



Snohomish County PUD #1

# **GEOHERMAL HEAT PUMP INSTALLATION STANDARDS**

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# **SNOHOMISH COUNTY PUD #1**

## **GEOHERMAL HEAT PUMP INSTALLATION STANDARDS**

### **A. INTRODUCTION**

The purpose of this standard is to assist contractors and/or District customers in designing and installing heat pump systems that will (a) reduce energy use, (b) provide adequate air conditioning 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. Residential Energy Audit** - To qualify for a Heat Pump Loan or Incentive, a District customer must have a District residential energy audit performed on the residence in which the heat pump system is to be installed.

**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. Weatherization** - We recommend that customers complete, or be in the process of completing, all weatherization measures recommended by the energy audit performed on the residence. Any exceptions to this practice must be approved by the District.

**4. Contractor List** - Customers (excluding “Do It Yourselfers”) having a heat pump system installed through the District’s Loan Program or Incentive Program shall select a contractor from the District’s Registered Heat Pump Installers List.

**5. 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 receive written authorization from the District prior to installing heat pumps under the District's Loan Program or Incentive Program and shall be on the District's Registered Installers List.

**2. Heat Pump System Information** - In addition to the information required on the Heat Pump Bid Proposal (see attached bid information sheet), equipment performance bins and a EWT (Entering Water Temperature) – loop length with design EWT information shall be supplied to the District, for each job, by the contractor.

**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 geothermal heat pump application, installation, or service on an annual basis. The District recommends the contractor have IGSPA certified installers and service mechanics.

**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. This offer shall be made prior to the date of work completion.

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 owners manual for the equipment installed, demonstrate filter cleaning or replacement and demonstrate the operation of all indoor thermostat controls and indicator lights. Contractor should explain the different operating modes of the heat pump system (e.g., heating, emergency heat) 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 and Refrigerating Institute (ARI) Standard 330. All Equipment shall be listed and certified by ARI and display the ARI symbol of certification. All equipment shall also be listed by Underwriter's Laboratories and shall display UL approval.
- 2. Performance** - All heat pumps installed under the District's Loan Program or Incentive Program shall meet the minimum Washington State Energy Code requirements. Approved heat pumps shall have a minimum C.O.P. of 3.2 and a minimum EER of 12.
- 3. Starting Requirements** – All heat pump systems shall have a “start assist type” start. These are also known as “soft start” or “capacitor relay start”.

## **F. EQUIPMENT SELECTION**

- 1. Balance Point** - The heat pump should be sized for a balance point of 25°F. The acceptable range of balance point lies between 22°F and 27°F. The District must approve any deviation beyond this range.
- 2. Heat Loss Calculations – The District will provide the customer with the heat loss to be used when sizing a system.** Design temperatures to be used are 20°F outside temperature and 70°F inside temperature for a temperature difference of 50°F. The use of a lower outside design temperature for a particular customer's residence must be approved by the District. In cases where the recommended weatherization measures have not yet been completed, heat loss calculations shall be made on the basis of those measures being completed.
- 3. Supplemental Heater Sizing** - 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 not exceed 100% of design heat load.
- 4. Domestic Water Heating** – It is recommended to install a new hot water tank whenever the equipment that is installed, has the ability to preheat the domestic water. All heat pump systems having a separate dedicated domestic hot water (dhw) preheat capabilities shall have a primary dhw tank of no less than an 80 gallon capacity.

## **G. EQUIPMENT INSTALLATION**

- 1. Accessibility** - Special care should be taken in the placement of the geothermal unit. Each panel with a serviceable component behind it should be removable and have adequate room for easy service access. Check the layout configuration for: 1) Air discharge, 2) Filter removal, 3) Supply and domestic water connections, 4) Placement of flow and/or loop pump center, 5) Component replacement accessibility.

## 2. Ground Loop Systems -

- a. Ground loops shall be one of the following: horizontal, vertical, pond or lake and open loops. The type of loop installed will depend on specific needs, soil conditions, available land area etc.
- b. The loop material shall be polyethylene pipe, PE345534C, PE355434C, or PE345434C when tested under ASTM 3350 as the minimum cell classification number acceptable for polyethylene pipe. Closed loop systems pipe, and fittings shall be connected by butt or socket fusion, or stab fittings. Barbed fittings shall not be used.
- c. Antifreeze shall be added to all horizontal systems to prevent freezing. Antifreezes should be biodegradable and present no hazard to the environment. Up to a 20 percent solution is usually adequate.

## 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. Maximum supply static pressure loss shall be .10 inches. Return ducts should be designed for a static pressure loss of .05 inches of water per 100 feet of equivalent length. Maximum return static pressure loss shall not exceed .06 inches. The total duct system static pressure loss shall not exceed the external static pressure capacity of the indoor fan.

**3. Duct Velocities** - Velocities for the applicable range of duct sizes should be as follows:

	Size Sufficient For	Recommended (FPM)	Maximum (FPM)
Main Supply Duct	1-1/2 Tons	800	900
	5 Tons	1100	1200
Branch Duct/Risers	6 Inches	500	600
	8 Inches	600	700
Main Return Duct	1-1/2 Tons	700	800
	5 Tons	950	1100
All Registers/Diffusers/Grills		500	600



**4. Minimum Air Flow** - The air distribution system design and installation shall be such that the air flow across the indoor coil will be at least that specified by the heat pump manufacturer. Optimum air distribution for the equipment should be provided whenever it is feasible to do so.

**5. Blower Requirements** - Heat pump blower sizing should be adequate to meet an optimum of 450 CFM/Ton. A minimum of 400 CFM/Ton or manufacturers recommendations is acceptable.

## **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”. Fibrous glass ductwork may be installed in lieu of sheetmetal ductwork and in accordance with recommended practices given in SMACNA “Fibrous Glass 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. Turning Vanes** - Turning Vanes should be used at any “T’s” present in the supply air duct network. Turning Vanes shall be used at the last turn in the return air system next to the coil.

**4. Insulation** - All accessible supply and return ductwork, both existing and new, running through unconditioned spaces shall be stripped of all insulation, sealed with mastic only and re-insulated. Upon completion the final R-value shall not be less than a nominal R-8. (Vinyl covered and bubble wrap insulated ducting are the only exceptions and do not need to be stripped) Ducts shall be insulated in accordance with Snohomish County Weatherization and Heat Pump Specification.

**5. Existing Ductwork** - The contractors, where existing ductwork is to be utilized, shall be responsible for inspecting such ductwork and shall correct any defects found, (i.e., untaped duct joints, disconnected ducts, ducts sagging due to lack of supports). In unconditioned spaces, air handler connections, plenums, and any ductwork connected to plenums shall be secured and sealed prior to insulating. Prior to installation of duct insulation, all duct supports shall be repaired and all joints secured with sheet metal screws and sealed with mastic.

**6. 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. SPECIFICATIONS FOR REPAIR AND SEALING OF AIR DISTRIBUTION SYSTEMS**

### **1. Sealant Application Guidelines:**

- a. Surface shall be clean before applying sealant.
- b. Joint reinforcing tape must be applied in a manner in which the mesh must be visible through the tape upon completion.
- c. Water based mastic must be applied between 40°F and 110°F.
- d. Mastic shall not be applied when the air handler is running.
- e. Fiberglass mesh embedded in mastic shall be used if gap is greater than 1/8 inch or if the connection cannot be secured with screws.

### **2. Sealing Boot and Registers:**

- a. Gaps between the boot or return registers and the duct shall only be sealed using a UL listed metal tape.
- b. Non-butyl, metal tape is not allowed for sealing boots and registers.
- c. If needed, the outer termination of each boot shall be secured to the adjoining floor, wall, or ceiling with screws, nails, or staples.
- d. When boot terminations are sealed to adjoining surface, caulk, mastic or butyl tape should be used.

### **3. Sealing and Connecting the Air Handler Cabinet:**

- a. The air handler and cabinet (other than removable panel) shall be sealed at all seams, gaps, and penetrations.
- b. The air handler or cabinet filter access shall be gasketed with a reusable metal cover.

### **4. Sealing Building Cavities:**

- a. Building cavities used to transport conditioned air, including chaseways and stud cavities, shall be sealed to the extent practical, using fiberglass mesh embedded in mastic or other suitable material.

- b. Ductboard, sheetmetal, or other approved material shall be used to block off and to isolate chases as needed to reduce leakage.
- c. Fiberglass tape and mastic, mechanical fasteners, or foam sealant shall be used to connect and seal blocking material.

#### **5. Sealing and Connection Rigid Metal Ducts and Ductboard:**

- a. All accessible ductboard and metal ductwork, both inside and outside the conditioned space, shall be sealed to provide permanent, airtight connections using a duct sealing mastic or fiberglass mesh embedded in mastic.
- b. All of the following locations shall be sealed, to the extent determined to be necessary by the District.
  - (1) Connections to the handler fan cabinet and plenums.
  - (2) Ductwork-to-ductwork connections.
  - (3) When determined to be necessary by the District, seams, including lateral seams, elbows and joints from the factory, and field joints.
- c. All metal parts of the duct system shall be mechanically fastened to adjacent parts using screws. Round ducts shall use a minimum of 3 screws and rectangular ducts shall use a minimum of 4 screws.
- d. Longitudinal seams with gaps greater than 1/8 inch shall be reconnected with screws before sealing.

#### **6. Sealing and Connecting Flex Ducts:**

- a. All accessible flex duct connections, both inside and outside the conditioned space shall be sealed to provide permanent, airtight connections. Connections may be sealed using approved mastic or approved tapes and clamps.
- b. Connections between *plastic lined ducts* and transitions, plenums, metal ducts, or other flex ducts shall follow the ADC Flexible Duct Performance and Installation Standards.
  - (1.) Splices between two plastic lined ducts shall use 20 gauge sleeves that are at least 4 inches long.
  - (2.) The inner liner shall be sealed to the duct fitting collar or metal sleeves using mastic, and secured with compression straps.
  - (3.) The insulation shall completely cover the liner and duct fitting collar or sleeve.

- (4.) The outer vapor barrier shall be sealed with metal type or compression strap.
- c. Connections between ***metal lined ducts*** and transitions, plenums, metal ducts, or other flex ducts shall follow the AFC Flexible Duct Performance and Installation Standard for pressures of .4 WG and over.
  - (1.) The duct core shall be secured to the fitting or other duct using not less than three (3) screws.
  - (2.) All core connections shall be sealed with mastic and mesh.
  - (3.) The insulation shall cover the core completely.
  - (4.) The outer vapor barrier shall be sealed with compression straps.

## **7. New Duct Installation:**

Where new duct installation is required.

- a. Flex duct installation shall comply with all applicable sections of the ADC Flexible Duct Performance and Installation Standards.
- b. Duct board shall be assembled following manufacturer's recommendations for tape application.
- c. Building cavities shall not be used to transport conditioned air to and from the air handler. Ductwork must be continuous from the airhandler to the register or grille.
- d. Each part of the duct system shall be mechanically attached to adjacent parts.

## **8. Supporting New and Existing Ducts:**

- a. Ducts shall not rest on the ground.
- b. Rigid ducts shall be supported in a stable manner.
- c. Flex ducts shall be fully stretched avoiding unnecessary bends.
- d. Horizontally run flex duct shall be supported at least every 4 feet, or per manufacturer's specifications, so as to prevent sag and/or compression of the duct.
- e. Vertically run flex duct shall be supported at least every 6 feet, or per manufacturer's specifications.
- f. Hangers or supports shall be at least 1/2 inch in width, and shall not compress the duct when installed.

## **9. Insulation:**

Newly installed flex ducts shall have a minimum labeled insulation value of R-8.

## **10. Filters:**

Replaceable air filters shall be inspected and replaced if necessary.

## **11. Depressurization of Combustion Appliance Zones:**

Pressure differences between combustion appliance zones and outside shall be tested under worst case conditions.

## **K. 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 air cleaners and bag type filters are preferred.

## **L. NOISE AND VIBRATION ABATEMENT**

**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.

## **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  $\frac{3}{4}$  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 crawl-spaces. 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 penetration holes that have been cut between the heating envelope and outside shall be sealed both inside and out.

## **N. SUPPLEMENTAL ELECTRIC HEATERS**

**1. Sizing** - The combined capacity of the supplemental heaters shall not exceed the design heat load of the structure.

**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's. 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. 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. 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 have; (a) the capability of limiting the use of supplemental heat during the warm-up period, as per District specifications, and; (b) allow the user to set multiple setback periods.

**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.

**P. CODE REQUIREMENTS**

**1. Air Distribution System** - The air distribution system shall comply with local codes and ordinances, manufacturer's recommendations, and the provisions of the latest revision of NFPA Standard for Installation of Residence Warm Air Heating and Air Conditioning (National Fire Protection Association Standard 501 B), as it applies.

**2. Refrigeration** - All field-erected refrigerant piping shall comply with the requirements of the latest revision of American National Standard Safety Code for Mechanical Refrigeration (American National Standards Institute Standard B 9.1).

**3. Electrical Wiring** - All electrical wiring shall comply with the manufacturer's recommendations, the National Electric Code, and all local codes and ordinances (see UL 55, 557, National Electrical Code). Separate adequately protected branch circuits shall be provided for each outdoor unit, indoor unit, and supplemental electric heater assembly.