ENERGY STAR® Homes Northwest

GEOTHERMAL HEAT PUMP
DESIGN AND INSTALLATION STANDARDS

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ENERGY STAR Homes Northwest

Geothermal Heat Pump Design and Installation Standards

1.0 CLOSED LOOP GROUND HEAT EXCHANGERS

1.1 Installation Personnel and Training Required.

1.1.1
The loop contractor shall have a certified installer (technician) trained by IGSHPA or an IGSHPA certified manufacturer's training program.

1.1.2
Ground heat exchanger fabricators shall have completed a heat fusion school in which each participant has performed a heat fusion procedure under direct supervision of an IGSHPA Association Certified Heat Fusion Technician or DOT certified heat fusion technician.

1.1.3
Certified technicians shall attend a retraining school annually. A single failure of a fusion joint will void the certification, and the technician shall be retested to demonstrate satisfactory performance.

1.1.4
Local and State laws and ordinances as they pertain to buried pipe systems shall be strictly followed, or the necessary variance obtained from the proper jurisdiction.

1.2 System Sizing

1.2.1
The recommended method and form for heating and cooling load calculations is available in the Air Conditioning Contractors of America (ACCA) Manual J. This or an equivalent method shall be performed using Component U-values and F-values in the heat loss and heat gain coefficients that reflect the actual construction of the building. Heating loss calculations shall be made using 70°F indoor design temperature. The recommended ASHRAE winter design temperature and cooling design temperature for the nearest weather station representative of the installation shall be used. Heat pump system shall be sized to meet or exceed the heating design load of the house. Installed auxiliary heating shall not exceed 150% of the heating design load. All supplemental heaters greater than 5 kW shall be staged. Sizing documentation shall be provided to the ENERGY STAR Homes Northwest Verifier.

1.3 Thermostats

1.3.1
An electronic thermostat shall be installed to control the heating and cooling system. 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.

1.3.2
Heat Pump Thermostat Capability: Heat pump thermostats shall have the capability of supporting a lock out to limit supplemental heater use. The thermostat shall have a minimum of two stage heating control.

1.3.4 Thermostat Staging: Resistance electric heat shall not be energized under the first heating stage of the indoor thermostat. Thermostat indicator lights shall provide a visible indication when the auxiliary stage or emergency heat is operating.

1.3.5 Emergency Heat Relay: All indoor thermostats shall include a manual selector switch to permit all supplemental heaters to be energized under control of the indoor thermostat (with the bypassed) when the compressor or refrigerant system is inoperative.

1.4. Design Methods and Compliance

1.4.1 The manufacturer of GSHP equipment shall provide design standards for minimum ground heat exchanger lengths.

1.4.2 The manufacturer's design procedure shall follow a recognized methodology such as presented in:

1.4.2.1 Closed-Loop/Ground-Source Heat Pump Systems: Installation Guide, GSHPA Publication, Oklahoma State University.

1.4.2.2 Data Design Manual for Closed-Loop/Ground-Source Heat Pump Systems, ASHRAE.

1.4.3 The ground heat exchanger design shall be clearly documented as complying with manufacturer's standards.

1.5 Equipment Installation

1.5.1 All equipment shall be located and installed according to manufacturer specifications and guidelines, all applicable codes and standards, and accepted industry practices.

1.6. Ground Heat Exchanger Materials

1.6.1 Acceptable pipe materials for the underground buried portion of the ground heat exchanger are polyethylene and polybutylene.

1.6.2 The pipe and fittings of the buried system shall be warranted by the manufacturer for ground source heat pump service.

1.6.3 Sufficient information shall be permanently marked on the length of the pipe that allows the pipe to be properly identified.

1.6.4 Specification of Polyethylene pipe will be by cell classification number. The specification for PE pipe shall be as follows:

"Polyethylene pipe furnished under this specification shall be manufactured in accordance with dimensional specifications of ASTM D-2513 or ASTM F-714, as appropriate, using a resin having a cell classification of ######Z as defined by ASTM D-3350. This resin shall exhibit not more than 20% failures (F20%) when tested for 192 or more hours under ASTM D-1693, Condition C.

1.6.5 The minimum cell classification number acceptable for polyethylene pipe is PE3455434C or PE355434C when tested under ASTM D-3350.

1.6.6 The specification for PB pipe shall be as follows:

Polybutylene pipe furnished under this specification shall be manufactured in accordance with ASTM Standard ASTM D-2581. The material shall be:

1.6.6.1 Either Class B (general purpose and dielectric, in colors) or Class C (weather resistant, black in color containing not less than 2% carbon black).

1.6.6.2. Type II (density, 0.91 to 0.92 g/cm).

1.6.6.3 Grade 1. (Low rate 0.25 to 0.75 g/10 min).

For fusible pipe, dimensional standards are given by ASTM D 2666 and D3000.

1.7 Pipe Joining methods

1.7.1 The only acceptable method for joining buried pipe systems is by a heat fusion process. No other method is acceptable.

1.7.2 For polyethylene pipe, butt fusion is recommended.

1.7.3 For polybutylene pipe, socket fusion is recommended.

1.8 Flushing, Purging, Pressure and Flow Testing

1.8.1 Vertical loops will be pressure tested before installation.

1.8.2 All horizontal components of the ground heat exchanger will be flushed, pressure and flow tested prior to backfilling.

1.8.3 Heat exchangers will be tested hydrostatically at 150% of the pipe design rating, or 300% of the system operating pressure if this value is the smaller of the two.

1.8.4 No visible leaks shall occur within a 30 minute period.

1.8.5 All fusion joints and loop lengths shall be visibly checked to verify that no leaks have occurred due to fusion joining or shipping damage.

1.8.6 Flow rates will be compared to calculated values to assure that there is no blockage or kinking of any pipe.

1.8.7 A minimum velocity of 2 ft/sec in each piping section shall be maintained for a minimum of 15 minutes to remove all air.

1.9 Piping arrangement

1.9.1 All piping arrangements, including pipe diameters, header arrangements, parallel and series loops, reverse returns, etc. shall conform to manufacuturer's recommendations and approved design criteria. Field substitutions shall not be allowed without prior approval.

2.0 PIPE PLACEMENT AND BACKFILLING

2.1. Horizontal Systems

2.1.1 Sharp bending of pipe around trench corners shall be prevented by using a shovel to round corners. Manufacturer's recommendations shall be followed.

2.1.2 Backfilling procedure will include prevention of any sharp-edged rocks from coming into contact with the pipe by removal of the rocks before backfilling, backfilling through a coarse screen for a 6 inch cover, or use a 6 inch cover of sand. Clods resulting from use of a backhoe shall be broken up so air pockets formed around the pipe will not reduce heat conduction between the earth and the pipe. In some types of soils, wetting or flooding may be required.

2.1.3 Horizontal return bends shall be backfilled by hand to properly support the pipes and prevent kinking.

2.2 Vertical Bore Holes.

2.2.1 The dry section of a vertical bore holes shall be backfilled to ensure good heat transfer. Local and State codes as to backfilling requirements shall be followed. In some cases a bentonite grout/slurry will be required.

3.0 INDOOR PIPING AND CIRCULATION SYSTEM

3.1 Circulator Sizing and System and Components

3.1.1 The circulator wattage should not exceed 100 watts/ton. For circulation systems with water control value does not apply. The use of water control valves on closed loops is not recommended unless required by the manufacturer.

3.1.2 Proper sizing of the circulating pump will be within the Heat Pump Manufacturer's recommended flow rate for the specified unit.

3.1.3 Particulate contaminants shall be removed if they exist or could become a problem for the circulation pump.

3.1.4 Pressurization of the circuit shall be to a minimum of 10 to 15 psi when installed in the summer and 25 to 30 psi when installed in the winter.

3.1.5 The circulation system shall incorporate flow and temperature sensing for testing the performance of the water side of the heat pump system. Pressure and temperature sensing ports at the inlet and outlet of the heat pump water heat exchanger are required, even if permanent sensors are also installed. The sensing ports should be within two (2) feet of the heat pump, and should be at the unit connections whenever possible.

3.1.6 Service valve handles should be removed and the port plugged.

3.1.7 Boiler type service valves are not recommended.

3.1.8 Garden type hose connections shall not be left on the circulation system.

3.1.9 Transition fitting shall be inside or accessible.

3.1.10 All indoor piping, including the heat pump water heat exchanger shall be insulated to prevent condensation.

3.2. Antifreeze Selection and Use.

3.2.1 Manufacturer's recommended/required antifreeze solutions shall be stated and meet Local and State requirements.

3.2.2 Acceptable circulation component material for the antifreeze specified shall be given.

3.2.3 Manufacturer shall provide a list of all known acceptable materials used in the closed-loop circulation system. All metal parts contacting the circulating fluid shall be defined in terms of metallurgical content.

3.2.4 Manufacturer's recommendations should be followed when charging an earth loop with antifreeze.

3.2.5 In cases where the antifreeze is considered flammable, the antifreeze shall be diluted with water to a point at which it is nonflammable before it can be used indoors.

3.2.6 All systems shall be labeled and identified at the service ports. The labels shall be of a permanent type with the following information:

3.2.6.1 Antifreeze type and concentration
3.2.6.2 Service-date.
3.2.6.3 Company name.
3.2.6.4 Company phone number and responsible party or person.

4.0 GROUND SOURCE HEAT PUMPS

4.1 Water Source Heat Pumps.

4.1.1 Water source heat pumps used in conjunction with ground heat exchangers shall be certified by the respective manufacturer to operate satisfactorily at the recommended maximum and minimum entering water temperatures as set forth in the design of the ground heat exchanger.

4.1.2 The maximum and minimum design entering water temperatures shall not exceed the manufacturer's published data.

4.1.3 The water source heat pump will be ARI certified under rating ARI 325 for ground water heat pumps. For ground heat exchanger designed with EWT in the heating mode of 60 degrees Fahrenheit or greater, ARI 320 is acceptable.

4.1.4 Maximum and minimum entering liquid temperatures will be determined by the local ground temperatures and acceptable practice and within the manufacturer's limits.

4.2 Heat Pump Piping and materials.

4.2.1 All indoor piping, including the heat pump water heat exchanger shall be insulated to prevent condensation.

5.0 COMMISSIONING AND VERIFICATION FOR GROUND SOURCE HEAT PUMPS

5.1.1 Participating Installer shall refer to manufacturer's guidelines during installation and shall adhere to the manufactures start-up procedures. A copy of the start-up procedure and results shall be submitted, along with the factory performance data on the specified unit, to the verifier.

5.1.2 If not included in the start-up procedure, submission shall include documentation of loop type and size, as well as steady-state run time measurement of the ground loop pump amps, volts, and pump run-time fraction (if it does not run continuously).

5.1.3 Measure airflow across across the unit's coil to verify system meets design criteria, per *ENERGY STAR® Homes Northwest SPECIFICATIONS AND TECHNICAL REFERENCE FOR SITE-BUILT SINGLE FAMILY HOMES*