Residential Ground Source Heat Pump System Installation Standards[1]

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[1] These standards have been revised from those orginally developed by the Umatilla Electric Cooperative.

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1.0 INTRODUCTION

1.1 "Should and Shall" will be interpreted as follows:

A Where shall or shall not is used for a provision, that provision is mandatory if compliance with the standard is claimed.

B Where should is used it will indicate provisions which are not mandatory but which are desirable as good practice.

2.0 NEW EQUIPMENT REQUIREMENTS

2.1 Heat Exchanger

Systems shall use either a closed-loop ground heat exchanger or a closed-loop pond/lake heat exchanger. Open-loop systems and direct exchange systems are not allowed.

2.2 Ground Source Heat Pumps:

A Equipment shall be manufactured by a company appearing in the ARI Unitary Directory.

B Ratings: Systems shall have the following:
- i AHRI/ISO label;
- ii U.L or ETL-US label; and
- iii Energy Star label.

C Performance
- i Systems shall be Energy Star rated.
- ii The primary air-handler fan for water-to-air systems shall use an electrically commutated permanent magnet motor.

D Heat pump units shall be shipped factory pre-charged with refrigerant.

2.3 Loop Circulation Pump

A Pumps shall be rated by UL or ETL-US.

B Performance
- i Total installed pump power shall be no greater than 165 Watts per nominal ton of installed heat pump capacity.
- ii Pumps shall be sized to provide 3 gallons per minute per nominal ton of installed heat pump capacity.
- iii Pumps shall be cast iron or bronze in construction.
- iv Pumps shall be approved for use with the fluid used in the system.
- v Flow centers shall have filling and air purge ports.

2.4 Ground Loop Heat Exchanger Piping

A Ratings

i HDPE and PEX piping shall be rated and designed for use with ground source heat pump systems per IGSHPA's latest "Closed-Loop/Geothermal Heat Pump Systems: Design and Installation Standards".

B Materials and Application
- i HDPE shall be heat fused: either socket weld, electrofusion, or butt welded
- ii PEX shall use non-metallic connection methods.

2.5 Desuperheater Coil shall:
- A be approved for use with the GSHP unit by the manufacturer of the GSHP unit;
- B have a vented double wall heat exchanger; and
- C be constructed of copper, cupro-nickel, or stainless steel.

2.6 Desuperheater Circulation Pump shall:
- A be rated by UL or ETL-US;
- B be bronze in construction; and
- C be rated for potable water.

2.7 Desuperheat Preheat Buffer Tank (no elements connected)
- A Approved Manufacturer
  - i IAPMO/NSF/GAMA rated electric tank manufacturer
- B Minimum Efficiency Rating
  - i GAMA EF rating 0.93
- C Materials and Application
  - i Glass Lined Steel tank, 50 gal min size

3.0 PARTICIPATING INSTALLER REQUIREMENTS

3.1 Training

Participating Installer shall be responsible for the technical competence and qualifications of all salespeople, installers, and service mechanics. These personnel should participate in at least one manufacturer's training session on ground source heat pump application, installation, or service or receive equivalent training. All the Participating Installer's installers shall be IGSHPA certified and Factory Certified Fusion Technician.

At least one System Installer or Technician on each HVAC Contractor job shall be certified in Air Conditioning Contractors of America (ACCA) Manual D. System Designers shall be certified in ACCA Manual D and Manual J.

Alternately, duct design, heat pump sizing, and installations may be certified by the utility if the utility has staff that is certified in ACCA's Manual D and Manual J.

3.2 Certification

Each heat pump system installed shall be certified as a "PTCS Commissioned Heat Pump." This requires testing and documentation of auxiliary heat controls (Section 4.4), airflow across indoor coil (Section 6.3), loop sizing (section 4.2) and Horizontal Loop Installation (Section 5.4).

Heat pump commissioning PTCS certification shall be submitted to the utility. The utility shall maintain record of certifications and make the records available to BPA, the RTF, or the RTF approved PTCS Service Provider upon request.

3.3 New System Warranty

All system components, including the ground loop, shall be warranted for a period of no less than 5 years.

3.4 Consumer Instruction

Participating Installer shall instruct the consumer in proper operation and maintenance of the heat pump system. Participating Installer shall provide the consumer with the manufacturer's owner's manual, demonstrate filter replacement (or cleaning), and demonstrate the operation of all indoor thermostat controls and indicator lights to the consumer

4.0 NEW EQUIPMENT SELECTION

4.1 Heating and Cooling Calculations

A Heating loss and cooling gain calculations shall be made using 70°F indoor design temperature for heating and 75°F for cooling.

B The recommended ASHRAE 97.5% winter design temperature and 1% cooling design temperature for the nearest weather station representative of the installation shall be used.

C The recommended method and form for calculations is available in the Air Conditioning Contractors of America (ACCA) Manual J. Alternate computer or manual methods of calculating heating and cooling loads may be used if approved in advance by the utility.

D Component U-values and F-values used in the heat loss and heat gain coefficients shall reflect the actual construction of the building and be generally consistent with those found in ACCA Manual J 7th Edition, or later.

E A copy of the whole house heating and cooling load calculations shall be submitted to the utility. The utility shall hold the calculations on file and make them available to BPA, the RTF, or the RTF approved PTCS Service Provider upon request**.**

F An infiltration rate of 0.5 or 0.8 air changes per hour shall be used for houses built in or after 1980 or before 1980, respectively, in sizing calculations unless a house (de)pressurization test has been performed and an estimate is made using the result.

G Where available, the results of duct pressurization testing shall be used to estimate the duct system efficiency used in sizing calculations. If a duct pressurization test has not been performed on the house, a default duct system loss of 25 percent shall be used for non-PTCS certified systems or 15% for PTCS certified systems. Exception: If the air handler and all ductwork are within the thermal envelope of the house, 0 percent shall be used as the duct system loss in sizing calculations. Hydronic distribution systems shall assume a distribution system efficiency of 15%.

4.2 Horizontal Ground Loop Sizing:

Horizontal Ground loops shall be designed and sized for 30 degree minimum Entering Water Temp (EWT).

4.3 Vertical Ground Loop Sizing:

Vertical Ground loops shall be designed and sized for 30 degree minimum Entering Water Temp (EWT).

4.4 Pond/Lake Loop Sizing:

Pond/Lake loops shall be designed and sized for 30 degree minimum Entering Water Temp (EWT).

4.5 Heat Pump Unit Sizing

Rounding up or down to the nearest 6,000 Btu/hr (½ ton) capacity at ARI rating conditions, heat pumps shall be sized using a maximum 25°F Balance Point. Heat pumps shall be sized to meet the house load at a 25°F or lower outside air temperature and at 30°F entering water temperature (EWT).

4.6 Auxiliary Heat Sizing

Installed auxiliary heat capacity shall not exceed 125 percent of the heating design load.

4.7 Control of Auxiliary Heat

Systems shall employ control strategies that minimize the unnecessary use of auxiliary heat. Auxiliary heat shall not operate during a first stage heating call (unless system is switched to emergency heat). Auxiliary heat shall be controlled in such a manner that it does not engage when the outdoor air temperature is above 30°F, except when emergency heating is required during a refrigeration cycle failure. Method of controlling auxiliary heat shall be documented by the certified heat pump Technician and submitted to the RTF-approved PTCS Service Provider.

5.0 NEW EQUIPMENT INSTALLATION

5.1 Access

Equipment shall be located to allow easy service access and adequate working space for servicing any component without removal of piping, duct work, or other permanently installed fixtures. Special care shall be taken in locating components which require frequent attention, such as filters.

5.2 Location and Support of Indoor Units

Indoor units shall be located to permit smooth duct transitions and shall be adequately supported or placed in a suitable platform in accordance with manufacturer's instructions and recommendations.

5.3 Outdoor Horizontal Loop Installation

A Loops shall be installed at a minimum 5' depth Below Grade in accordance with Section 4.2 and be designed in an IGSHPA approved configuration.
B All header piping shall be configured in reverse return and stepped down in size to maintain a purging velocity of 2 feet per second in all parts of the piping
C Loops shall be flushed using a properly sized flush cart per IGSHPA
D If native soils have sharp rocks that could puncture or damage piping, backfill with screened soil or sand.
E Any direct potable water connections shall be protected by approved backflow prevention devices.

5.4 Outdoor Vertical Loop Installation

A All vertical/angled ground drilling operations and procedures shall conform to Federal, State, and Local regulations with respect to the protection of ground water.
B Borehole placement shall be within 1 foot of design specifications.
C A detailed drilling log shall be produced for each borehole.
D All vertical/angled boreholes shall be grouted.
E The borehole grout shall be installed by pressure tremmie grout method from the bottom of the borehole to the top in one continuous operation.
F At a minimum, 20% solids bentonite grout shall be used to backfill and seal each borehole.

5.5 Outdoor Pond/Lake Loop Installation

A The heat exchanger shall be installed beneath at least 8 feet of water. This minimum shall be maintained throughout the year.
B Installations shall be in accordance with the manufacturer's recommendations.

6.0 DUCT WORK

6.1 Design Requirements

This section applies to all new duct work, including the addition of duct systems to existing housing or significant alterations to existing duct systems.

A Flex Duct

Flex duct shall not be used for main supply trunks in crawl spaces or areas that could be subject to physical damage from normal occupant activities, weather or animals. When flex duct is used for main trunks or run outs the size shall be determined by using the "Wire Helix Flexible Duct" scale on an ACCA Duct Sizing Slide Rule, or equivalent and all other requirements in Section 6.0 of these specifications shall be met. Flex duct shall be supported in a manner that does not create restrictions in air flow and located to minimize bending.

B Building Cavities and Ducts

In newly installed ductwork, building cavities shall not be used as ducts to convey return or supply air.

C Static Losses

Supply and return ducts shall be designed on the basis of not more than 0.10 and 0.08 inches loss per 100 feet, respectively or a calculated friction rate using ACCA Manual D.

Supply and Return Ducts shall be designed so that the total external static pressure does not exceed the available static pressure provided by the air handler at design CFM.

D Maximum Velocities

New duct work shall be designed so air velocities do not exceed the following:

Supply Ducts

Main Ducts	900 FPM
Branch Ducts	600 FPM
Supply Outlet Face Velocity	700 FPM
Return Grills Face Velocity	500 FPM
Filter Grille Face Velocity	300 FPM

Velocity shall not create unacceptable noise levels and return air shall be sufficient size to meet requirements of installed systems.

E Duct Connections

All new and all readily accessible existing duct joints, plenum drives, metal joints to include all slips and drives shall be mechanically fastened with screws. Flexible ducts shall be attached using nylon/plastic straps tightened with a manufacturer approved tool (hand tightening is not acceptable) or stainless steel worm drive clamps. Mastic and/or tape shall not be used as mechanical fasteners.

F Zonal Pressure Relief

In new system construction, sufficient return pathways shall be provided between axial zones (e.g. bedrooms) and the main body of the dwelling. Return pathways include return ducts, pass-through grilles, pressure-relief ducts, or similar devices.

6.2 Duct Installation

A Support

i Ducts shall be properly supported before ducts are sealed and insulated. All new and all accessible existing duct joints and metal joints shall be mechanically fastened with screws. Flexible ducts shall be attached using nylon/plastic straps and tightened with a tool manufactured specifically for tightening nylon/plastic straps around HVAC duct. (hand tightening is not acceptable). Stainless steel worm drive clamps are also allowed. Mastic and/or tape shall not be used as mechanical fasteners.

B Duct Sealing

i All new and all accessible existing HVAC supply and return ducts, air handlers, and plenums outside the conditioned space shall be sealed at all joints and corners, including prefabricated joints, with duct mastic meeting UL 181 standards. It is unnecessary to seal longitudinal seams unless they are damaged. Tape is not allowed except for use on operable doors in the system such as on the air handler. In this case, cleaning the joint at an operable door with a suitable solvent and sealing with a UL-181BMX listed tape may be used.

ii All duct insulation should be installed and supported using mechanical fasteners such as permanent plastic straps or nylon twine. Tape may be used on insulation seams to provide a continuous barrier.

C Insulation

i All newly installed rigid ducts and plenums and accessible uninsulated existing rigid ductwork outside the heated space shall be insulated to a minimum R-11. A vapor barrier meeting a flame spread rating of 25 or less and smoke developed rating of 50 or less (in accordance with ASTM E-84) shall be installed on the outside surface of the insulation.

ii All newly installed flexible HVAC ducts outside the heated space shall have an Air Diffusion Council (ADC) certified minimum R-value of R-8.

iii All newly installed HVAC ducts routed within exterior wall cavities shall be insulated to a minimum installed value of R-8 between the duct and the exterior wall sheathing.

iv All duct insulation shall be installed and supported using mechanical fasteners such as permanent plastic straps or nylon twine. Tape is not a mechanical fastener. Approved tape may be used at insulation seams to provide a continuous barrier.

6.3 System Air Flow

A All existing ductwork shall be inspected by the HVAC Contractor for conditions which will affect the efficiency or proper operation of the new heat pump system. It is the Participating Installer's responsibility to ensure existing ductwork is compatible with the equipment that is installed.

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

C After installation and start-up, total airflow in the heat pump mode (in cubic feet per minute, or CFM) across the heat pump coil shall be measured using a TrueFlow plate or using duct pressurization fan matching method per plate. This shall be reported to the RTF approved PTCS Service Provider using the "PTCS Heat Pump Startup Form".

D The total external static pressure acting on the system air handler shall be tested with approved instruments and recorded at time of startup and submitted to the RTF approved PTCS Service Provider using the "PTCS Heat Pump Startup Form" or RTF approved equivalent form.

7.0 FILTERS

7.1 Location

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 and outside air will pass through the filters before crossing the indoor coil.

7.2 Type and Size

Filter types and sizes shall meet the manufacturer's instructions and recommendations. Filters and/or air cleaners that are not an integral part of the equipment and not selected by the manufacturer shall be accepted if the total CFM is within the range as specified by 6.3.B. Any filter that exceeds 0.22 inches pressure drop at 500 feet per minute as installed shall not be allowed.

8.0 CONDENSATE PIPING

8.1 Piping Material

Condensate drain piping shall meet IMC and shall be copper, plastic, or other corrosion-resistant material.

8.2 Drains

Condensate drain lines shall be trapped and run to an open drain or outside of the building foundation. Condensate shall not be drained into a crawl space or direct connected into a sewer line.

8.3 Condensate Pump

Condensate drain lines shall be pitched in the direction of flow to prevent backup of overflow of water in the drain pan. If the indoor unit is lower than the floor drain or dry well, a condensate pump shall be installed to pump condensate to the level of the drain or dry well. A check valve shall be installed if pump is not equipped with one.

9.0 HYDRONIC SYSTEM

9.1 Allowed Installations

Hydronic delivery systems are only allowed in newly poured concrete slabs designed for 100 degree Fahrenheit design water delivery temperatures.

9.2 Slab Floor Insulation Requirements

Slab floors used as part of a heating system shall have R-15 4' perimeter and R-10 under the rest of the slab.

10.0 ELECTRICAL

All field wiring, line and low-voltage, shall comply with the manufacturer's recommendations, the National Electrical Code, and all local codes and ordinances.

11.0 INDOOR THERMOSTATS

11.1 Installation

Indoor thermostats shall be located and installed according to the manufacturer's instructions and recommendations.

11.2 Auxiliary Heat Indicator

Thermostat shall provide a visible indication when the auxiliary stage or emergency heat is operating.

11.3 Heating and Cooling

Thermostats used for both heating and cooling shall have a manual changeover feature or heating/cooling lockout to prevent cross-cycling between heating and cooling.

12.0 DOCUMENTATION

12.1 Pictures – Horizontal Loops

The following pictures shall be submitted to the utility for closed loop horizontal loops:

A Pictures of the installed horizontal loop prior to backfill to show the depth of the trench, the length of the trench, and the pipe configuration.
B Pictures of the backfill process.

12.2 Pictures – Pond/Lake Loops

The following pictures shall be submitted to the utility for pond/lake loops:

A Pictures of the assembled loop prior to sinking into pond/lake to show the amount of pipe and the pipe configuration.

12.3 Pictures – Vertical Loops

The following pictures shall be submitted to the utility for vertical loops:

A Pictures of an assembled u-bend prior to installing into bore.

12.4 Loop Documentation – Horizontal Loops

Installer shall submit to the utility, documentation of the following, as installed:

A Feet of Pipe,
B Depth of Pipe,

C Spacing between trenches,
D Spacing between pipes,
E Accurate sketch of as-built trench layout, and
F Documentation of loop design for 30 degree (or higher) entering water temperature.

12.5 Loop Documentation – Pond/Lake Loops

Installer shall submit to the utility, documentation of the following, as installed:

A Feet of Pipe or Heat Exchanger Description,
B Depth of Pipe/Heat Exchanger within Pond/Lake,
C Size of pond/lake in acres,
D Accurate sketch of the as-built heat exchanger(s) and supply and return piping layout, and
E Documentation of loop design for 30 degree (or higher) entering water temperature.

12.6 Loop Documentation – Vertical Loops

Installer shall submit to the utility, documentation of the following, as installed:

A Depth of Bores,
B Number of Bores,
C Accurate sketch of the borehole locations and supply and return piping layout, and
D Documentation of loop design for 30 degree (or higher) entering water temperature.

12.7 Heat Pump System Documentation

Installer shall submit to the utility, documentation of the following:

A House heat loss rate in Btu/hr/degF, including documentation of input assumptions.
B Heating Pump System make and model number, including heating capacity at the Balance Point determined in section 4.5.
C Balance Point Worksheet or other documentation of determination of the balance point.