

Context for Residential Heat Pump SOP

Background

Because of confidentiality agreements, I've had to be innovative and creative for writing samples. My dad is an electrician and refrigeration specialist, a subject-matter expert (SME) that I collaborated with to create a standard operating procedure (SOP). My dad walking me through a process from which I could create a procedure was a random idea that developed when I least expected it but an idea that I surely needed.

- **Audience:** An entry-level electrician or technician with prior knowledge of the subject matter.
- **Percentage of I wrote:** 100%.
- **Original content or revised content:** The document is my original writing.
- **Resources for drafting content:** My resources were the residential electrician (the SME) and two Whirlpool installation guides. My SME walked me through the process, and I took notes. Through research, I discovered the Whirlpool installation guides and used them to fill in some gaps of information after retrieving as much information as I could from questioning the SME. After asking questions in various ways and seeing the SME didn't quite know how to fill in the gaps, I felt I needed to perform some research for more content.
- **Content editing:** I edited the document myself as someone confident in my editing abilities because of my background. The document underwent heavy editing.
- **Style guide usage:** A company style guide was not used to write this document. Because this was a document that I created in my personal time to increase the number of samples in my portfolio, a company style guide was not applicable. I created a template that is a good template for content that will be published as a pdf or Word document. When a style guide is not applicable, I create a style sheet when needed to ensure consistency within a document.
- **Additional useful context, such as deadlines, achievements, etc.:** The SOP is a draft document. There are questions I plan to ask the SME to make revisions before creating the final copy. I would like to facilitate usability testing by following the steps or having another novice user follow the steps to connect a residential heat pump. Following the procedure to complete the operation would reveal missing information and help ensure accurate information.

- **Changes after publication and why:** The document is in draft form, so there is not yet a final/published. To finalize the document, I need the SME to review the content I added from the other resource for accuracy and relevance to the audience.

My Process

My dad, the SME, lives in the state where I grew up. When I was home once, I asked if there was a technical operation that we could walk through with him explaining the operation while I write the procedure. I expressed that it could be an operation already completed at home or that he needed to complete, like adding freon to the unit at the house. There was no technical task he needed to complete, so he explained an operation completed at my childhood home: connecting a high-efficient heat pump.

As the SME explained the procedure, I asked questions when information was not clear and when I recognized that some steps were missing. I took pictures as he explained things and used another resource to fill in information gaps (source noted in the SOP).

How I Went Above and Beyond

Because of the quality of work I believe in delivering, I usually do above the bare minimum. I went beyond what is required in the following ways:

- ensured the procedure was easy to read and scannable by using a template that I created for SOPs before this project.
- included hazard information in the operation table of each operation and safety notes throughout, designed to stand out to ensure users are aware of safety hazards. Including safety notes and hazards is likely expected but including this information in a non-avoidable way makes a difference.
- created a logo for the fake company, which guided the template colors to stay on brand.
- included document control elements: document number, revision history page, and header and footer that help with recognizing differences in copies, especially when pages are printed and separated from the entire document.
- took pictures and included them in the SOP to increase understanding.

Standard Operating Procedure:

Connecting a Residential High-Efficient Heat Pump

Operation: Installation
SOP No: MJ-HEHP-01

REV: 0 Date: DRAFT

CHG: 0 Date:



Approval

<u>Name</u>	<u>Title</u>	<u>Signature</u>	<u>Date</u>
Marilyn Jones	Technical Writer	_____	_____
Jerry Jones	Electrician and Refrigeration Specialist	_____	_____

DRAFT 1

General Safety Requirements

1. Disconnect all power before servicing the heat pump.
2. Only individuals who are entry-level technicians or a higher-level technician shall install or repair the heat pump.
3. Handle refrigerants safely. To avoid breathing difficulty or death:
 - a. Never purge refrigerants into an enclosed room or space.
 - b. If an indoor leak is suspected, thoroughly ventilate the area before working.
 - c. To avoid frostbite or blindness from possible extremely cold refrigerant, avoid contact and wear gloves and safety goggles.
 - d. Seek medical help immediately if refrigerant (also called Freon™) gets on skin or eyes.
 - e. Never burn refrigerant to avoid the production of poisonous gas.
4. To avoid possible explosion:
 - a. Never apply flame or steam to a refrigerant cylinder. If a cylinder must be heated for faster charging, immerse it in warm water.
 - b. Never fill a cylinder with more than 80% of liquid refrigerant.
 - c. Never add anything other than R-22 to an R-22 cylinder or R-410A to an R-410A cylinder. The service equipment used must be listed or certified for the type of refrigerant used.



- d. Store cylinders in a cool, dry place, and never use cylinders as a stand or roller.
- e. Use only returnable (not disposable) service cylinders when removing refrigerant from a system.
- f. Ensure the cylinder is free of damage.
- g. Ensure the hydrostatic test date is not over 5 years.
- h. Ensure the pressure rating meets or is higher than 400 lbs. When not sure, do not use the cylinder.


General Location Requirements

1. The heat pump is designed to be located outdoors with enough clearance for free entrance to the inlet and discharge air openings. The location must also allow enough room for a person to service the heat pump.
2. If possible, select a shaded area, an area not in path of direct sunrays, for the location of the heat pump. North or east locations are usually most desirable. Position the heat pump to avoid direct contact with water, snow, or ice from a roof line overhead.
3. The heat pump must be installed on a solid, level mounting pad that will not settle or shift. Separate the pad from the building structure to avoid possible transmission of sound or vibration from the heat pump into the residence.
4. The heat pump foundation should be raised 3 in. or more above finish grade. In areas with prolonged below-freezing temperatures, and/or snowfall, the heat pump should be elevated above the average snow line.
5. If the heat pump is to be installed on a flat roof, it should be on a platform or other support which will raise the inlet air opening 12 in. or more above the surface of the flat roof.
6. Ensure free drainage of condensate from defrost cycles. This will prevent ice accumulation. The heat pump should be located away from walkways to prevent possible icing from defrost condensate.
7. Avoid placing the heat pump near areas such as sleeping quarters or study rooms. Normal operating sound levels may be intolerable near certain rooms. A shift in sound type does occur during the defrost mode. The defrost mode generally lasts no longer than 10 minutes.

Orifice and Electrical Requirements

1. Check the indoor coil orifice to see whether it matches the required orifice for the indoor coil and heat pump combination being installed.
2. Refer to the refrigerant charge label located on the inside of the heat pump access panel for the correct orifice size required.
3. Replace the orifice with the correct size if this size is not already installed in the indoor coil. Instructions for replacing the orifice are provided with the indoor coil.
4. All wiring must be suitable for outdoor use. Use copper conductors only.
5. All field wiring must be done in accordance with National Electrical Code requirements, applicable requirements of UL, or local codes, where applicable.
6. Electrical wiring, disconnect means, and over current protection are to be supplied by the installer. Refer to the rating plate for the maximum over current protection, minimum circuit ampacity, and operating voltage.

Hazards: <input checked="" type="checkbox"/> Low <input type="checkbox"/> Moderate <input type="checkbox"/> High Location: Outside Residence Procedure: Connecting a Residential High-Efficient Heat Pump	SOP No.: MJ-HEHP-01 Date: DRAFT Rev. No.: 0 Date: Chg. No.: 0 Date:
Operation: Mount the Heat the Pump	Operation No: 1


CAUTION

EXCESSIVE WEIGHT. Moving the unit alone can result in back or other injury. **USE TWO OR MORE PEOPLE TO MOVE AND INSTALL THE UNIT/HEAT PUMP.**

INSTRUCTIONS

NOTE: The heat pump may be referred to as “unit” or “system” throughout this SOP.

1. Mounting the Heat Pump

1.1. CHOOSE a location to mount the heat pump.

NOTE: Structure, obstructions, other units, and anything else that may interfere with air circulation must be considered when finding a place to mount the heat pump. A good minimum airflow clearance for a unit is 20 inches to accommodate various models. The unit can be at ground level or on a flat roof.

At ground floor level, the unit must be on a solid, level foundation. To reduce possible sound, the foundation slab should not contact an important part of the building foundation. If on a roof, weight and weather must be considered. To reduce possible noise vibration, absorbing pads or springs can be installed between the unit legs or frame and roof mounting assembly.

1.1.1. **ENSURE** the location will allow the top of the unit to be unobstructed.

1.1.2. If vertical conditions require the unit to be placed under an obstruction, **ENSURE** there is a minimum of 60 inches between the top of the unit and the obstruction.

1.1.3. **ENSURE** the side opposite any structure (house, etc.) has room for a person to service the unit.

NOTE: It is better to avoid installing the unit in a corner.

1.1.4. **ENSURE** the foundation is sufficient to support the unit.

NOTE: A concrete slab raised above ground is an appropriate base. A company or person who can lay a concrete foundation may be needed.

1.2. **SITUATE** the unit to permit free unobstructed drainage of the defrost water and ice.

1.3. **ENSURE** the unit is elevated to allow drainage and airflow during severe weather.

NOTE: 12” of elevation is good to accommodate the lowest temperature.

1.4. **BOLT** a disconnect box to the wall on the outside of the residence near the heat pump with screws or anchors, depending on if residence is brick or wooden.



SPECIAL REQUIREMENTS

N/A

EQUIPMENT, TOOLS, GAGES, AND SUPPLIES

Item	Quantity Required
cement slab	as required
disconnect box	1
heat pump	1
level	1
screws or anchors	as required

DRAFT 1

Hazards: <input checked="" type="checkbox"/> Low <input type="checkbox"/> Moderate <input type="checkbox"/> High Location: Outside Residence Procedure: Connecting a Residential High-Efficient Heat Pump	SOP No.: MJ-HEHP-01 Date: DRAFT Rev. No.: 0 Date: Chg. No.: 0 Date:
Operation: Run the Refrigerant Lines	Operation No: 2

NOTICE: The compressor oil for R-410A heat pumps can easily absorb moisture, which could cause compressor failure. Do not leave heat pump open to the atmosphere any longer than necessary for installation.

INSTRUCTIONS

1. Running the Refrigerant Lines from the Indoor Furnace to the Outside

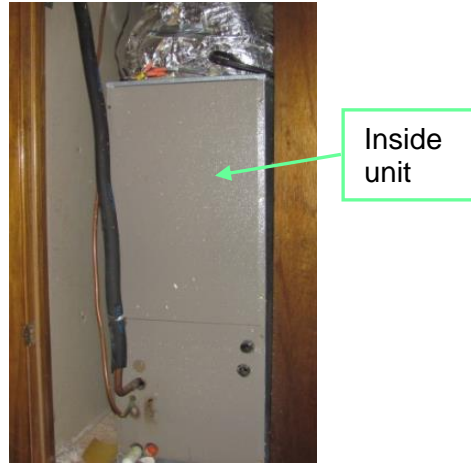
1.1. **OBTAIN** two copper, refrigerant lines: suction line and discharge line.

NOTE: Heat pumps should be installed only with specified line sizes for approved system combinations with elevation differences up to 20 ft. and total length of up to 50 ft. Installations of greater than 50 ft. are not recommended.

Recommended Interconnecting Tubing		
	0 to 50 ft.	
<i>Unit Tons</i>	<i>Suction</i>	<i>Liquid</i>
2	3/4	3/8
2 ½	3/4	3/8
3	3/4	3/8
3 ½	7/8	3/8
4	7/8	3/8
5	7/8	3/8

NOTE: The lines will be used to connect the inside unit, which will be referred to as the inside furnace, to the outside heat pump.

1.2. **RUN** the refrigerant lines from the inside furnace through the wall or ceiling to outside the residence where heat pump is located.



- 1.2.1. When running lines through a wall, **DO NOT ALLOW** the refrigerant lines to come in direct contact with plumbing, ductwork, floor joists, wall studs, floors, and walls.
 - 1.2.1.1. **AVOID** suspending lines with wire or straps to keep lines from plumbing, studs, and so on.
 - 1.2.1.2. **USE** an insulated or suspension-type hanger, and **KEEP** both lines separate.
- 1.2.2. **ENSURE** there are no sharp bends or kinks in the lines for best performance.
- 1.2.3. When running lines through a wall, **ENSURE** there is room for sound/absorbing material to be installed between the tubing and foundation.
- 1.2.4. **FILL** any gap between the wall and refrigerant lines with a pliable silicon-based caulk such as RTV or a vibration damping material.

NOTE: Lines from the inside furnace ran to the outside of the residence can hang outside the wall until ready to connect to the heat pump.

SPECIAL REQUIREMENTS

N/A

EQUIPMENT, TOOLS, GAGES, AND SUPPLIES

Item	Quantity Required
copper lines: suction line and discharge line	1 of each
silicon-based caulk	as required

Hazards: <input checked="" type="checkbox"/> Low <input type="checkbox"/> Moderate <input type="checkbox"/> High Location: Outside Residence Procedure: Connecting a Residential High-Efficient Heat Pump	SOP No.: MJ-HEHP-01 Date: DRAFT Rev. No.: 0 Date: Chg. No.: 0 Date:
Operation: Connect Electric, Thermostat, and Refrigerant Lines to the Heat Pump	Operation No: 3

⚠
DANGER
⚠

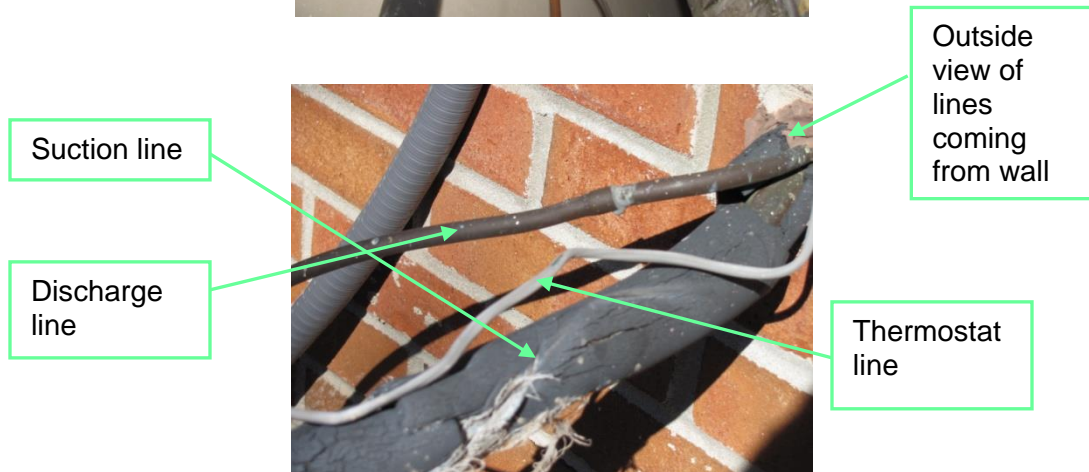
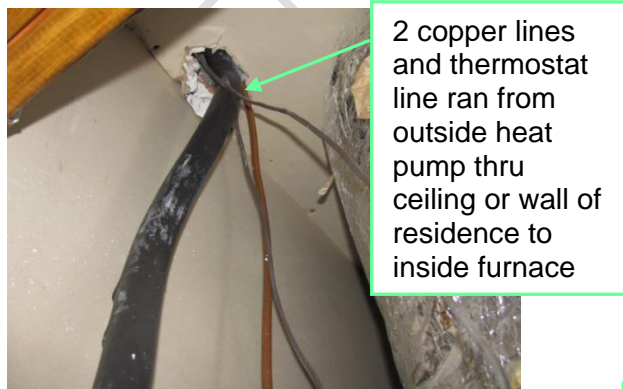
ELECTRICAL SHOCK/DEATH HAZARD. Electrical currents through systems while servicing or parts/panels can cause death or electrical shock. **DISCONNECT POWER BEFORE SERVICING. REPLACE ALL PARTS AND PANELS BEFORE OPERATING.**

INSTRUCTIONS

1. Connecting the Thermostat Line

- 1.1. **RUN** a thermostat line (27 or 28 volts) from the inside furnace to the outside heat pump along with the refrigerant lines.

NOTE: The cable or conduit and fittings connected from the disconnect to the heat pump shall be rated for outdoor use.



- 1.2. **RUN** another thermostat line from the inside furnace to the thermostat.

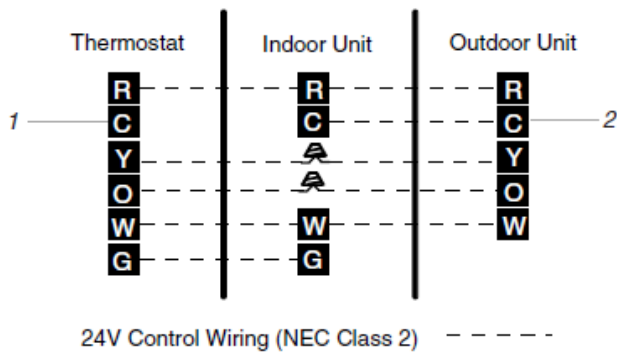


Thermostat
before cover
removed

1.3. **CONNECT** the low voltage circuit by connecting the correct colored wires according to the diagram below:

- R: constant 24v power for heating mode (red)
- C: common (blue)
- Y1: contactor (yellow)
- O/B: reversing valve in cooling mode (usually orange; dark blue on Ruud or Rheem systems)
- W: auxiliary heat, backup heat, or heat strips (white)
- G: blower (green)

Typical Wiring Connection (low voltage circuit)



1. Do not connect C (common) connection between indoor unit and thermostat except when required by the indoor thermostat. Refer to the thermostat installation instructions.
2. C (common) connection between indoor unit and outdoor unit required for proper operation.



Thermostat
line
connected
by wiring

2. Connecting the Refrigerant Lines

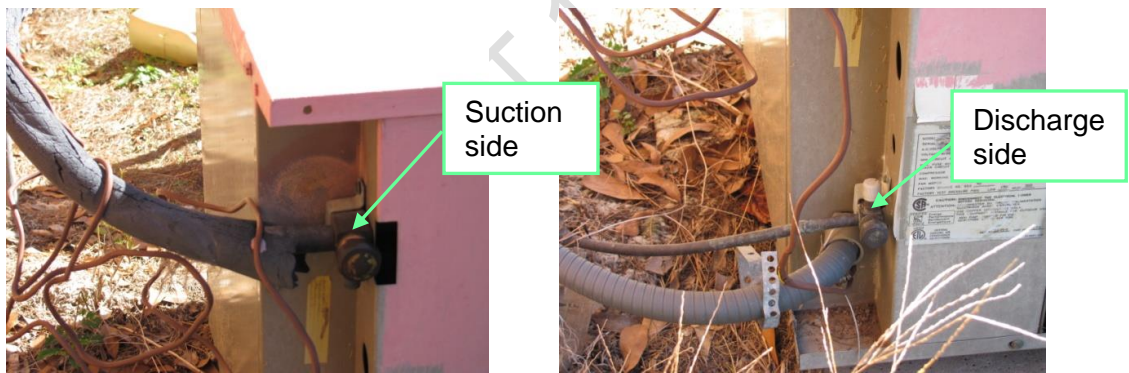
2.1. **WELD/CONNECT** the refrigerant lines to the evaporator coil on the inside furnace.

NOTE: On trailers, they are sometimes screwed to the inside furnace.



- 2.2. **STEP** outside and **WELD/CONNECT** the refrigerant lines to the outside heat pump where the valves are located, the non-insulated line to the discharge side and the insulated line to the suction side, using a welder and 15-15% hard silver solder.

NOTE: There is a suction side and discharge side on the heat pump. The suction side is bigger than the discharge side. The discharge side is always the high side (has a higher pressure). The suction side contains the low pressure.



- 2.3. **ENSURE** there are no sharp bends or kinks in the lines for best performance.

NOTE: The suction line/wire always sweats (formed condensation that drops from the suction line) and is therefore covered with insulation.



3. Connecting the Electric (Breaker) Line

- 3.1. **RUN** a 240 electric line (breaker line) from the outside or inside breaker box to the outside heat pump.

NOTE: When the line is run from the inside breaker box, it should be run through the ceiling. It can be run underneath the residence for a wooden house. The heat pump will not work without this step, step 3. A double 30 or 40-amp breaker is required for the heat pump to operate.

- 3.2. **CHECK** the heat pump rating plate to determine if the system is rated single phase or three phase and follow the appropriate instructions below:

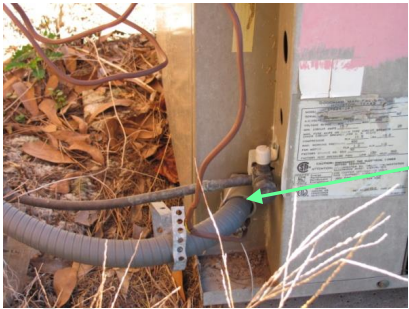
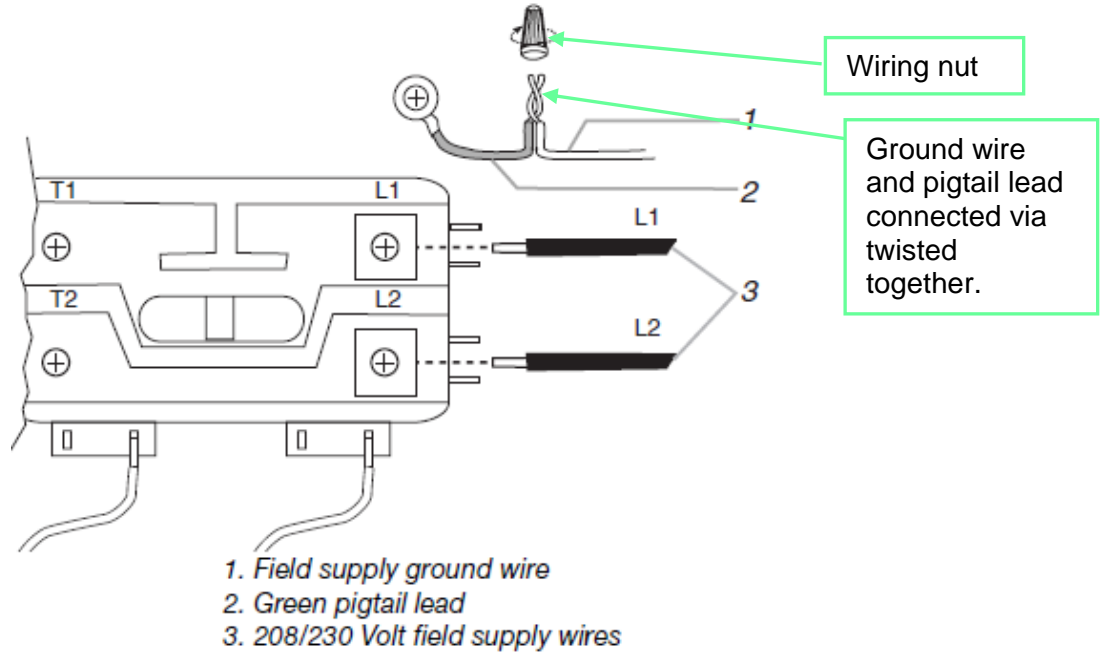


IF SINGLE PHASE

- 3.2.1. Electrically **GROUND** the heat pump.
- 3.2.2. **CONNECT** the ground wire to green pigtail lead.
- 3.2.3. **USE** a copper wire to connect the electric line.
- NOTE:* For single phase, a 10-2 wire is used.
- 3.2.3.1. **CONNECT** the field supply wires L1 and L2 to contactor terminals L1 and L2.
- 3.2.3.2. Using a U.L. listed wiring nut, **CONNECT** the ground wire to the green pigtail lead.
- 3.2.3.3. **CONNECT** the low voltage circuit.
- 3.2.4. **REPLACE** the control box cover.
- 3.2.5. **RECONNECT** the power.

IF THREE PHASE

- 3.2.6. Electrically **GROUND** the heat pump.
- 3.2.7. Connect the **GROUND** wire to the green pigtail lead.
- 3.2.8. **USE** copper wire to connect the electric line.
- 3.2.8.1. **CONNECT** the field supply wires L1, L2 and L3 to contactor terminals L1, L2 and L3.
- 3.2.8.2. Using a U.L. listed wiring nut, **CONNECT** the ground wire to the green pigtail lead.
- 3.2.8.3. **CONNECT** the low voltage circuit.
- 3.2.9. **REPLACE** the control box cover.
- 3.2.10. **RECONNECT** the power.



- 3.3. **RUN** a 240-volt electric line (breaker line) from the outside or inside breaker box to the inside furnace.
- 3.4. If the furnace is completely electric, use a no. 4 sized wire. If the furnace is gas and air, use a 12-2 sized wire (120 volts).

SPECIAL REQUIREMENTS

N/A

EQUIPMENT, TOOLS, GAGES, AND SUPPLIES

Item	Quantity Required
thermostat line, 27 or 28 volts	2
240-volt electric line	1
double 30 or 40 amp breaker box	as required
welder	1
15-15% hard silver solder	as required

Item	Quantity Required
wiring nut	as required
refrigerant lines	as required
electric line wire	as required

DRAFT 1

Hazards: <input checked="" type="checkbox"/> Low <input type="checkbox"/> Moderate <input type="checkbox"/> High Location: Outside Residence Procedure: Connecting a Residential High-Efficient Heat Pump	SOP No.: MJ-HEHP-01 Date: DRAFT Rev. No.: 0 Date: Chg. No.: 0 Date:
Operation: Charge the Heat Pump	Operation No: 4

INSTRUCTIONS

1. Charging the Heat Pump

- 1.1. **PRESSURIZE** the lines and indoor coil with dry nitrogen not to exceed 20 psi.
 - 1.1.1. **PRESSURE TEST** the system with dry nitrogen and soapy water to locate leaks.
ALTERNATE TO 1.1.1 – CHARGE the system to 10 psi using the appropriate refrigerant, and use nitrogen to finish charging the system to working pressure.
 - 1.1.2. **APPLY** a leak detector to suspect areas.
 - 1.1.3. If leaks are found, **REPAIR** them, and **REPEAT** the pressure test.
 - 1.1.4. If no leaks are found, **CONTINUE** to system evacuation.
- 1.2. **EVACUATE** the indoor coil and lines to a minimum of 500 microns to remove contamination and moisture, and then **DISCONNECT** the vacuum pump.
- 1.3. **OPEN** the suction and liquid service valves fully.
- 1.4. **PUT** about 1 lb. of freon into the suction line, and **OPEN** the suction and liquid service valves fully.
- 1.5. **START** the heat pump with the thermostat on the inside of the residence.



- 1.5.1. **USE** freon gages to check the Freon in the heat pump.

NOTE: On an R-22 unit, if the gage read about 65-70 on the suction side, the heat pump is charged. If it reads about 40-50, the refrigerant (Freon) is low. Freon will need to be added. On a 410A unit, if the gage reads about 125 on the suction side, the heat pump is charged. If it reads about 80-85, the freon is low and will need to be added.

NOTE: There is an old unit (10 series – carry R-22) and a new unit (carry 410A freon).



NOTE: The gage has a low side (suction side) and a high side (discharge side) also.

1.5.2. **SCREW** the low side of the freon gages to the suction side of the heat pump.



1.5.3. **SCREW** the high side of the Freon gages to the discharge side of the heat pump.

1.6. **OPEN** the appropriate freon tank and let the freon go in on the suction side.

NOTE: The discharge side of the gage should read about 300 or 350. If it reads around 400-450, something is wrong with the unit. Once the unit is charged, it is ready to release/produce heat or air.

SPECIAL REQUIREMENTS

N/A

EQUIPMENT, TOOLS, GAGES, AND SUPPLIES

Item	Quantity Required
R-22 or 410A refrigerant (Freon) tank	as required
freon tank gages	as required
dry nitrogen	as required
soapy water	as required

References

Residential Electrician, Jerry Jones

Whirlpool® and Whirlpool Gold® Heat Pump Installation Instructions: Models WHP43, WHP43, WHP44, WGHP43, WGHP44, WGHP46, WGHP48, and WPIO-259L

Whirlpool® Heat Pump Installation Instructions 46922G003 (July 2003)

DRAFT 1