

GUIDE TO INSTALLING AIR-SOURCE HEAT PUMPS IN COLD CLIMATES

A COMPANION TO NEEP'S GUIDE TO SIZING & SELECTING AIR-SOURCE HEAT PUMPS IN COLD CLIMATES



INTRODUCTION

High-quality installations of air-source heat pump (ASHP) systems generate referrals, increase sales, reduce callbacks and improve customer comfort and satisfaction. Installation practices also have a major impact on efficiency and performance of an ASHP system. Efficient ASHPs have seen significant sales growth in colder climates in recent years. This guide provides a list of minimum requirements and best practices, as well as homeowner education and system setup guidance, to help ensure efficient air-source heat pumps and happy customers in cold climates.

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

INSTALLATION REQUIREMENTS AND BEST PRACTICES

Line set

- **Installers shall follow manufacturer's instructions** for minimum and maximum line set length and height change.
- **Insulation must cover entire line set length** (both pipes) to avoid condensation and energy loss. Once insulated, the outdoor portion of line set shall be protected with a rigid cover to avoid insulation damage.
- **UV-resistant tape or other mechanical protection shall be installed as needed** to ensure that any remaining exposed insulation is protected. UV-protected insulation products meet this requirement.
- **Line set penetration through the building enclosure shall be made rodent-proof** (e.g. with 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 shall be sealed with insulating sealant/spray foam;** any insulation disturbed by installed line set shall be returned to original (or better) condition.

Refrigerant Tubing

- **Create new flare fittings** (where used), using flaring tool and measurement gauge appropriate to the applicable refrigerant and in accordance with manufacturer's instructions. Apply refrigerant oil to the end of each flare. Connect tubing with appropriate nuts (supplied by manufacturer) and tighten to manufacturer's torque specifications.
- Once used, **DO NOT REUSE** manufacturer provided tubing flares and fittings.
- Any brazed connections shall be completed with dry nitrogen to prevent oxidization.
- **Best Practice:** Don't use flare fittings at all except where necessary. Make tubing connections using gasketed press/crimp designed for the refrigerant and tubing type (e.g., Sporlan Zoom Lock®, Vulkan LokRing®). Always carefully follow manufacturer's instructions for preparation and installation. Use factory-supplied flare adapters where necessary to connect to equipment, and avoid field-fabricated tubing flares entirely.

ASHPs come in a number of configurations, and in some cases the following guidance may be specific to one or more of those system types. There are many variations and terms used, but these guidelines will focus on the following broad categories: "ductless ASHP" refers to any non-ducted cassette type indoor unit (including wall-mount air handlers, floor mounted consoles, in-ceiling cassettes, etc.); "compact-ducted ASHP" refers to remote air handlers that are typically designed for compact, concealed-ceiling or short-duct configurations; and "centrally ducted ASHP" refers to whole-house systems with central air handlers. The icons shown here are used below to indicate when guidance is specific to a certain system type. All items without icons are generally applicable to all ASHP configurations.

Applies to:



Ductless ASHP



Compact-ducted ASHP



Centrally ducted ASHP

Refrigerant Charge

- **Line set shall be pressure tested using dry nitrogen and triple-evacuated with vacuum pump per manufacturer's instructions.** Vacuum shall be held at 500 microns or less for a minimum of 15 minutes in each of the three vacuum cycles, and valved off to check for pressure changes increasing that indicate contamination or leaks. Each evacuation shall be alternated with nitrogen under pressure. Pressure test refrigerant lines only at pressures lower than the pressure rating of service valves (typically 300-350 PSI), or per manufacturer's specifications).
- Refrigerant charge shall be adjusted **ONLY IF NECESSARY**, because many installations do not require adjustment from pre-charge levels with standard line set. Always consult manufacturer's instructions.
- **Carefully follow manufacturer's recommendations for adjusting refrigerant charge when using any non-standard line set length.** Consult manufacturer's current installation manual and/or software design tools to verify refrigerant protocols. Proper procedures for weighing and recovering refrigerants shall always be followed. Always use a scale when adding/removing refrigerant and document changes on equipment tag.

Condensate Drain

- **Drain shall slope downhill.** Drain can be routed with line set and run to a suitable termination point, away from crawl spaces, walkways and outdoor equipment. Use an external condensate pump when required.
- **Some units have limited vertical lift built in;** do not exceed manufacturer's specifications for the vertical lift allowed before a continuous downward slope.



Outdoor Unit Installation

- **Unit shall 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 unit does not interfere with view through, or operation of, windows or doors.
- **Location of outdoor unit(s) shall always be approved by the customer.** Outdoor units should be located in inconspicuous places – e.g. at the rear of the building – for aesthetic and noise considerations.
- **The outdoor unit shall be level, both side-to-side and front-to-back.**
- **Do not place units at less than manufacturer allowed clearances for multiple units.** Multiple units shall not be placed 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.** When wall-mount is not possible, secure outdoor units to a pad, risers and/or the surface on which they are set using a factory-approved stand and bolts or adhesive. Risers shall be tall enough to avoid anticipated snow. Ensure that any ground mounted unit is on soil that is well drained and will not heave with frost. Best Practice: Preferred installation is to use wall brackets designed for attachment to foundation wall, where ground clearance allows.
- **Avoid proximity to walkways or other areas** where re-freezing defrost meltwater might cause a slip-and-fall hazard.

RECOMMENDED TOOLS:



Ratchet
Flaring Tool



Torque
Wrench



Programmable
Refrigerant
Charging Scale



Vacuum
Pump

*Photo credit: NEEP (Northeast Energy Efficiency Partnerships)

- **When possible, avoid installing outdoor unit(s) 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 shall be installed with drip caps or shields approved by the manufacturer.
- **Best Practice:** 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 device manufacturer’s instructions and all applicable codes and standards.
- **Best Practice:** Drain pan heaters are not generally needed in situations where meltwater clearance and protection from precipitation are adequate. If drip cap and ground clearance are provided, pan heaters may be of limited value except in extreme (e.g. marine) environments and may be disabled or avoided.

Placement of Indoor Unit

- **Indoor wall mounted units shall be installed with adequate clearance from the ceiling.** Always maintain the minimum top clearance for ductless units as required by manufacturer’s instructions; whenever possible, units shall be installed with additional clearance (6” minimum from ceiling) for ceiling heights up to 8 feet from the floor. In rooms with higher or vaulted ceilings, units shall be installed whenever possible so that the air discharge is no higher than 8 feet from the floor.



- **Best Practice:** As space allows, install floor-mounted unit(s) or compact-ducted systems with floor registers, especially in larger living areas and lower levels of 2-story homes.



Ducting

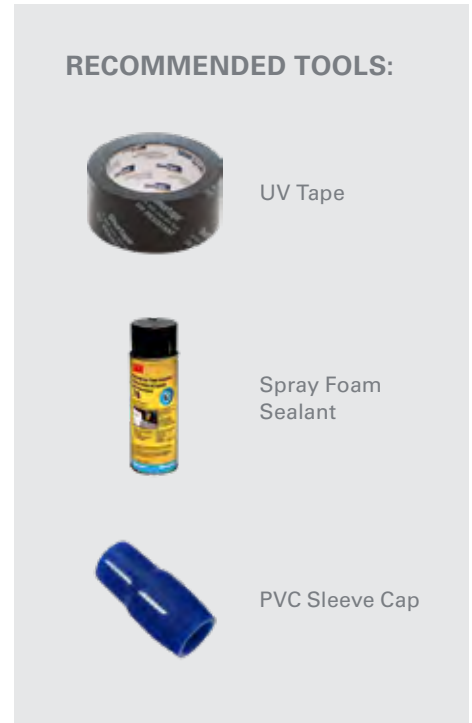
- **Design ducts to minimize friction losses.** Pay close attention to available static pressure, especially with compact-ducted air handlers (many of which have much lower available static pressure than typical air handlers). Refer to ACCA Manual D for duct design guidance.



- **Avoid ducts in unconditioned spaces when possible.** If ducts and/or air handlers in unconditioned space can’t be avoided, all joints and seams in duct shall be thoroughly sealed with duct mastic and all components shall be insulated to a minimum of R-8.



- **When installing central ASHP systems using existing ducts, always ensure that ductwork is adequately sized** for the heat pump air flow requirements and available static pressure.



*Photo credit: NEEP (Northeast Energy Efficiency Partnerships)

SYSTEM SETUP


Thermostat – Installer Setup

- **In larger spaces (> 300 sq ft), a fixed, wall-mounted control shall be installed in a location that will be representative of the space the unit is serving.** Set up the controls so that the temperature is sensed at the control, rather than in the air handler. Return-air temperature sensing controlled by a handheld remote (standard for most ductless units) is acceptable for smaller rooms or isolated zones that have no significant thermal/comfort problems.
- **Use standard guidance for thermostat placement** (interior wall, away from direct sunlight, appliances, or drafts).
- **Temperature sensing may need adjustment, especially for wall-mounted indoor units.** Adjust sensing offset settings for 2-4 degrees (“more heating” and “less cooling”) for high-wall installations and other situations where air distribution to the space may be compromised (this may require further adjustment based on occupant feedback or actual room temperatures).
- **For systems that include heat pumps plus a central HVAC system, use an integrated multi-stage control when that is available.** If not, advise on customer use of two thermostats. Temperature settings can be adjusted to reduce backup heat and emphasize heat pump operation as desired (see under “Homeowner Education”).
Best Practice: With or without the use of an integrated control, consider installing an outdoor cutout control on the central system thermostat so that the central heat is locked out when the temperature is above the cutout temperature. (Set the cutout between 20 and 35F, and adjust as needed for occupant comfort).



Control Settings – Installer Controls

Check installer settings as needed. They should include the following, as applicable:

- 1) Retain installer settings during power outage.
- 2) Use “efficient home” settings when available to improve cycling behavior in low load situations.
- 3) Some compact-ducted air handlers require adjustment for static pressure on duct systems.

- 4) When available, installer settings shall be set to avoid continuous fan operation, even at low speeds.

Homeowner Education

- A copy of the manufacturer’s Owners Manual shall be provided to homeowner, and basic controls and operation shall be demonstrated.
- Provide a copy of Getting the [Most Out of Your Heat Pump¹](https://neep.org/sites/default/files/ettingTheMostFromYourHeatPumpConsumerGuideFINAL.pdf), or equivalent.

ADDITIONAL RESOURCES

- U.S. DOE Building America Solution Center (HVAC-Heating Equipment) – <http://basc.pnnl.gov/>
- ENERGY STAR Verified HVAC Installation (ESVI) Program – https://www.energystar.gov/index.cfm?c=hvac_install.hvac_install_index
- ACCA Standard 5 (ANSI/ACCA 5 QI-2015); HVAC Quality Installation Specification – <http://www.acca.org/standards/quality>
- NEEP’s Assessment Report – Air-Source Heat Pump (ASHP) Installation Practices in cold-climates (publication forthcoming)

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¹ <https://neep.org/sites/default/files/ettingTheMostFromYourHeatPumpConsumerGuideFINAL.pdf>