrench.

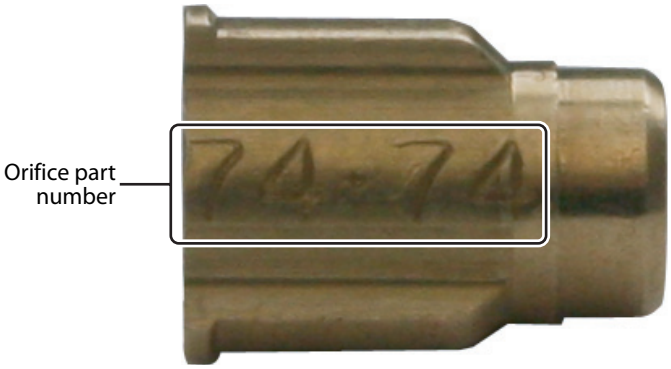
Figure 8: Separate orifice assembly



Pipes and compression fittings not shown for clarity

5 Replace the pre-installed orifice (stamped with "60") with the orifice appropriately sized for your installation:

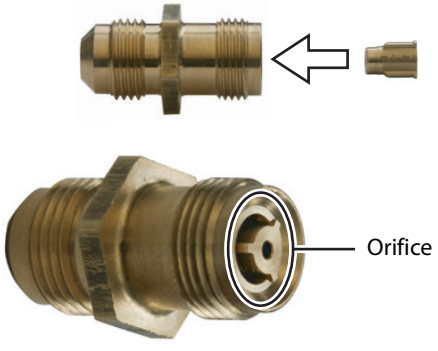
Figure 9: Orifice part number location



Balance system size	Orifice size	Orifice part number
1.0 ton	0.042"	42
1.5 ton	0.051"	51
2.0 ton	**0.060"**	**60**
2.5 ton	0.067"	67
3.0 ton	0.074"	74

Make sure that you insert the orifice nose-down into the downstream coupling (the coupling with the thin nut machined into it, without a screen filter).

Figure 10: Correctly installed orifice



Pipes and compression fittings not shown for clarity

6 Tighten the orifice assembly 1/4- to 1/2-turn past finger-tight, then check for leaks.

CAUTION

Closely inspect the two halves of the orifice assembly. Make sure that the ends are free from burrs and deformations, which can interfere with a proper seal between the halves.

7 Open the upstream shutoff valve. You will need to check the balance line for leaks whenever you pump down or pressurize the system.

Installing an external condenser

The R.A.S.E.R.S unit is equipped with two condenser ports to allow connection with a single external condenser (optional). This external condenser may be used for discharging excess heat (as to an air-cooled condenser) or for heating a secondary fluid. For a refrigerant schematic showing the condenser connection, see Figure 4 on page 8.

To install the external condenser:

1 Select a condenser that's sized to match the capacity of the R.A.S.E.R.S unit. For example, if the R.A.S.E.R.S unit is a 5-ton unit, the condenser should be sized for 5 or more tons of cooling capacity.

2 Mount the condenser and connect it to the R.A.S.E.R.S unit according to the condenser manufacturer's specifications. The condenser must also be installed at a level that is level with or higher than the R.A.S.E.R.S unit to provide a gravity-assisted, unrestricted flow of condensed refrigerant from the condenser to the receiver in the R.A.S.E.R.S unit.

3 Insulate the **To Condenser** (hot vapor) line with insulating material rated for temperatures of up to at least 250°F.

Installing the temperature sensor probe

The temperature sensor probe monitors the water storage tank temperature. The probe sends its readings to the thermostat controller, which directs the R.A.S.E.R.S unit to warm the tank water as needed.

To install the temperature sensore probe:

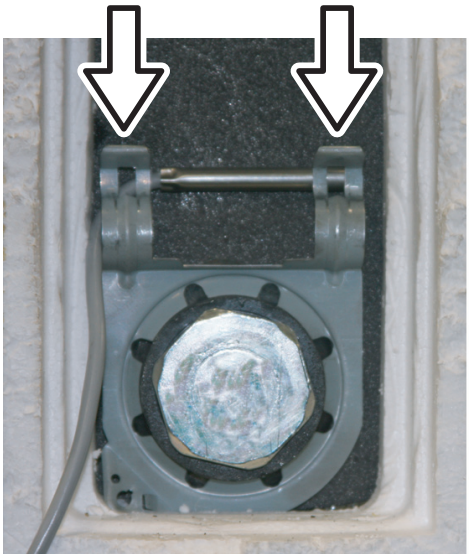
1 If you are installing the probe into a previously installed water tank, drain the water from the tank.

2 Install the *thermo port* (the port for holding the temperature sensor probe) into the lower part of the water storage tank.

Figure 11: Thermo port and probe clip

3 Slide the temperature probe into the probe clip.

Figure 12: Probe, cable, and clip with probe installed

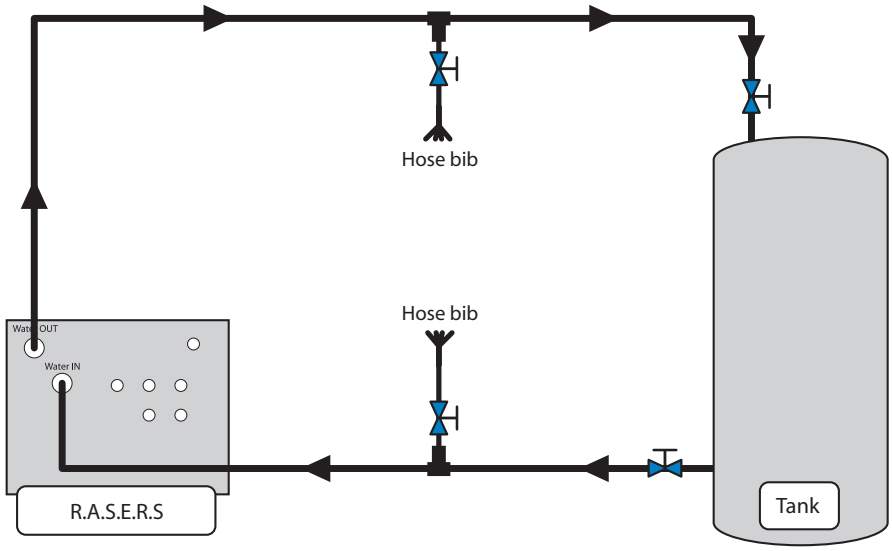


Installing water service

Water quality

We strongly recommend that treated soft water (less than 3 grains total hardness) be used in the R.A.S.E.R.S System. Soft water helps minimize scaling in the system that can occur if untreated well water or non-softened potable water is used. If no treated or softened potable water is used, then two additional tees with additional shutoff valves **must** be installed in the water lines between the water storage tank and the heat exchanger, similar to the following schematic.

Figure 13: Descaling system connections



To connect the water supply:

1 Install a check valve or back flow preventer valve onto the water supply line.

CAUTION

UL standards, as tested by ETL, require this valve to prevent the flow of water from the R.A.S.E.R.S System back into the water supply system.

2 Connect the water supply to the water storage tank.

TIP

We recommend using the State water heater, which meets all of the above requirements and is available from Eco Evolution Technologies.

Tank requirements:

- Sized and designed to satisfy the needs of the application
- Meets all applicable codes
- 40-gallon capacity (minimum). Recommended capacities:
  - 2-person household: 40-gallon capacity (minimum)
  - 4-person household: 80-gallon capacity
  - 6-person household: 120-gallon capacity

- Includes four ports:
  - Two 1" ports (one at the bottom of the tank, one about halfway up) for circulating water with the R.A.S.E.R.S unit. If these ports aren't already installed, you must install them.
  - Two 3/4" ports at top (standard on hot water heaters) for fresh water intake and hot water output

3 Connect the **Water In** water service port on the R.A.S.E.R.S unit to the lower circulation port on the water storage tank.

CAUTION

We recommend that you use 1" I.D. (inside diameter) or larger copper, PEX, or fiberglass tubing for proper flow capacity. Pipe larger than 1" may be needed if the tank is not located within 10 feet of the R.A.S.E.R.S unit.

CAUTION

You should use only pipe rated for continuous service at 130°F (54.4°C) or higher. See Figure 14 on page 17 for an example schematic of a detailed, complex (multi-floor, pool, etc.) installation.

4 Connect the **Water Out** water service port on the R.A.S.E.R.S unit to the upper circulation port on the water storage tank. The same tubing recommendations as for the *Water In* connection apply.

Figure 14: Complex hydronic, single-tank system schematic

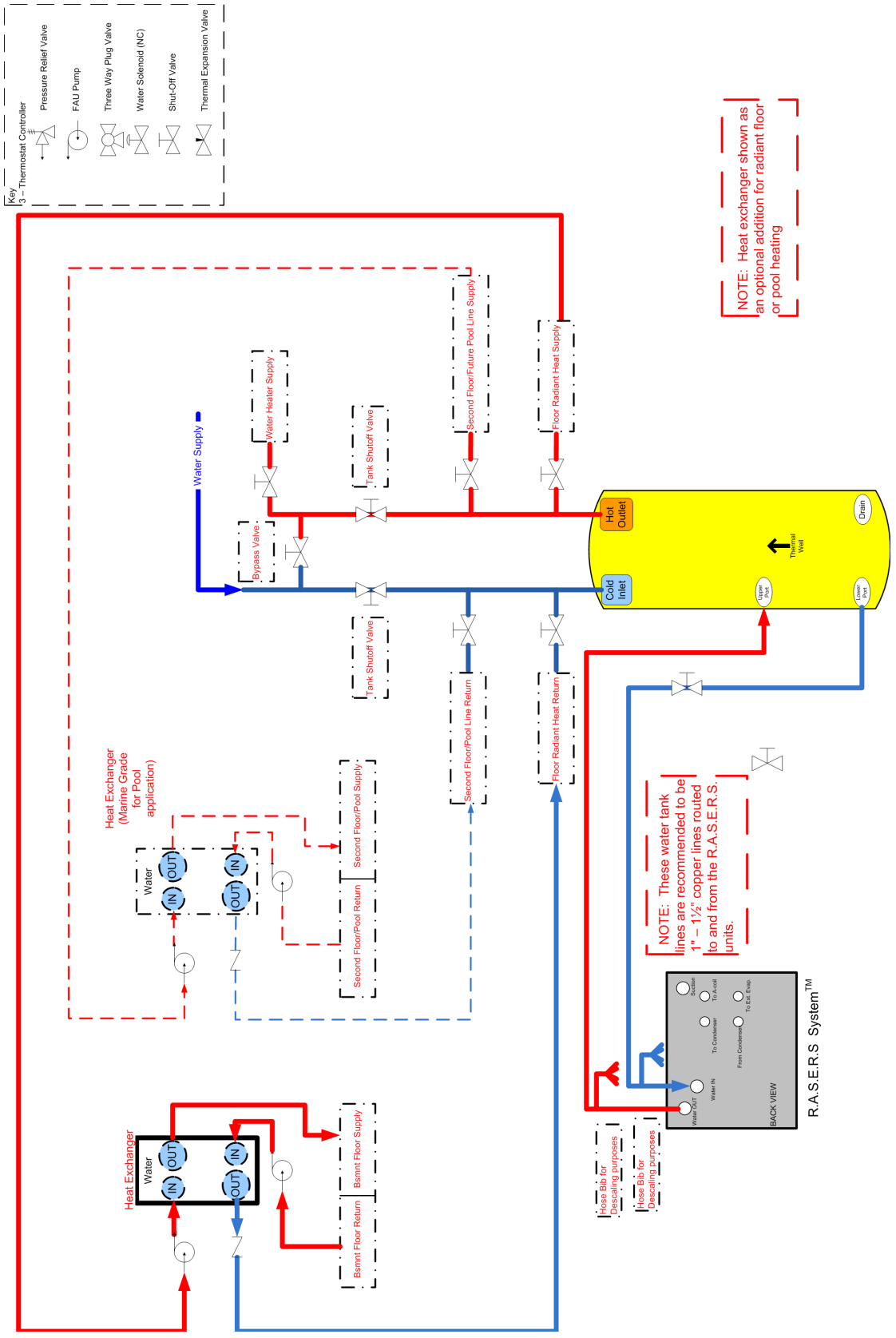
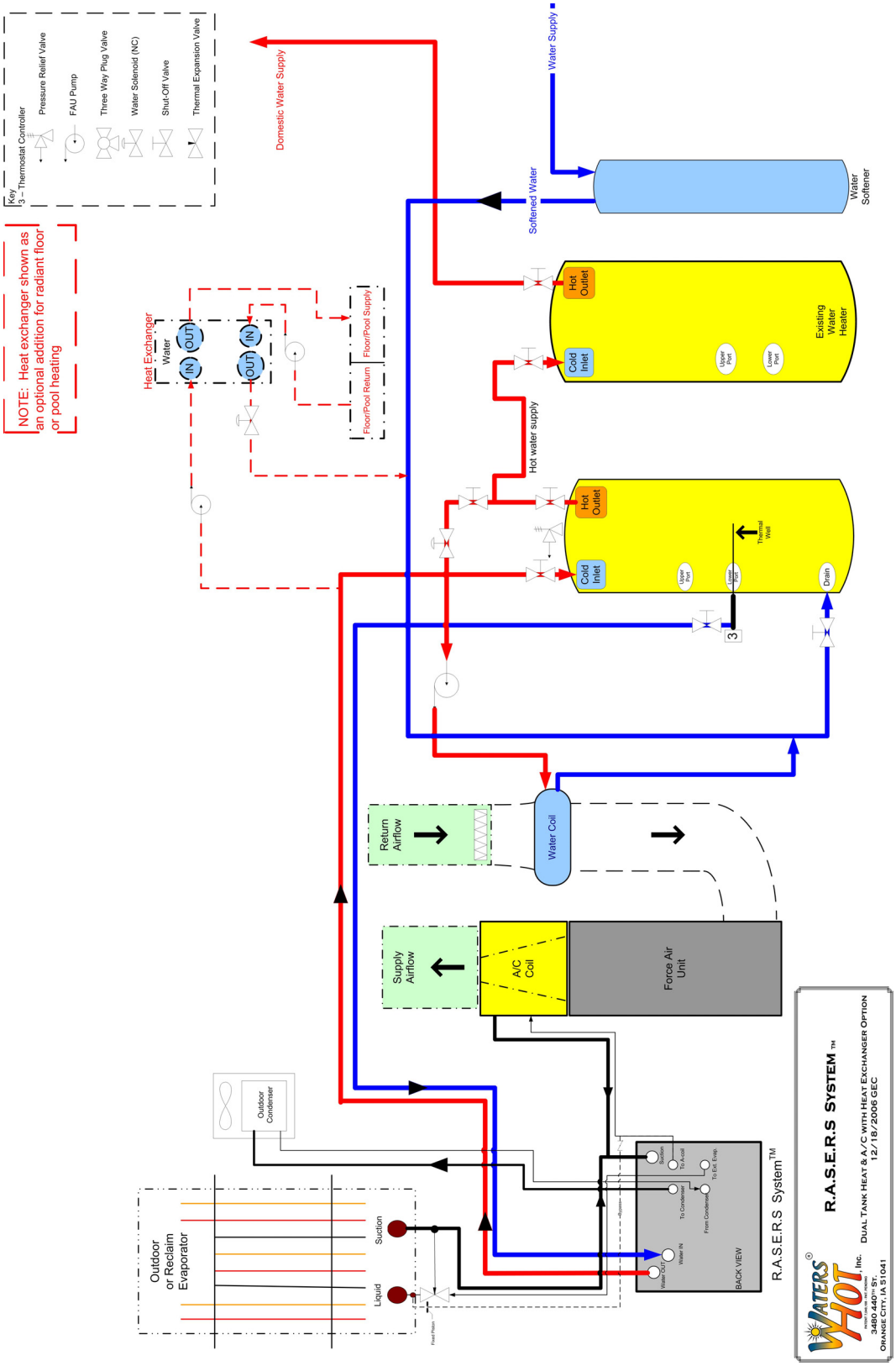


Figure 15: Complex hydronic, dual-tank system schematic



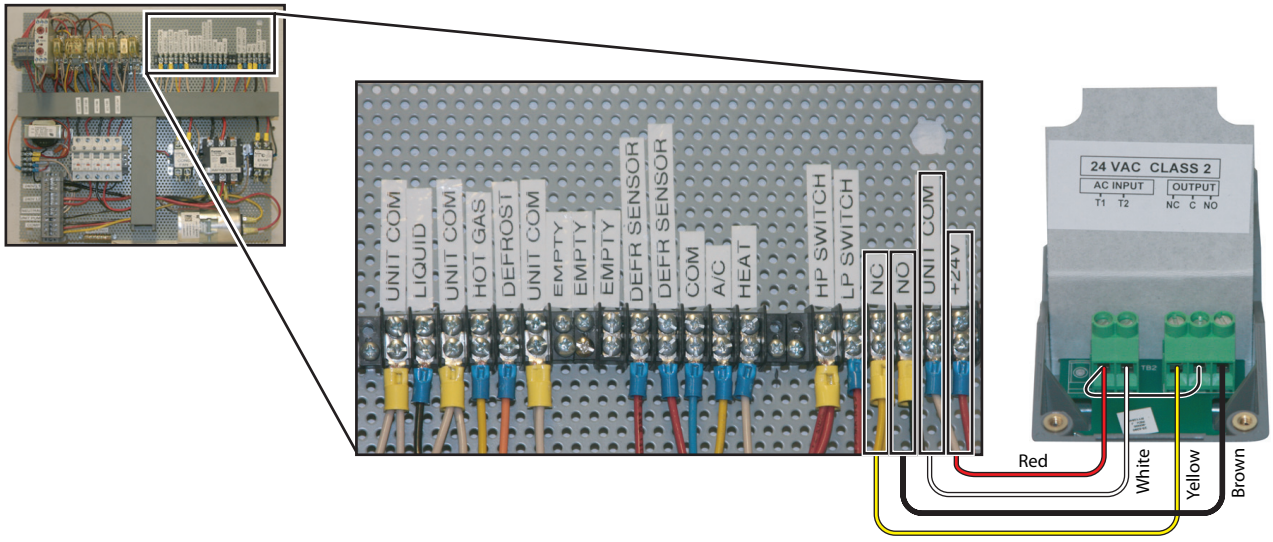
Installing the thermostat controller

1 Connect the thermostat controller to the terminal strip located on the R.A.S.E.R.S unit's electrical panel using a 4-strand thermostat wire (not included).

NOTE

The thermostat controller is powered by a 24V transformer system, which is connected to the 17-pole terminal strip.

Figure 16: R.A.S.E.R.S thermostat terminal points

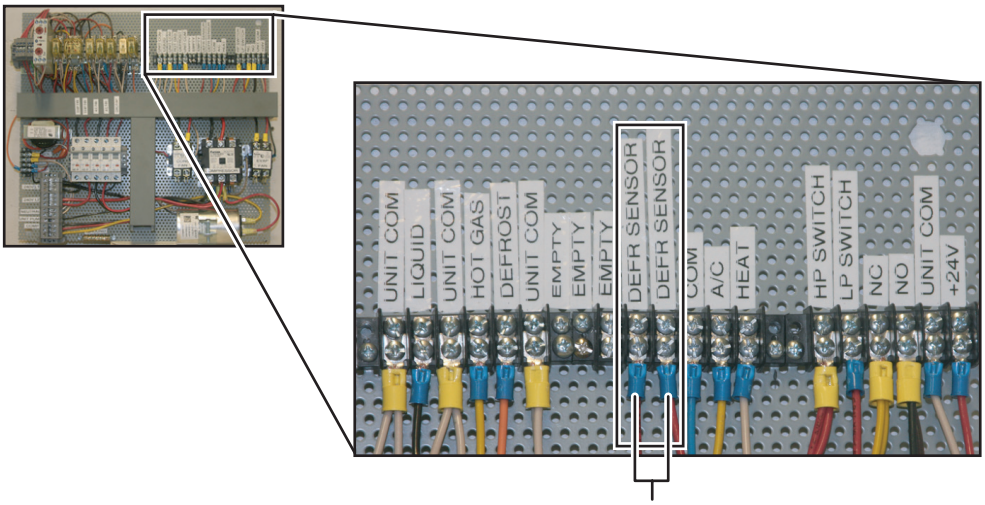


Connect the leads as follows:

- Red wire (hot lead)—Connect the thermostat controller's **T1** terminal to the R.A.S.E.R.S unit's **+24V** terminal.
- Jumper wire—Connect the thermostat controller's **T1** and **C** terminals.
- White wire (common)—Connect the thermostat controller's **T2** terminal to the R.A.S.E.R.S unit's **UNIT COM** terminal. (24VAC, tank thermostat)
- Yellow wire—Connect the thermostat controller's **NC** (*normally closed*) terminal to the R.A.S.E.R.S unit's **NC** terminal.
- Brown wire—Connect the thermostat controller's **NO** (*normally open*) terminal to the R.A.S.E.R.S unit's **NO** terminal.

2 Connect the temperature probe's leads to the **DEFR SENSOR** terminals on the R.A.S.E.R.S unit's electrical panel.

Figure 17: Temperature probe wire connections



Temperature probe connections
(either wire can connect to either terminal)

TIP

The terminals are interchangeable, so it doesn't matter which lead is connected to which **DEFR SENSOR** terminal.

Connecting electrical service

For the system's electrical schematic, see Figure 19 on page 22.

To connect electrical service to the R.A.S.E.R.S system:

1 Wire according to local code. The R.A.S.E.R.S unit requires single-phase 208/240V service.

2 Install a 50A 2-pole breaker exclusively for the R.A.S.E.R.S unit into the building's main power breaker panel.

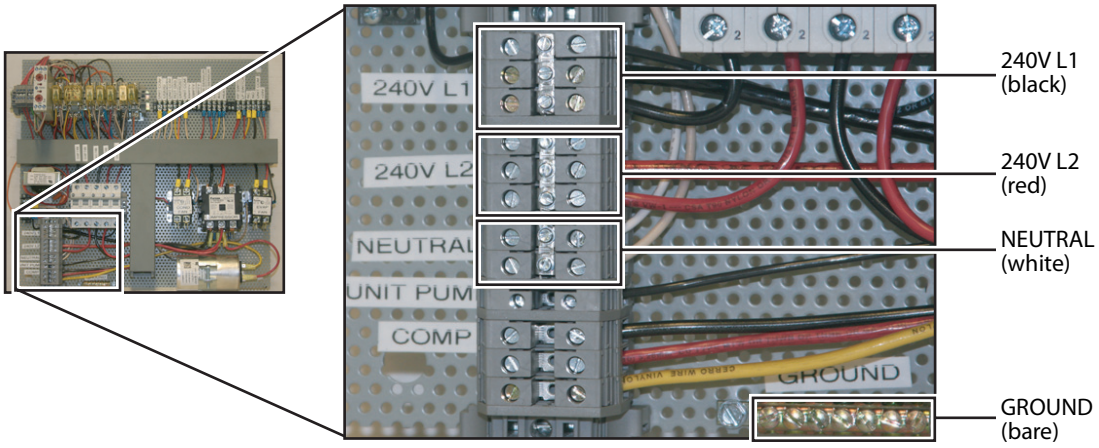
3 Connect the main electrical panel's R.A.S.E.R.S breaker to the RA.S.E.R.S unit. We recommend that you use 8 gauge, 3-wire plus ground, stranded copper wire.

4 Install a service disconnect switch that can interrupt the electrical service to the R.A.S.E.R.S unit if repair or maintenance is needed. Switch must be clearly marked and installed within sight of the R.A.S.E.R.S unit, ideally right next to it. (Switch installation configuration depends upon your local electrical code.)

5 Connect the three service power wires as follows:

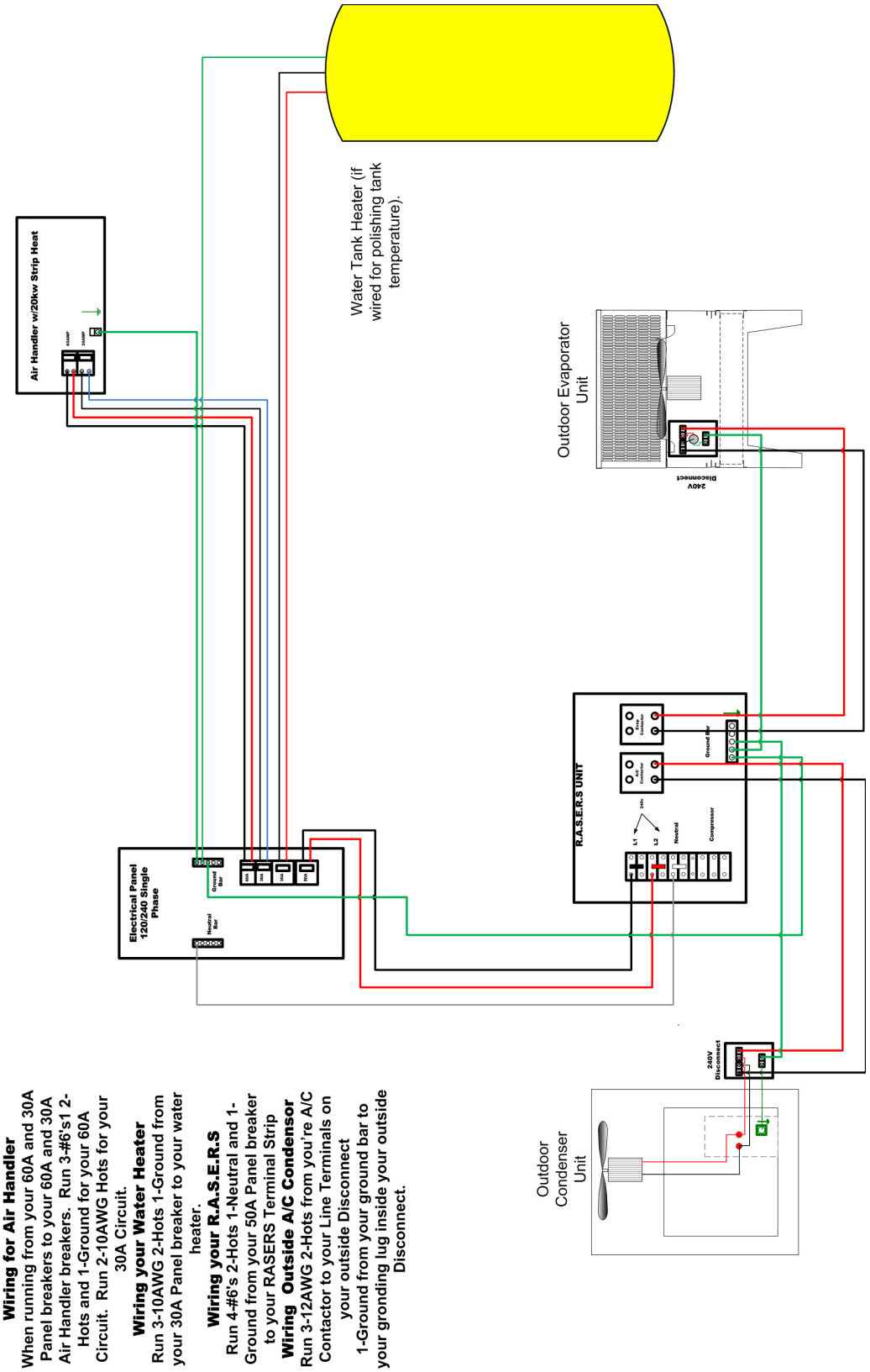
- Black wire to the R.A.S.E.R.S unit's **240V L1** terminal
- Red wire to the R.A.S.E.R.S unit's **240V L2** terminal
- White wire to the R.A.S.E.R.S unit's **NEUTRAL** terminal
- Bare or green wire (ground) to the R.A.S.E.R.S unit's **GROUND** terminal

Figure 18: Electrical service terminals



6 Turn on the R.A.S.E.R.S unit's breaker at the main power breaker panel to energize the leads to the R.A.S.E.R.S unit's electrical control panel.

Figure 19: R.A.S.E.R.S System electrical schematic



Starting the electrical system

1. If the 50A breaker is in the **ON** position, and the refrigeration valve on the receiver is opened, and the water fluid is in the heat exchanger, move the switch in the disconnect control box to the **ON** position. The following events should occur:
   - **a** There should be power to the thermostat controller. The controller may be blinking and the read out may be alternating between "ASd" and the temperature in the tank, as measured by the probe in the thermo well.
   - **b** The blinking of the LED is normal and signifies that there is an internal timer in the controller that is counting down the time in minutes.

     This feature of the thermostat controller is protecting the compressor by giving the pressures on both sides of the compressor, the suction side and the high pressure side, to equalize prior to starting. Whenever the unit stops or loses power, the controller resets the anti-cycle delay timer to allow the refrigerant gas pressure to equalize.
   - **c** When the unit shuts down because it has reached the water set point temperature, it will restart again when the temperature of the water has dropped to the level where the controller will call for heat again.
2. When the compressor is running, you can check the head pressure and the suction pressures. Connect the high-pressure line for the gauge set to the Schrader valve on the high-pressure side of the compressor and the low-pressure gauge set on the suction side of the compressor.
   - **a** The high pressure reading on the compressor at startup, when the water temperature in the tank is approximately 60°F ~ 80°F, should be between 300-450 lbs inch^2.

     The pressure setting for the suction side at startup should be between 35-110 lbs if the water temperature is less than 80°F. As the temperature of the water increases, the head pressure will climb up to between 300-450 lbs, and the pressure on the suction side of the compressor may climb to between 35-110 lbs.
   - **b** It is important to properly balance the refrigerant charge and thermal expansion valve settings on the evaporator.

Starting the water system

1. The system may have to be primed to make sure that there is an adequate amount of water in the water condenser (brazed plate heat exchanger).

   If there is no water in the water condenser when the system is started up, the refrigerant gas will rapidly warm up, which will then rapidly increase the hot gas pressure on the high-pressure side of the compressor, which will then shut down the compressor (with the high-pressure switch) if the pressure exceeds 500 lbs of pressure.

   Water in the water condenser will remove the heat, which then causes the temperature and subsequent head pressure of the refrigerant gas to be in the normal operating range.
2. After the system has been primed, when the system shuts off, the pressure of the water in the system will keep water in the brazed plate heat exchanger until the system starts up again.
3. If the unit needs to be serviced and the water line opened, the system may have to be re-primed prior to subsequent operation of the system.

Charging the unit

To charge the system with refrigerant

1 Integrity check the refrigerant system for leaks.

a Release pressure from the system, then evacuate the system with a vacuum pump to approximately 50 ~ 100 millitorr (microns) of vacuum. The system must be evacuated to remove moisture and non-condensables.

b Pressurize the system with nitrogen gas on the suction side only.

CAUTION

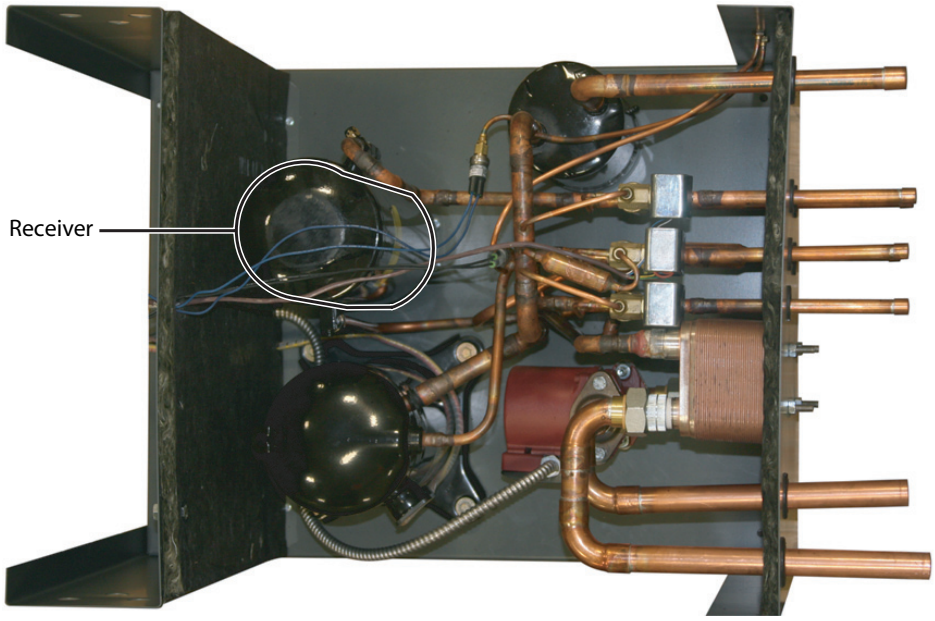
Most refrigerant oils are hygroscopic, having a high affinity for water (readily absorbs water). Water absorption can lead to the creation of hydrochloric and hydrofluoric acids, which can harm system components.

c Locate and repair any leaks that the integrity check discovers, then do another integrity check until all leaks have been repaired.

2 Open the receiver's king valve.

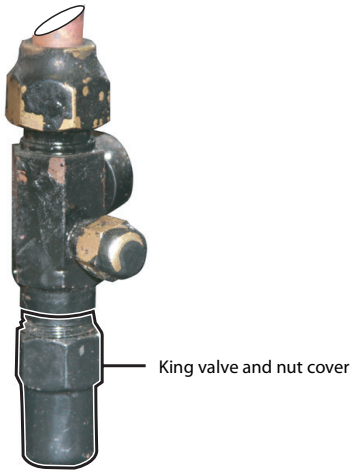
a Locate the refrigerant receiver at the back right of the R.A.S.E.R.S unit when looking at the front.

Figure 20: Receiver



b Locate the receiver's king valve on the back of the receiver.

Figure 21: Receiver king valve



c Remove the valve's nut cover.

d Use a refrigeration wrench or small crescent wrench to turn the stem clockwise until the valve is completely open.

CAUTION

Do not use plumber's pliers or other pliers to open the valve. Doing so can damage the stem and prevent the stem seal from operating properly.

e Replace the nut cover onto the stem of the valve and tighten it.

3 Add refrigerant following standard refrigeration procedures and specifications. Only a trained refrigeration technician is qualified to perform this task.

a Charge the system with refrigerant. The R.A.S.E.R.S unit has **not** been pre-charged with refrigerant. The system will need about 15 lbs of R-410A, depending upon the application and equipment installed. For estimating purposes, see "Estimating and adjusting the refrigerant charge" on page 25.

b Use superheat and subcooling measurements to adjust the charge in the refrigerant system.

- See "Measuring superheat" on page 27
- See "Measuring subcooling" on page 26

Estimating and adjusting the refrigerant charge

The system should be supplied with enough refrigerant to fill the liquid lines from the external air-cooled condenser to the receiver, and from the receiver to the TX valve, plus at least 1 lb of refrigerant to be stored in the receiver (the amount of refrigerant stored in the line between the flat plate condenser and the receiver is negligible in comparison).

The receiver is capable of holding enough refrigerant to hold the charge from the external condenser when it is not in use.

When the external condenser is not in use, the 3-way reclaim valve will draw down the refrigerant in the condenser liquid lines to suction to avoid issues with ambient temperature changes at the condenser.

You can use the following table to estimate the amount of refrigerant that will be needed. In most cases, by applying standard refrigeration system charging procedures, an experienced technician will arrive at approximately the same quantities of refrigerant as indicated in the chart.

Figure 22: Table for estimating R-410A refrigerant needs

R-410A temperature	50°F (°C)	60°F (°C)	70°F (°C)	80°F (°C)	90°F (°C)	100°F (°C)	110°F (°C)	120°F (°C)	130°F (°C)
Density, lb/ft^3	**70.76912**	**69.18923**	**67.53311**	**65.78718**	**63.93333**	**61.94638**	**59.78969**	**57.40635**	**54.69944**
Specific volume, lb/ft^3	**0.01413**	**0.01445**	**0.01481**	**0.01520**	**0.01564**	**0.01614**	**0.016723**	**0.01742**	**0.01828**
Copper Pipe Size	Pounds of R-410A per foot of pipe (saturated liquid)								
3/8"	0.0383	0.0374	0.0365	0.0356	0.0346	0.0335	0.0324	0.0311	0.0296
1/2"	0.0714	0.0698	0.0681	0.0663	0.0645	0.0625	0.0603	0.0579	0.0552
5/8"	0.1146	0.1121	0.1094	0.1066	0.1036	0.1004	0.0969	0.093	0.0886
3/4"	0.1712	0.1674	0.1634	0.1592	0.1547	0.1499	0.1446	0.1389	0.1323
7/8"	0.2379	0.2325	0.227	0.2211	0.2149	0.2082	0.201	0.1929	0.1838
1 1/8"	0.4055	0.3965	0.387	0.377	0.3664	0.355	0.3426	0.329	0.3134
1 3/8"	0.6177	0.6039	0.5894	0.5742	0.558	0.5407	0.5218	0.501	0.4774

Charge the system to the subcooling of the liquid line leaving the condenser. First, verify the superheat of the TXV, then set the subcooling on the R.A.S.E.R.S system (because the superheat is fixed). The superheat is fixed at 8°~12°F in most systems. Subcooling is the amount of liquid held back in the condenser. This allows the liquid to give up more heat, below saturated pressure-temperature. For every one degree of subcooling at the same condensing pressure, capacity increases 0.5%. Increasing subcooling, with an increase of discharge pressure and compression ratio, decreases capacity. Add 5°F subcooling for every 30 feet of liquid line lift.

Measuring subcooling

What is subcooling?

Subcooling is the cooling of a liquid past the point of its condensation from vapor.

To check subcooling:

1. Take a temperature reading with a thermometer attached to a liquid line after the condenser.
2. Take the head pressure and convert it to temperature on a temperature/pressure chart.
3. Subtract the two numbers. The result is the amount of your subcooling.

Subcooling on systems that use a thermostatic expansion valve (TXV) should range about 5 ~ 15°F subcool. Higher subcooling indicates that excess refrigerant is backing up in the condenser. On TXV systems with high superheat, make sure that you check the subcooling as refrigerant is added. If the superheat doesn't change but subcooling increases, the problem is with the metering device. In the case of a TXV, it's likely that the power head needs to be replaced.

Head pressure (converted to temperature) — Liquid line temperature = Subcool

Example:

124˚F — 90˚F = 34˚F Subcool

For example, 438 psi head pressure on an R-410A system converts to 124°F. The liquid line temperature is 88°F. Subtracting the two numbers gives 36°F subcool.

Measuring superheat

What is superheat?

Superheat describes the difference between the vapor point (i.e., temperature at which the refrigerant evaporates at a given pressure) and the actual temperature of the refrigerant exiting the evaporator coil. After the liquid refrigerant has changed to a vapor, any additional heat added to the vapor raises its temperature as long as the pressure to which it is exposed remains constant. *Superheat vapor* describes a gas with a temperature higher than its saturation temperature corresponding to its pressure.

NOTE

Superheat's primary function is to protect the compressor. Improving evaporator efficiency is secondary.

To find the superheat, always subtract the saturated temperature from the actual temperature. 50°F - 40°F = 10°F superheat.

Actual temperature — Saturated temperature = Superheat

Example:

50˚F — 40˚F = 10˚F Superheat

To check superheat:

1. Measure superheat at the evaporator. For most applications, measure the temperature of the suction line 8 ~ 12" from the suction service valve and near the bottom of the line. Make sure that you securely fasten the temperature probe to the suction line and insulate the probe and the suction line.
    - We recommend 5 ~ 15°F superheat at the compressor.
    - We recommend using the pressure/temperature method of measuring superheat. Take the temperature at the evaporator outlet and the suction pressure measured at the compressor as the evaporator saturation pressure. Measure the suction pressure at the suction service valve and convert it to its corresponding saturated suction temperature.

High superheat and high subcooling may indicate a problem with the metering device.

Starting the refrigeration system

To start the refrigeration system:

1. Make sure that the king valve on the receiver has been opened completely. This allows the refrigerant to flow through the refrigerant side of the R.A.S.E.R.S unit.

    The typical target of superheat coming back to the compressor is 5 ~ 15°F superheat.

    It may be necessary to adjust the thermal expansion valve in the evaporator panel to reach the desired amount of degrees of superheat in the system.

2. Allow the system to heat the water to at least 100°F before the expansion valve is set and before making final adjustments to the amount of refrigerant and the degrees of superheat. Because the water supply may run cold (50~60°F), bringing the tank water temperature up to 100°F may take several minutes (approximately 1~3 minutes per °F).

Configuring the thermostat controller

Set the following parameters on the thermostat controller:

- SP = Set Point (120°F or lower)
- DIF = Temperature difference (2°F)
- ASD = Anti-short cycle delay (1 or 2)
- OFS = Temperature Offset (0)
- SF = Super Failure Operation (1)
- Heating Mode = Jump 1 jumper is installed
- Set Point at cut Out = Jump 2 jumper is installed

Legal notices

Patented technology

Patent #7,040,108 and Patent Pending

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