Appendix I

Geothermal Heat Pump Design and Installation Standards

October 1, 2001

1.0 CLOSED LOOP GROUND HEAT EXCHANGERS

1.1 Installation Personnel and Training Required.

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

1.1.2 Ground heat exchanger fabricators must 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 must attend a retraining school annually. A single failure of a fusion joint will void the certification, and the technician must 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 a variance obtained.

1.2. Design Methods and Compliance

1.2.1 The manufacturer of GSHPA equipment must provide design standards f or minimum ground heat exchanger lengths.

1.2.2 The manufacturer's design procedure must follow a recognized methodology such as presented in:

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

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

1.2.3 The ground heat exchanger design must be clearly documentable as complying with manufacturer's standards.

1.3. Ground Heat Exchanger Materials

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

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

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

1.3.4 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. Acceptable products are ABC pipe as manufactured by ABC Pipe Company, Somewhere, USA or equal.

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

1.3.6 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:

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

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

1.3.6.3 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.

1.4 Pipe Joining methods

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

1.4.2 For polyethylene pipe, butt fusion is recommended.

1.4.3 For polybutylene pipe, socket fusion is recommended.

1.5 Flushing, Purging, Pressure and Flow Testing

1.5.1 Vertical loops will be pressure tested before installation.

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

1.5.3 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.

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

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

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

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

2.0 PIPE PLACEMENT AND BACKFILLING

2.1. Horizontal Systems

2.1.1 Sharp bending of pipe around trench corners must be prevented by using a shovel to round corners. Manufacturer's recommendations must 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 must 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 must 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 certical bore holes must be backfilled to ensure good heat transfer. Local and State codes as to backfilling requirements must 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 must be removed if they exist or could become a problem for the circulation pump.

3.1.4 Pressurization of the circuit 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 must 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 acceptable. The sensing ports should be within two (2) feet of the heat pump.

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 must not be left on the circulation system.

3.1.9 Transition fitting must be inside or accessible.

3.1.10 All indoor piping must be insulated.

3.2. Antifreeze Selection and Use.

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

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

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

3.2.4 Manufacturer's recommendations should be followed when charging an earth loop with antifreeze. The antifreeze solution must be acceptable under state and local codes. The solution type must be clearly tagged on each system.

3.2.5 In cases where the antifreeze is considered flammable, the antifreeze must be diluted with water to a point that it is nonflammable before it can be taken indoors.

3.2.6 All systems must be labeled and identified at the service ports. The labels must 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 must 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 must be insulated to prevent condensation.

5.0 AIR FLOW REQUIREMENTS

5.1 Heat Pump Air Flow.

5.1.1 The heat pump air flow must be within the manufacturer's guidelines.

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