

Air Source Heat Pumps Best Practices Installation Guide

Companion Guide to the Minnesota ASHP Collaborative's Design Guide

Introduction

High quality installation of air source heat pumps (ASHPs) improves system performance and efficiency, optimizing heating down to colder temperatures. This performance improvement can ensure customer satisfaction and comfort, which in turn reduces callbacks, generates referrals, and increases sales. This guide outlines the best practices for all ASHP installations, as well as guidance on homeowner education to help keep customers happy and ASHPs efficient in cold climates. For guidance on equipment selection, system sizing, and proper design, see our ASHP Design Guide, which provides information on

specific applications, like ductless ASHP displacing zonal electric heat.

Heat pumps should always be installed by licensed, trained professionals. Always follow the manufacturer's specification and installation instructions, as well as all applicable building codes and regulations. All installers should attend a manufacturer's training or preferred installer program.

This guide is a great complement to the manufacturer's guidance in that emphasizes quality installations, honing in on best practices for optimized performance.

Installation Requirements and Best Practices

Line Set

- Installers should follow the manufacturer's instructions for minimum and maximum line set length and height change.
- Line set must meet the manufacturer's specification for the indoor unit — adaptations to the outdoor portion can be made if necessary.
- Insulation must cover the entire line set length (i.e., both pipes) to avoid condensation and energy loss. Once insulated, the outdoor portion of the line set should be protected with a rigid cover to avoid insulation damage. Note: It is important to also insulate flare nuts to stop liquid or frost from developing under the flare nut, which can cause cracks.
- UV-resistant tape or other mechanical protection should be installed as needed to protect any remaining exposed insulation. UV-protected insulation products meet this requirement.
- Line set penetration through the building enclosure should be protected from rodents (e.g., with a PVC sleeve and cap drilled to the size of the refrigerant lines, metal-wool stuffing, or similar).
- All penetrations through the shell of the home should be sealed with insulating sealant/spray foam. Any aspects of the insulation disturbed by installed line set should be returned to proper condition.



Ensure that the insulation is thorough and covers the entire line set, as shown here.



Be sure to air seal all wall penetrations.

- Prevent partial kinks in line sets. Partial kinks can cause significant impact to heat pump reliability and performance in cold temperatures. Kinks typically occur in line sets that are greater than or equal to 7/8" in diameter. Follow these steps to check for partial kinks:

1. Remove line set covers.
2. Set the machine to its most powerful mode so it heats at full capacity.
3. Feel along the entire length of the line set for hot spots, which indicate where any partial kinks are located.

REQUIRED TOOLS: Ratchet flaring tool, programmable refrigerant charging scale, torque wrench, R401A gauge and hose set, vacuum pump (not pictured), flare gauge (not pictured)



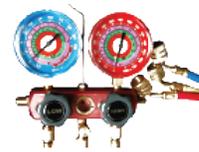
RATCHET
FLARING
TOOL



PROGRAMMABLE
REFRIGERANT
CHARGING SCALE



TORQUE
WRENCH



R410A
GAUGE AND
HOSE SET

Refrigerant Tubing

- Create new flare fittings using a ratchet flaring tool and measurement gauge appropriate to the refrigerant and in accordance with the manufacturer's instructions. Apply refrigerant oil to the end of each flare.
- Connect tubing with the appropriate nuts (supplied by manufacturer) and tighten to the manufacturer's torque specifications.
- Once used, **DO NOT REUSE** manufacturer-provided tubing flares and fittings. **DO NOT** use tubing and flare fittings that were not provided by the manufacturer.
- Any brazed connections should be completed with dry nitrogen to prevent oxidation.

Refrigerant Charge

- Pressure test the line set using dry nitrogen and triple vacuum pump evacuation per manufacturer's instructions.
- The vacuum should be held at 500 microns or less for a minimum of 15 minutes in each of the three vacuum cycles, and then valved off to check for pressure changes that indicate contamination or leaks. Each evacuation should be alternated with nitrogen under pressure.
- Test refrigerant lines only at pressures lower than the rating of service valves (typically 500–600 PSI, or per manufacturer's specifications).
- Refrigerant charge should be adjusted **ONLY IF NECESSARY** — many installations do not require adjustment from pre-charge levels with standard line set.
- Carefully follow the manufacturer's recommendations for adjusting refrigerant charge when using any nonstandard line set length. Consult the current manufacturer installation manual and/or software design tools to verify refrigerant protocols. Always follow proper procedures for weighing and recovering refrigerants. Always use a scale when adding or removing refrigerant.

Condensate Drain

- The drain should slope downhill. It can be routed with line set and run to a suitable termination point — away from crawl spaces, walkways, and outdoor equipment.
- Alternately, use an external condensate pump when required.
- Ductless systems may have limited horizontal or vertical lift built in. Do not exceed the manufacturer's specifications for allowable vertical lift before a continuous downward slope.

Outdoor Unit Installation

- Outdoor units should be placed to allow for free air flow. Follow manufacturer's guidance on clearance from obstructions, including walls, overhangs, protrusions, and other features. Ensure that outdoor units do not interfere with windows or doors.
 - Install outdoor units in a location protected from the wind if possible. Wind chill can affect heat pump performance, and facing into the wind can push freezing rain or snow into the system. If this cannot be avoided, install a wind baffle from the manufacturer to protect the system.
- The customer should always approve the location of outdoor units. The units should be located in inconspicuous places for aesthetic and noise considerations (e.g., behind the building).
 - Locate outdoor units away from bedrooms and other quiet spaces.
- Follow manufacturer-allowed clearances when placing multiple units. Multiple units should not be installed above each other or with outdoor fan outlet flow pointing directly at another unit (except when explicitly recommended by manufacturer).
- Ensure adequate clearance above historical average maximum snow depth, typically 14" in Minnesota. Secure outdoor units to a pad, risers, or the surface they sit on using a factory-approved stand and bolts or adhesive. Ensure that any ground-mounted unit is on soil that is well drained and will not heave with frost. The outdoor unit should be level both side-to-side and front-to-back. Best practice: use wall brackets designed for attachment to foundation wall, when ground clearance allows.
 - Installations can also use wall mounts or brackets designed for attachment to foundation wall. In these cases, use double-ended vibration absorbers to prevent both noise transfer through the wall and premature failure of the attachments.



Proper placement: on brackets, insulated tubing, rigid line cover, wind baffle.



Equipment stand: keeping the unit above the snow (to some degree).

- Avoid proximity to walkways or other areas where re-freezing defrost meltwater might cause a slip-and-fall hazard.
- When possible, avoid installing outdoor units directly under any drip line from the roof or other overhang that would subject them to falling snowmelt, ice, or concentrated rain runoff.

When this is unavoidable and a functioning gutter is not present, outdoor units should be installed with drip caps or shields approved by the manufacturer.

- Install surge suppressors at service disconnect to protect sensitive electronics. Alternatively, suppressors may be installed at circuit breaker box if device is approved for such application. Follow manufacturer's instructions and all applicable codes and standards.
- Drain pan heaters are strongly recommended for cold-climate ASHPs that operate below 32 degrees Fahrenheit. These are not generally needed for non-cold-climate systems in situations where meltwater clearance and protection from precipitation are adequate.



Proper outdoor placement, showcasing a drip cap/snow shield.

Homeowner Education

- Provide a copy of the manufacturer's owner manual to the homeowner
- Take the time to demonstrate basic controls and operations to homeowners. Review maintenance schedule and other activities with them.

Additional Resources

- U.S. Department of Energy Building America Solution Center (HVAC-Heating Equipment) — basc.pnnl.gov
- ENERGY STAR®-Verified HVAC Installation (ESVI) Program energystar.gov/index.cfm?c=hvac_install.hvac_install_index
- ACCA Standard 5 (ANSI/ACCA 5 QI-2015); HVAC Quality Installation Specification acca.org/standards/quality

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