

## **Sample of Geothermal Loopfield Specifications**

### ***Closed Circuit Vertical Heat Exchanger (VHE)***

#### **Description of Work**

- A. This design has been prepared in accordance with the materials standards and accepted installation practices of the (*IGSHPA*). The loopfield contractor shall comply with these standards and practices as well as all State and local regulations pertaining to the installation.
- B. The loopfield contractor is responsible for all aspects involved with the complete geothermal loopfield installation. All materials, drilling, excavation, hauling of backfill, pumping, soil compaction and labor required shall be included in the bid price.
- C. The loopfield contractor shall take note: there is no guarantee to the loopfield contractor that the location of any existing utilities are exactly as indicated on the plans. Some areas may require hand digging to locate that utility. The loopfield contractor must include in the bid price, the repair of any domestic water, electrical, communication or any service line that may be damaged during the construction of this project. Any offsets required to route over or under existing lines shall also be included in the bid price of the project.

#### **Qualifications**

- A. The loopfield contractor must have on this project a certified *IGSHPA* installer. The loopfield contractor performing this work must have a minimum of two years experience in performing underground closed circuit VHE work of this project's size or larger.
- B. VHE fabricators must be heat fusion certified by an authorized high density polyethylene (HDPE) pipe manufacturer's representative of the brand of pipe used. Certification must include: successful completion of a written heat fusion exam as well as demonstrating proper heat fusion techniques under the direct supervision of the authorized HDPE pipe manufacturer's representative.

#### **Products**

##### **A. Pipe**

The pipe shall be PE3408 HDPE with a minimum cell classification of 45434C per ASTM D3035-93 and a SDR11 (160 psi) rating for u-bends and header pipe 2 inches or smaller and a minimum of DR15.5 (110 psi) for header pipe greater than 2 inch in diameter. This pipe will carry a warranty of no less than 25 years.

Each pipe shall be permanently indent marked with the manufacturer's name, nominal size, pressure rating, relevant ASTM standards, cell classification number and date of manufacture.

All piping used for VHE will have factory hot-stamped lengths impressed on the side of the piping indicating the length of the VHE at that point. The length stamp shall read zero on one end and the actual VHE total length on the other end.

The VHE will have a factory fused u-bend with pipe lengths long enough to reach grade from the bottom of the bore so no field fusions are required below the header pit.

##### **B. Vaults/Manifolds**

The vault structure should be a composite structure of steel and concrete. The inner shell consists of a heavy-duty steel frame and base with steel interior walls, ceiling and floor that are specially treated with a rubberized rust resistant coating. The outer shell of the wall and ceiling consists of 8" thick reinforced poured concrete.

The vault is shipped from the manufacturer preformed for concrete pour with all reinforcement rods, manifolds, and piping secured in place. The vault is set on an 18" level base of compacted gravel. Concrete, supplied by the contractor, is then poured into the vault form and screeded off the top of the form. Once the concrete cures, the outer form walls are removed and the vault is ready to fuse on the circuit and manifold piping.

HDPE pipe, joined together with heat fusion, should be used for all of the vault's circuit and main header piping. This HDPE pipe is tough, non-corrosive, and leak proof. All of the vault's circuits include valves and pressure/temperature ports for complete isolation, pressure testing and flow balancing. Acceptable manifolds are manufactured by *GHP Systems, Inc.*

#### C. Fittings

Pipe fittings shall meet the requirements of ASTM D2683 (for socket fusion fittings) or ASTM D3261 (for butt/saddle fusion fittings). Each fitting shall be identified with the manufacturer's name, nominal size, pressure rating, relevant ASTM standards and date of manufacturer.

#### D. U-bend Pipe Separators

The u-bend pipe separators used to position the u-bend pipes against the borehole wall directly across from one another -- shall be the *GeoClip* brand manufactured by *GBT, Inc.* These separators will be positioned every ten feet on the u-bend pipe.

#### E. Bentonite Grout

The thermally enhanced bentonite grout used to seal the VHE shall have a minimum thermal conductivity of 0.57 Btu/hr-ft°F and a minimum of 43% solids. This grout will also have a permeability rate of less than  $1 \times 10^{-7}$  cm/sec.

#### F. Locating Tape

Locating tape must be foil backed, two inches wide or greater, with a continuous message printed every 36 inches or less reading: "*CAUTION GEOTHERMAL PIPELINE BURIED BELOW*". The tape shall be highly resistant to alkalis, acids, and other destructive agents found in the ground.

#### G. Field Location

The four outside grid bores should be surveyed after drilling is complete, but before horizontal trenching is done.

### Execution

#### A. Drilling

The vertical boreholes will be drilled to a depth that allows complete insertion of the VHE to its specified depth. The maximum borehole diameter will be six inches. If a larger diameter is required, it must be approved by the design engineer.

#### B. U-bend Pipe Assembly

The u-bend pipe shall be filled with water and pressured to 100 psi to check for leaks before insertion. If necessary, an iron (sinker) bar can be attached at the base of each u-bend to overcome bounciness. This iron bar will have all sharp edges adequately taped to avoid scarring and/or cutting of the polyethylene pipe. No driving rod that is pulled out after u-bend insertion will be allowed. U-bend pipe separators (*GeoClips*) will be attached at ten feet intervals to the u-bend along with the grouting tremie as per manufacturer's recommendations. The entire u-bend pipe assembly is inserted to the specified depth in the borehole.

#### C. Grouting Procedure

The VHE is to be grouted from the bottom up, in a continuous fashion, using a one inch HDPE tremie pipe. The tremie pipe will be pulled out during the grouting procedure maintaining the pipe's end just below grout level within the borehole. All State regulations will be met for borehole grouting of the VHE.

#### D. Heat Fusion Pipe Joining

All underground pipe joining will be heat fused by socket, butt or saddle (sidewall) fusion in accordance to ASTM D2610, ASTM D2683 and the manufacturer's heat fusion specifications. The operator shall be heat fusion certified and experienced in executing quality fusion joints.

#### E. Excavation and Backfilling for Piping

The loopfield contractor shall do all excavating, backfilling, shoring, bailing and pumping for the installation of his work and perform necessary grading to prevent surface water from flowing into trenches or other excavations. Sewer lines shall not be used for draining trenches. All pipe and conduit ends shall be kept sealed and lines left clean and unobstructed during construction. Only material suitable for backfilling shall be piled a sufficient distance from banks of trenches to avoid overloading. Unsuitable backfill material shall be removed as directed by the design engineer.

Sheathing and shoring shall be done as necessary for protection of work and personnel safety. Unless otherwise indicated, excavation shall be open cut except for short sections. The loopfield contractor shall install geothermal locating tape 18 inches above all horizontal/header piping.

Prior to drilling or trenching, the loopfield contractor shall be responsible for reviewing with the general contractor the location of underground utilities. Existing utility lines uncovered during excavation shall be protected from damage during excavation and backfilling.

#### F. Pipe Installation

The u-bend pipe ends will be sealed with fusion caps or tape prior to insertion into the borehole. Reasonable care shall be taken to ensure that the geothermal loopfield pipe is not crushed, kinked, or cut. Should any pipe be damaged, the damaged section shall be cut out and the pipe reconnected by heat fusion.

The VHEs must be connected as indicated on the plans. The header design accounts for balanced flow as well as flushing and purging flow rates. No variations can be made in the circuit hookup or the pipe sizes that are indicated without approval from the design engineer. The minimum bend radius for each pipe size shall be 25 times the nominal pipe diameter or the pipe manufacturer's recommendations, whichever is greater. The depth of all headers and supply and return piping is indicated on the plans and must be maintained.

Circuits will be pressure tested before any backfilling of the header trenches is executed. The individual circuits will be pressure tested with water at 60 psi, however, not to exceed DR 11 pipe working pressure at bottom of the u-bend pipe.

### **Testing and Cleaning**

#### A. Cleaning

During installation, all debris, and small animals shall be kept out of the pipe. Ends of the HDPE pipe shall be sealed until the pipe is joined to the circuits.

#### B. Flushing and Purging

Each supply and return circuit shall be flushed and purged with a water velocity of two feet per second. The lines shall be left filled with clean water and then pressure tested. If connection to the manifold is not immediate, piping must be capped. The loopfield contractor must coordinate with the mechanical contractor on propylene glycol antifreeze installation. The mechanical contractor is responsible for the propylene glycol antifreeze. See mechanical specifications for antifreeze.

### **Shop Drawings and Inspection of Geothermal Loopfield**

A. Before geothermal loopfield construction begins, the loopfield contractor must submit shop drawings to the design engineer. The shop drawings shall include all applicable manufacturer's specifications,

warranties, and material safety data sheets for all materials used in the geothermal installation. No substitutions will be allowed without authorization from the design engineer.