Snohomish County PUD #1

HEAT PUMP SYSTEM

INSTALLATION STANDARDS

January 2026

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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) ensure 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 desirable as good practice.

C. CUSTOMER ELIGIBILITY

1. Single Family Residence - These requirements apply to existing single-family residences which is defined as single family detached, manufactured homes, townhouses, and condominiums with four (4) attached dwellings or less, up to three (3) stories in height. Townhouses and condominiums in buildings with more than four (4) attached dwellings do not qualify. Individual condominiums that do not vertically overlap with other dwellings are exempt from the number of attached dwellings requirement.

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** – For each installation, the contractor shall provide a completed Heating Rebate Application customer invoice showing the instant rebate has been provided to the customer, and any other supporting documentation listed in the workbook.

3. **Training** - The contractor should be responsible for the technical competence and qualifications of his sales staff, 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 the purchaser the following:

a) The heat pump system will be designed to provide adequate and dependable comfort conditions according to 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. The warranty will be in effect as of the date the system successfully meets program requirements and passes any inspections.

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. The 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.

a) **Performance** - Heat pumps installed under the District's Heat Pump Program shall meet the following minimum efficiency requirements:
b) Ducted HSPF2 7.5 and SEER2 13.8
c) Ducted inverter HSPF2 8.5 and SEER2 13.8
d) **Starting Requirements** – All ducted heat pump systems should have a "start assist type" start. These are also known as "soft start" or capacitor relay start," or be inverter driven.

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

F. EQUIPMENT SIZING

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

2. **Heat Loss Calculations** –Installation contractor shall use the Heat Pump Sizing Calculator in the Heating Rebate Application. In cases where planned weatherization measures have not yet been completed, the contractor will review the potential comfort and system implications of not making 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 should 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. Care should be taken in locating components which require frequent attention, such as filters.

2. **Outdoor Units**

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

3. **Refrigerant Piping** - The distance between the two sections of split units should not exceed the manufacturer's maximum recommended length, horizontally or vertically, and shall be designed to ensure adequate oil return. When accessible, the refrigerant piping should be replaced when replacing an existing R22 unit with a new R410a unit or new R454B unit.

   Flush kits should only be used when the refrigerant piping cannot be replaced.

   a) The condensate should be routed to the exterior of the building, see spec M. CONDENSATE PIPING

H. DUCT DESIGN

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

   SMACNA: "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** - The total duct system static pressure should not exceed .8 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 between 350 and 450 cubic feet per minute (CFM) per 12,000 BTU/hr. output at AHRI rating conditions or specified by the heat pump manufacturer.

I. DUCT INSTALLATION

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

2. **Balancing Dampers** - Balancing dampers should 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 should have balancing dampers installed. The whole-house system should be balanced to ensure acceptable air flow at each supply register and to meet the heat loss of each room. All balancing dampers should be installed 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 should contact the District to determine if there will be sufficient clearance in the crawl space after 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 filter(s) 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 should be installed, or 2" (MERV-9) pleated in conjunction with filter grill(s) or 1" electronic air cleaners are acceptable in space constrained installations.

K. NOISE AND VIBRATION ABATEMENT

1. **Indoor Unit** - Suitable means should 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. A sound absorbing liner should 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 should 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 should be sealed with spray tacking or other similar methods to ensure fiber particles are prevented from circulating within the system or residence.

2. **Outdoor Unit** - Outdoor units should be located to avoid transmission of objectionable noise to adjacent properties, sleeping areas, or other areas where noise control is critical. The outdoor unit should 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 off the property line.

L. REFRIGERANT PIPING

1. **Field Installed Piping** - Field installed piping should be refrigerant grade, seamless copper tubing. Fittings should be wrought copper.

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

3. **Penetrations** - Refrigerant piping passing through openings in the unit cabinet or the building structure should be installed 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 should be sealed, inside and outside after the refrigerant piping has been installed.

4. **Support** - Refrigerant piping should be supported properly to prevent excessive sagging, movement, or vibration. Support 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 should 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 should 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 should be insulated with a minimum 1/2-inch-thick continuous closed cell foam rubber.

7. **Pipe Protection** - Any exposed refrigerant pipe insulation should 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 should be installed in accordance with manufacturer's instructions and recommendations. Piping should be the size of the equipment drain connection, but not less than ¾ inch nominal pipe size. Pipe should be copper, plastic, or other corrosion resistant material.

2. Drains - Condensate drain lines should be trapped and run to a floor drain or outside the building foundation, should not be drained into crawlspaces, connected to the residences plumbing drain lines, and terminate with either a 90 or 45 deg fitting and not exceeding 4 inches above grade

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

4. Condensate Removal System - Condensate drain lines should 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 should be installed. Condensate drain lines should 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 should be sealed, inside and outside, after the refrigerant piping has been installed.

6. Condensate Pump Termination – Condensate pump hose terminations should be run to the outside of the home and terminated with in 4in above grade and cannot be terminated in any manner that allows condensate to run down the exterior of the home. If the condensate hose is terminated to the washer drain or equivalent, it must be secured to prevent removal.

7. Condensate Pans – Condensate pans are required to be installed under all air handlers installed in horizontal applications including attics and crawl spaces. Condensate pan drains should be run to the exterior in accordance with condensate drain requirements.

N. SUPPLEMENTAL ELECTRIC HEATERS

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

2. **Stages** - The supplemental heater should be installed with the manufacturer's maximum available number of stages. Heater elements should be energized in increments of no greater than 10 kW in no case for normal heat pump operation should 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 30° or 35° F.

O. EQUIPMENT MIXING

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

a. The specific combination of refrigerant coil and electric furnace has been approved by UL.

b. Has an AHRI listing

c. The capacity of the electric heat elements does not exceed the design heat load for the structure.

d. The electric heat elements can be staged in increments of 10 kw or less.

e. The removal of electric heat elements to meet the design heat load supplemental heat capacity requirements does not violate the UL listing.

f. The electric furnace is "Heat Pump Ready."

g. Minimum program HSPF, SEER, HSPF2, SEER2 and CFM requirements can be achieved.

P. INDOOR THERMOSTATS –

SHALL:

1. 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. Have the capability of limiting the use of auxiliary heat during the warm-up period using site installed temperature sensor.

3. Allow the user to set multiple setback periods.

4. Have a heating/cooling lockout to prevent cross-cycling between heating and cooling.

5. Be compatible with variable speed fans and inverter driven compressors.

6. Provide an indicator light which is energized whenever the emergency heat is on.

Q. COMPLIANCE WITH APPLICABLE CODES & MANUFACTURER'S REBATES

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 accessible.
   - **b)** Ducts in basements are considered 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 if 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 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; 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), and supported with twine. Twine must be non-stretching polypropylene or polyester (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, and 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.