



# **Snohomish County PUD #1**

## **HEAT PUMP SYSTEM**

### **INSTALLATION STANDARDS**

**May 1, 2017**

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# SNOHOMISH COUNTY PUD #1 HEAT PUMP SYSTEM INSTALLATION STANDARDS

## A. INTRODUCTION

The purpose of this standard is to assist contractors in designing and installing heat pump systems that will (a) reduce energy use, (b) provide adequate comfort, and (c) insure satisfactory equipment operation.

## B. DEFINITIONS

**1. Shall** - Where “shall”, “shall not”, or “must” is used for a provision in this standard, the provision is mandatory. Any deviation from the intent of the provision must be approved by the District.

**2. Should** - Where “should” or “recommended” is used for a provision in this standard, this indicates that the provision is not mandatory, but is definitely desirable as good practice.

## C. CUSTOMER ELIGIBILITY

**1. Single Family Residence** - To qualify for a Heat Pump Rebate, a District customer must have a single family residence which is defined as single family detached, manufactured home, and multi-family buildings with four (4) attached units or less, up to three (3) stories in height. Multi-family residences and condominiums in buildings with more than four (4) attached units and greater than three (3) stories in height do not qualify for the rebate.

**2. Existing Heating System** - The existing heating system for the residence in which the heat pump system is to be installed must have a permanently installed electric heating system that serves as the primary heating source for the residence.

**3. Contractor List** - Customers having a heat pump system installed through the District’s Program shall select a contractor from the District’s Registered Heat Pump Contractor List.

**4. Permits** - The customer and/or the contractor shall be responsible for all permits required by State and local ordinances for the installation of the heat pump system.

## D. CONTRACTOR REQUIREMENTS

**1. District Approval** - The contractor shall be on the District’s Registered Heat Pump Contractor List.

**2. Heat Pump System Information** – The contractor shall provide an AHRI certificate matching the equipment installed, PUD Sizing Calculator, PUD Heat Pump Start-Up Sheet, and paid invoice to the District, for each installation. (Ductless heat pumps do not require a PUD Sizing Calculator or Start-Up Sheet *unless* the system is designed to heat the whole home. )

**3. Training** - The contractor shall be responsible for the technical competence and qualifications of his sales people, installers, and service mechanics. These personnel should participate in at least one manufacturer's training session on heat pump application, installation, or service on an annual basis.

**4. Guarantees/Warranty** - The heat pump contractor shall guarantee to the purchaser the following:

a) The heat pump system will be designed to provide for adequate and dependable comfort conditions according to generally accepted industry standards for heating at the stated design temperatures and loads.

b) Assurance of readily available and adequate service, service facilities, and replacement components and parts.

c) For a minimum of a two-year period, running concurrently with the heat pump manufacturer's product warranty, the contractor shall provide, without charge, replacement parts and service. Warranty is considered to be in effect as of the date the system passes final District inspection.

d) The manufacturer's warranty shall be maintained during the entire period of any warranty coverage.

e) Extended Warranty - The contractor shall offer to all consumers the manufacturers third through fifth year extended warranty or service agreement.

f) Consumer Instruction - The contractor shall instruct the consumer in proper operation and maintenance of the heat pump system. The contractor shall provide the consumer with the manufacturer's owner's manual for the equipment installed, demonstrate filter cleaning or replacement and demonstrate the operation of all indoor thermostat controls, indicator lights, and maintenance. Contractor shall also explain the different operating modes of the heat pump system (e.g., heating, emergency heat, defrost) and the effects of obstructing registers and return air grilles.

g) 24 Hour Service - Contractor shall provide 24 hour emergency service and phone number.

## **E. EQUIPMENT REQUIREMENTS**

**1. Ratings** - Heat pump equipment shall meet the performance, safety, and rating requirements as given in the latest revision of Air-Conditioning, Heating and Refrigeration Institute (AHRI). All equipment shall be listed and certified by AHRI and display the AHRI symbol of certification. All equipment shall also be listed by Underwriter's Laboratories and shall display UL approval.

**2. Performance** - Heat pumps installed under the District's Heat Pump Program shall meet the following minimum HSPF and SEER requirements:

- a) Ducted HSPF 9 and SEER 14
- b) Ducted inverter HSPF 10 and SEER 14
- c) Ductless HSPF 9 and SEER 14

**3. Starting Requirements** – All ducted heat pump systems shall have a “start assist type” start. These are also known as “soft start” or capacitor relay start”, or be inverter driven.

**4. Locked Rotor Amps (LRA)** – Shall not exceed 127 LRA systems up to 4 tons and 140 LRA for systems over 4 tons. **IF THE LRA OF THE PROPOSED EQUIPMENT EXCEEDS THESE LEVELS CALL FOR APPROVAL.**

## **F. EQUIPMENT SELECTION**

- 1. Balance Point** – The heat pump system shall be sized using a balance point of 30°F or less, at AHRI rating conditions. When back-up heat is not being installed the balance point shall be not greater than the local design temperature. The acceptable ranges per system compressor type are as follows:
- a) 25-30 degrees for single stage
  - b) 20-30 degrees for two stage
  - c) Inverter system can be sized for 100% of the heating load.

**If the balance point of the proposed equipment exceeds these ranges call for approval.**

**2. Heat Loss Calculations** –Design temperatures to be used are 20°F outside temperature and 70°F inside temperature for a temperature difference of 50°F. In cases where planned weatherization measures have not yet been completed, heat loss calculations should be made on the basis of those measures being completed. The contractor will review the potential comfort and system implications of not doing the planned weatherization improvements.

**3. Supplemental Heater Sizing** – For ducted systems: Supplemental electric heaters shall be installed with sufficient capacity so that combined operation of the heat pump compressor and supplemental heaters will meet the design heat load. The total kw capacity of all strip heat shall be sized according to the btu/hr heat loss as follows:; up to 34,000 = 10kw, 34,000 to 42,000 = 12.5kw, 42,000 to 51,000 = 15kw, 51,000 to 59,000 =17.5kw, 59,000 to 68,000 = 20kw. All strip heat over 10kw should be staged whenever possible.

## **G. EQUIPMENT INSTALLATION**

**1. Accessibility** - Equipment shall be located for easy service access for the removal of any unit component without removal of any piping, ductwork, or other permanently installed fixtures or components. Special care should be taken in locating components which require frequent attention, such as filters.

## 2. Outdoor Units

- a) Shall be located to avoid restrictions of the outdoor air stream and to meet manufacturer's clearance recommendations
- b) Shall be level and placed on a permanent structural pad that:
  - i. Is isolated from the building structure.
  - ii. Provides adequate drainage.
- c) Shall not be placed within 6 feet of a dryer exhaust vent.

**3. Refrigerant Piping** - The distance between the two sections of split units shall not exceed the manufacturer's maximum recommended length, horizontally or vertically and shall be designed to insure adequate oil return. When accessible, the refrigerant piping should be replaced when replacing an existing R22 unit with a new R410a unit.

## 4. Ductless Heat Pumps –

- a) An indoor unit shall be installed in the main living area and the main living area shall have permanently installed electric heat prior to installation.
- b) Shall be sized to a balance point temperature equal to or less than the local design temperature, when back-up heat is not installed.
- c) Duct sealing and insulation is not required, when the unit is replacing an existing electric furnace, as the primary heat source.

## H. DUCT DESIGN

**1. Design Practices** - New ductwork shall be designed in accordance with recommended practices in any of the following manuals.

SSACNA: “HVAC Duct System Design”

ACCA: Manual G, “Selection of Distribution System”  
Manual E, “Room Air Distribution Consideration”  
Manual D, “Residential Duct Design and Equipment Selection”

ASHRAE: Handbooks

**2. Static Pressure Limitations** - Supply ducts should be designed for a static pressure loss of .08 inches of water per 100 feet of equivalent length. Return ducts should be designed for a static pressure loss of .05 inches of water per 100 feet of equivalent length.

**3. Minimum Air Flow** - The air distribution system design and installation shall be such that the air flow across the indoor coil is as specified by the heat pump manufacturer, or is between 350 and 425 cubic feet per minute (CFM) per 12,000 BTU/hr output at AHRI rating conditions if the manufacturer's literature is not specific.

## **I. DUCT INSTALLATION**

**1. Installation Practices** - Sheet metal ducts shall be installed in a workman-like manner in accordance with recommended practice given in SMACNA “low pressure Duct Construction Standards”. Insulated “Flex-Duct” shall not be used for supply air runs nor for return air runs over 30 lineal feet.

**2. Balancing Dampers** - Balancing dampers shall be installed as necessary at branch takeoffs, in boots at the end of branch ducts, and in main plenums to balance air flows in the system. All new supply ducts shall have balancing dampers installed. The whole-house system shall be balanced to assure acceptable air flow at each supply register and to meet the heat loss of each room. All balancing dampers shall be installed so as to be accessible for adjustment. Any other means of balancing the system must be approved by the District prior to its use.

**3. Minimum Clearances** - In the case where there is less than 18 inch clearance from the bottom of the floor joists to the ground, the contractor shall contact the District to determine if there will be sufficient clearance in the crawl space subsequent to ductwork installation. It is imperative that access to the entire crawl space be maintained for inspection, as well as for future access by the homeowner.

## **J. AIR FILTERS**

Air filters shall be installed in the return air system in a location that will be easily accessible to the user for filter servicing and in a position where all return air will pass through the filters before crossing the indoor coil. Filter types and sizes shall be according to the manufacturer’s instructions and recommendations. Electronic or 4 inch media/HEPA air cleaners are required. **Alternative applications shall be approved by the District.**

## **K. NOISE AND VIBRATION ABATEMENT**

**1. Indoor Unit** - Suitable means shall be provided to prevent transmission of objectionable noise or vibration generated by the indoor unit in accordance with the manufacturer’s instructions and recommendations. Flexible connectors should be installed at the indoor unit in both the supply and return duct systems. Sound absorbing liner shall be installed in both the supply and return plenums and should be installed inside sheet metal duct, supply and return, within at least 5 feet of the indoor air handler. Where sound absorbing liner is installed, it shall be permanently attached to the duct sheet metal with mechanical fasteners, in accordance with SMACNA’S “Duct Liner Application standard, 2nd Edition”. Attaching duct liner with adhesive only is not acceptable. Sound lining (including exposed edges) exposed to air circulation shall be sealed with spray tacking or other similar methods to insure fiber particles are prevented from circulating within the system or residence.

**2. Outdoor Unit** - Outdoor units shall be located to avoid transmission of objectionable noise to adjacent properties, sleeping areas, or other areas where noise control is critical. The outdoor unit shall be located so that the estimated DBA (refer to ARI Standard 270) at the property line does not exceed the Washington State Noise Ordinance Standards, nor any



applicable local noise standards. Units should be placed no closer than 5 feet of the property line.

## **L. REFRIGERANT PIPING**

**1. Field Installed Piping** - Field installed piping shall be refrigerant grade, seamless copper tubing. Fittings shall be wrought copper. Flared fittings are to be used when installing ductless heat pumps.

**2. Sizing** - To maintain oil return to the compressor and avoid efficiency and capacity loss, refrigeration piping shall be sized and installed in accordance with manufacturer's instructions and recommendations. Oil traps shall be utilized when applicable.

**3. Penetrations** - Refrigerant piping passing through openings in the unit cabinet or the building structure shall be installed so as to prevent wear or sound generation due to contact with the cabinet or building structure. Any openings in the building structure created for passage of refrigerant piping shall be sealed, inside and outside after the refrigerant piping has been installed.

**4. Support** - Refrigerant piping shall be supported properly to prevent excessive sagging, movement, or vibration. Supports should limit lateral movement, but permit normal thermal expansion and contraction. Isolation type hangers, or equivalent, should be used every ten feet to support refrigerant lines from floor joists and other parts of the structure.

**5. Leak Testing, Evacuation, and Charging** - Leak testing should be performed on the completed refrigeration system. Factory as well as field installed joints should be checked. A halide torch, electronic leak detector or high pressure nitrogen pressure test at 400 PSI should be used. Evacuations and charging shall be done according to the manufacturer's recommended procedures. Nitrogen should be used to clear lines prior to charging.

**6. Insulation** - All refrigerant vapor lines shall be completely insulated with a minimum of 3/8 inch thick continuous foam rubber insulation. Thicker wall insulation is recommended where vapor lines pass through unconditioned spaces, (i.e., crawlspace, unheated basement, and garage). Refrigerant vapor lines running exterior to the residence shall be insulated with a minimum 1/2 inch thick continuous closed cell foam rubber.

**7. Pipe Protection** - Any exposed refrigerant pipe insulation shall be protected by either line hide material or U.V. tape to protect the insulation.

## **M. CONDENSATE PIPING**

**1. Manufacturer's Recommendations** - Condensate drain piping shall be installed in accordance with manufacturer's instructions and recommendations. Piping should be the size of the equipment drain connection, but not less than 3/4 inch nominal pipe size. Pipe shall be copper, plastic, or other corrosion resistant material.

**2. Drains** - Condensate drain lines shall be trapped and run to a floor drain or outside the building foundation. Condensate shall not be drained into crawlspaces. Condensate drain lines shall not be connected to the residences plumbing drain lines. Any alternative condensate drain methods must be approved by the District.

**3. Condensate Trap** - A condensate trap that is adequate to contain sufficient water to block airflow back into the indoor unit shall be installed.

**4. Condensate Removal System** - Condensate drain lines shall be pitched in the direction of flow to prevent backup or overflow of water in the drain pan and to allow for gravity flow for drainage. If the indoor unit is lower than the drain location, a condensate pump shall be installed. Condensate drain lines shall be fastened and secure to prevent damage to drain lines.

**5. Piping Penetrations** - Any openings in the building structure created for passage of condensate piping shall be sealed, inside and outside, after the refrigerant piping has been installed.

#### **N. SUPPLEMENTAL ELECTRIC HEATERS – For ducted systems only**

**1. Sizing** - The combined capacity of the supplemental heaters shall not exceed 125% of designed heat load.

**2. Stages** - The supplemental heater shall be installed with the manufacturer's maximum available number of stages. Heater elements shall be energized in increments of no greater than 10 kw. In no case for normal heat pump operation shall the supplemental heaters be wired so that they will be energized in violation of manufacturer's specifications.

**3. Auxiliary Heat Control** - Auxiliary heat shall be controlled by an outdoor temperature sensor so it does not engage when the outdoor air temperature is above 35° F.

**4. Return Air Preheat** - Supplemental electric, woodstoves, or any other type of heating device should not be used to preheat the return air of an operating heat pump. If preheating return air is desired, a sensing device shall be installed to lock out the heat pump if the return air temperature exceeds manufacturer's specifications.

#### **O. EQUIPMENT MIXING**

The addition of refrigerant coils to an existing electric furnace assembly shall not be approved unless:

**1.** The specific combination of refrigerant coil and electric furnace has been investigated and approved by UL.

**2.** The capacity of the electric heat elements doesn't exceed the design heat load for the structure.

3. The electric heat elements can be staged in increments of 10 kw or less.
4. The removal of electric heat elements to meet the design heat load supplemental heat capacity requirements does not violate the UL listing.
5. Electric furnace is “Heat Pump Ready”.
6. Blower sizing meets minimum CFM requirements.

**P. INDOOR THERMOSTATS**

**1. Installation and Location** - Indoor thermostats shall be installed according to the manufacturer’s instructions and recommendations. If the present thermostat location is inadequate due to drafts, heat source, etc., the new thermostat should be installed in a more suitable location.

**2. Automatic Setback Thermostats** - If an automatic setback thermostat is to be installed, it shall (a) have the capability of limiting the use of supplemental heat during the warm-up period; (b) allow the user to set multiple setback periods; and c) have a manual changeover feature or a heating/cooling lockout to prevent cross-cycling between heating and cooling.

**3. Emergency Heat Relay** - The indoor thermostat shall include a manual switch to permit all supplemental heaters to be energized under control of the indoor thermostat. An indicator light shall be provided which is energized whenever the emergency heat is on.

**Q. COMPLIANCE WITH APPLICABLE CODES AND MANUFACTURER’S REQUIREMENTS** - Installation shall comply with all applicable codes and manufacturer’s specifications, including, but not limited to, those for sizing, airflow, protective devices, field wiring, equipment placement, air filter access, condensate lines and pumps, refrigerant piping, refrigerant charge, and condensate management.

**R. PRESCRIPTIVE DUCT SEALING** - This specification outlines the requirements for prescriptively repairing and sealing new or existing ductwork in existing single family homes and existing manufactured homes, heated with an electric forced air furnace or a heat pump.

1. Ducts in Unconditioned Space:
  - a) For new duct systems, the entire duct system is considered to be accessible.
  - b) Ducts in basements are considered to be in conditioned space; while vented crawlspaces, attics with floor insulation, and unheated garages are considered unconditioned.
  - c) The inner liner on manufactured home crossover ducts is considered accessible; while all other flexible duct connections, including those on single family homes, which have properly secured exterior liners, may be considered to have interior liners that are not accessible.
  - d) The belly of manufactured homes is considered accessible if a visual inspection via non-intrusive methods (mirrors, digital cameras etc.) identifies large holes/leaks.
  - e) All exposed ductwork shall be considered accessible.

- f) The furnace to plenum connection is considered accessible.
2. Previously Sealed Ducts: Cannot be treated through the Program, unless a PUD pre-inspection confirms that additional duct sealing is required.
3. Duct Repair
- a) All accessible portions of the duct system shall be repaired and mechanically fastened, where needed.
  - b) Inferior sections of duct—such as rusted, crushed, disconnected or sections otherwise ineffective—shall be repaired or replaced before duct sealing is performed.
  - c) When there are large gaps in sheet metal or duct connections, repairs shall be made using sheet metal, sheet metal screws, and/or mastic with mesh-reinforcing tape. Gaps greater than 1/4 inch shall be reinforced using mesh-reinforcing tape before applying mastic.
  - d) All metal ducts shall be secured using at least three sheet metal screws at each connection and an attempt be made to have them be equally distributed around the ducts.
  - e) All flexible ducts shall be joined to a section of rigid duct of matching diameter, including locations where two separate sections of flex duct meet. Both the inner and outer lining shall be tightly fastened using a compression strap tightened with a tool designed for that purpose. Tape may remain as long as a compression strap is installed to maintain a permanent connection.
  - f) In manufactured homes with two or more sections, defective or missing cross-over ducts shall be replaced.
4. Duct Support
- a) All accessible portions of the duct system which require support shall be supported.
  - b) To minimize the possibility of disconnection, flexible ducts shall be supported every 4 feet and within 3 feet of each connection to a rigid duct with straps that are not less than 1 1/2 inches wide each and that do not restrict airflow.
  - c) Ducts shall be supported above the ground. When contact with the ground is unavoidable, a minimum of R-4 closed-cell rigid insulation shall be placed between the duct and the ground. This duct shall not come in contact with standing water.
5. Duct Sealing and Acceptable Materials
- a) All accessible portions of the duct which require sealing shall be sealed with approved materials. The following are areas that shall be sealed: Plenum; Air-handler cabinet to plenum; Plenum-to-take-off connections; Longitudinal seams, Finger/dovetail joints; Branch T's, Y's and L's; Supply and Return Boots; Duct-to-duct connections; Gores on Adjustable Elbows; and End Caps.
  - b) Loose tape shall be removed from rigid metal ducts prior to sealing. Secured tape that remains must be completely covered with mastic which shall extend at least 1/2 inch beyond the tape edge on either side and be at least 1/8 inch thick.
  - c) Non-flex duct joints, connections and seams shall be sealed with UL-181 listed mastic.
  - d) The application of mastic shall be done according to manufacturer specifications.

- e) Take offs and crimped fitted joints shall be mechanically secured with screws and sealed with mastic.
- f) On the air handler, only foil or mastic HVAC tape labeled as meeting UL-181 standards may be used.
- g) Cloth-backed duct tape shall not be used to seal, secure, or fasten ducts.
- h) Boots shall be mechanically fastened to the subfloor and properly sealed with UL-181 mastic or UL-181 sealant.
- i) Flexible duct connections shall have the interior and exterior liners secured and air-sealed with nylon straps (Panduit or equivalent) and tightened with a manufacturer-approved tensioning tool. Steel band clamps with worm drive tension adjusters are also acceptable.
- j) The return shall be sealed if it is easily accessible and in unconditioned space
- k) End caps must be made of either sheet metal or a UL-181 approved rigid product.

**S. DUCT INSULATION** - Any existing insulation shall be removed and upon completion, all accessible supply and return ductwork, both existing and new, running through unconditioned spaces, shall have a final R-value not less than R-8 (bubble wrap material is not allowed). (Existing vinyl covered and bubble wrap insulated ducting in good condition with all seams taped are the only exceptions and do not need to be removed). Ducts subject to routine human contact (e.g., in garages, basements, attics used for storage) shall have a covering which provides physical protection to the insulation and has a flame spread of 25 or less when tested in accordance with the most current ASTM requirements.

**T. COMBUSTION APPLIANCE REQUIREMENTS** - Whenever there is a Combustion Appliance present in the house, garage, or other attached space, a UL listed, C-UL listed, or equivalent carbon monoxide detector shall be installed.