Table of Contents:

Section 1: Overview
Allowable Piping Materials...........................................3
Acceptable HDPE Pipe ................................................3

Section 2: Safety
Overview........................................................................5
Considerations...............................................................5
Extension Cords .............................................................6

Section 3: HDPE Joining Procedures
Introduction ...................................................................7
Thermal Heat Fusion Methods .....................................7
Inclement Weather.......................................................7
Socket Fusion ..................................................................8
Butt Fusion ....................................................................11
Saddle/Conventional Fusion .....................................13
Electrofusion .................................................................14
Mechanical Connections ..............................................15

Guide Revision Table:

<table>
<thead>
<tr>
<th>Date</th>
<th>By</th>
<th>Page</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
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</table>
Allowable Piping Materials
High-density polyethylene pipe (HDPE) and cross-linked polyethylene pipe (PEX) are the only two types of piping material suitable for use in buried ground loop systems. When burying HDPE or PEX pipe, mechanical fittings are not allowed with the exception of joints that are isolated from making contact with the soil (joints are heat shrink wrapped with plastic coating). Due to the inability to thermally fuse PEX, a header system in a vault or in the mechanical space is required, since mechanical fittings are necessary. For HDPE, fusion fittings allow the installer to bury the fittings because the pipe and fittings are heated to the melting point during the fusion process, and when cooled become one single piece of plastic. This manual will address the fusion process for HDPE.

Acceptable HDPE Pipe
There are many types of HDPE on the market, some of which would not work well for ground loop installations. For example, PE pipe used for water systems is typically designed for mechanical fittings, which requires that it be I.D. (inside diameter) controlled. This pipe would not work well for fusion (especially socket fusion), since the fusion fittings depend upon a consistent O.D. (outside diameter). HDPE must be specifically designed for heat fusion and for ground loop applications.

SDR (Standard Dimension Ratio -- the ratio of pipe outside diameter to the wall thickness) and cell classification must be selected to meet the requirements for a ground loop with durability and longevity. SDR11 is the minimum requirement to insure adequate wall thickness. Cell classification is based upon the characteristics of the HDPE pipe. Approved types are PE3408, PE3608, and PE4710. Before 2005, PE3608 and PE4710 would have been considered PE3408, since they both meet stress crack resistance and hydrostatic design stress (HDS), but in fact have higher ratings than PE3408.

Another material designation that is used in Europe, PE100, has created some confusion with PE4710. PE100 has a lot of different meanings for different manufacturers; the only requirement for a material to be PE100 is that it has a long-term hydrostatic strength of 10 MPa (usually referred to as a Minimum Required Strength). While some PE100 resins may be excellent resins, the PE100 designation covers no other important properties of the pipe such as stress crack resistance. Roth does not recommend PE100 for ground loop installation due to the inability to validate required cell classification.

Section 1: Overview
Minimum cell classification for HDPE is PE345434C or PE355434C for PE3408 pipe. Minimum cell classification for PE3608 pipe is PE345464C. Digit 7 indicates environmental stress crack resistance. The value of 3 is 192 hours; the value of 6 is greater than 2000 hours. Therefore, PE3608 meets the minimum cell classification for PE3408. The minimum cell classification for PE4710 is PE445474C, which meets the requirements for PE3408 or PE3608. However, PE3408 has been used for more than 25 years in ground loop applications, and therefore PE3608 and PE4710 are not necessary unless local, state/provincial, or federal code requires the use of a pipe different than PE3408.

The last requirement is long term stability, especially when the pipe is stored outdoors, exposed to sunlight. The last digit in the cell classification indicates the method of UV stabilization. The last digit (e.g. PE345434C) must be “C” to indicate that carbon black has been added to give the pipe better UV protection.
Avoid pipe that is not black in color and pipe that does not have “C” as the UV stabilization digit in the cell classification.

Along with the correct ground loop piping, fittings must meet requirements for O.D. controlled pipe. ASTM D2683 (Standard Specification for Socket-Type Polyethylene Fittings for Outside Diameter-Controlled Polyethylene Pipe and Tubing) and ASTM D3261 (Standard Specification for Butt Heat Fusion Polyethylene Plastic Fittings for Polyethylene Plastic Pipe and Tubing) are important designations to insure that the fittings will fuse properly to the pipe.

To summarize,

- HDPE must be O.D. controlled.
- HDPE must be SDR11 or better (SDR11 is recommended).
- HDPE must be type PE3408, PE3608, or PE4710. Do not use PE100.
- Minimum cell classification is PE345434C.
- Pipe must have UV stabilization (last digit in cell classification is “C”). Do not use pipe that is not black in color.
- Socket fittings must meet ASTM D2683; butt fusion fittings must meet ASTM D3261.
- Local, state/provincial, and federal codes supersede these requirements.
Section 2: Safety

Overview
Pipe fusion is necessarily performed outdoors in order to join the ground loop piping in the header trench. In many cases, trenches are damp or even wet. **Fusion should never be attempted in a wet trench.** HDPE can produce static electricity that could be dangerous in an explosive environment. If the piping can be fused outside of the trench, and dropped into the trench, safety will be greatly improved. Operators should not only read but also memorize the instruction manual for the fusion iron and all power tools used outdoors.

Considerations
Fusion irons should always be:
- Plugged in and turned on only when in use.
- Turned off when being carried.
- Stored indoors away from water and excessive heat.
- Used only when all safety guards are in place.
- Stored in heat resistant cover when not in use to avoid accidental burns.
- Held by the insulated gripping surface to avoid electrical shock.
- Used with safety goggles and other safety gear as appropriate.
- Used with a ground-fault circuit interrupter (GFCI), either permanently installed or a plug-in type.
- Plugged into a three-pronged outlet known to be grounded, unless they are double insulated. Used with a three-wired extension cord, if needed.
- Used in a dry area away from explosive fumes (gasoline or naphtha), dust or flammable materials.

Fusion irons should never be:
- Left unattended outdoors, even when you leave temporarily. Put the tool where no curious child or unqualified adult can misuse it.
- Plugged in while the switch is in the “on” position or while being carried or moved.
- Carried by the cord.
- Used while wet or close to water.
- Used near sharp edges or in conditions which can damage the product, its cord or its plug. Loose and broken wires are both shock and fire hazards.
- Repaired by anyone who is not a licensed electrician, authorized by the manufacturer or trained to repair the unit.
- Used after they have tripped a safety device such as a GFCI. Take the tool to a manufacturer-authorized repair center for service.
- Used when you are upset, angry or in a hurry.
- Used without guards or with an extension cord longer than 100 feet (30 meters).

Follow these rules to avoid water hazards:
- Keep outdoor outlets covered and dry between uses. New outlet covers are available that offer weather protection while a plug is inserted into the outlet.
- If possible, select a dry day to power-up outdoors.
- Keep cords and plugs away from sweating pipes and puddles.
- If an electrical tool falls into water, make sure you are dry and not in contact with water or metal surfaces and unplug it immediately. Do not reach into the water for it.
- Use a GFCI.
Extension Cords

Guidelines for selecting and using outdoor extension cords:

- Use only extension cords marked “For Outdoor Use.” Weather-resistant, medium-to-heavy gauge extension cords have connectors molded onto them to prevent moisture from seeping in and outer coatings that are designed to withstand being drug along the ground.
- Outdoor extension cords come in 25 to 150 feet (7.5 to 45 meters) length. Buy only the length you need. Above 100 feet (30 meters) should be avoided if possible.
- Use three-wire extension cords with 3-pronged plugs. Exception: Extension cords for use with appliances and tools that are “double-insulated.”
- Completely connect plugs. Push them in all the way. Do not plug one extension cord into another.
- Unwind cord before using. Do not use if damaged. Do not cover or walk on cords.
- Never leave an open line (no product plugged into the end of an extension cord while it is plugged into an outlet). Not even for a minute. Always unplug cords not in use.
- Never leave extension cords outside in the snow or very cold weather for extended periods.
- Replace outdoors extension cords every three or four years if damage is noted.

Match each outdoor electrical product to its extension cord:

- Match power needs (amperage) of electrical products with amperage rating of extension cords.
- The extension cord capacity should be as high as or higher than that of the electrical product attached to it. Amperage ratings for outdoor electrical products can range from 1 Amp to 15 Amps, and are found on nameplates attached to products. Compare them to the rating information on extension cord packaging and on labels permanently attached to cords.

To convert Amps to Watts, multiply by 120 Volts. For example, 10 A x 120 V = 1200 W. Match the extension cord gauge to the amperage rating of the tool. AWG on the above label stands for American Wire Gauge. Cords for outdoor use are generally either “heavy” (12 AWG / 2.1mm) or “medium” (14 AWG / 1.6 mm).

Note that when a person is immersed in water, the water could become electrified without involving a ground fault as the electric current passes through water (and perhaps a person) from one electrical pole to the opposite pole. In this case, the GFCI may not provide shock or electrocution protection. Extreme care must be exercised when water is in the trench. Pond loop repairs should be made on shore or with approved stab type fittings. Do not run an extension cord in the pond or lake in order to make repairs in a boat.
Section 3: HDPE Joining Procedures

Introduction
HDPE pipe or fittings are joined to each other by heat fusion. HDPE may be joined by mechanical fittings, but may not be buried. HDPE may also be joined to other materials by means of compression fittings, flanges, or other types of manufactured transition fittings (for example fusion by thread fittings).

Thermal Heat Fusion Methods
There are three types of heat fusion joints currently used in the industry: Butt, Saddle, and Socket Fusion. The principle of heat fusion is to heat two surfaces to a designated temperature, then fuse them together by application of a sufficient force. This force causes the melted materials to flow and mix, thereby resulting in fusion. When fused according to the pipe and/or fitting manufacturers’ procedures, the joint area becomes as strong as, or stronger than, the pipe itself in both tensile and pressure properties. As soon as the joint cools to near ambient temperature, it is ready for handling. Pipe manufacturer’s fusion temperatures, heat soak and cooling times must be followed for the specific brand of pipe being used.

Inclement Weather
Polyethylene has reduced impact resistance in sub-freezing conditions. Additional care should be exercised while handling in sub-freezing conditions. In addition, polyethylene pipe will be harder to bend or uncoil.

In inclement weather and especially in windy conditions, the fusion operation should be shielded to avoid precipitation or blowing snow and excessive heat loss from wind chill. The heating tool should also be stored in an insulated container to prevent excessive heat loss.

Remove all frost, snow or ice from the O.D. and I.D. of the pipe; all surfaces must be clean and dry prior to fusing.

The time required to obtain the proper melt may increase when fusing in cold weather. The following recommendations should be followed:

1. Maintain the specified heating tool surface temperature. Do not increase the tool surface temperature. At temperatures of 32°F (0°C) or below, the tool surface temperature should be checked between each fusion joint.
2. Do not apply pressure during zero pressure butt fusion heating steps.
3. Do not increase the butt fusion joining pressure.

In butt fusion, melt bead size determines heating time; therefore, the procedure automatically compensates when cold pipe requires longer time to form the proper melt size. For socket fusion, a sample fusion joint should be made to determine additional melt time before the project is started.

The outside diameter of polyethylene pipe and fittings will contract in cold weather conditions. This can result in loose or slipping cold rings. For best results, clamp one cold ring in its normal position adjacent to the depth gage. Shim around the pipe behind the clamp with paper, tape, etc., and place a second cold ring over this area. This cold ring will prevent slippage while the inner cold ring will allow for the pipe to expand during the heating cycle of the fusion process.

The proper cycle time for any particular condition can be determined by making a melt pattern on a piece of scrap pipe using the recommended standard heating time. If the melt pattern is incomplete, increase
the heating time by three (3) second intervals until a complete melt pattern is established. Each time the procedure is repeated, a new piece of scrap pipe should be used.

**Socket Fusion**

Socket fusion is the most popular joining method for ground loop installations for pipe sizes 2” and smaller diameter. This technique consists of simultaneously heating both the external surface of the pipe and the internal surface of the socket fitting until the material reaches fusion temperature, inspecting the melt pattern, inserting the pipe end into the socket, and holding it in place until the joint cools. Figure 1 illustrates a typical socket fusion joint. **NOTE:** All socket fusion fittings have a tight tolerance fit, which would not allow the pipe to be inserted into the socket when the joint is cold. If the joint goes together cold, the fitting should not be used.

Follow these general steps when performing socket fusion:
1. Select the equipment
2. Square and prepare the pipe ends
3. Heat the parts
4. Join the parts
5. Allow to cool
6. Examine the joint for quality

**1. Equipment Selection**

Select the proper size tool faces, and heat the tool to the fusion temperature recommended for the material to be joined, 500°F (260°C) for PE3408. Verify recommended temperature and times for heat soak and cooling with the pipe manufacturer. Figure 2 shows a typical socket fusion iron.

**2. Square and Prepare Pipe**

Cut the end of the pipe square. Chamfer the pipe end for sizes 1-1/4” diameter and larger (chamfering of smaller pipe sizes is acceptable, but normally not necessary). Remove any scrapes, burrs, shavings, oil, or dirt from the surfaces to be joined. A paper towel or clean cotton rag (no synthetic materials may be used) and alcohol (99% pure only) is the best method for cleaning the pipe. Do not touch the end of the pipe or fitting after cleaned. Clamp the cold ring on the pipe, flush with the depth gauge, ensuring that the depth gauge is squarely and fully seated on the end of the pipe at the proper position using a separate (thimble type) depth gauge. The cold ring will assist in re-rounding the pipe and provide a stopping point for proper insertion of the pipe into the heating tool and coupling during the fusion process. See figure 3 for examples of chamfer tool, cold rings, and depth gauge.

**Figure 1: Standard Socket Fusion Joint**

**Figure 2: Typical (double face) Fusion Iron**
3. Heating
Check the heater temperature. Periodically verify the proper surface temperature with a surface temperature-measuring device (temp sticks or markers, figure 4). When temperatures are below 32°F (0°C), check surface temperature before each fusion joint. If temperature-indicating markers are used, do not use them on a surface that will come in contact with the pipe or fitting. Bring the hot clean tool faces into contact with the outside surface of the end of the pipe and with the inside surface of the socket fitting, in accordance with pipe and fitting manufacturers’ instructions. Procedures will vary with different materials. Follow the instructions carefully (see table 1). NOTE: DO NOT DEPEND UPON THE THERMOMETER ON THE HEATING IRON, AS IT MAY BE OUT OF CALIBRATION.

4. Joining
Timing of a socket joint heat soak cycle starts when the cold ring contacts the heater socket (i.e. the pipe is fully inserted). The fitting is put on the heater first, then the pipe with the cold ring. Do not grab the cold ring when making the fusion joint. Hold the pipe only. The cold ring could slip or cause a misalignment. Simultaneously remove the pipe and fitting from the tool using a quick “snap” action. Immediately insert the pipe squarely and fully into the socket of the fitting until the fitting contacts the cold ring. If the joint is not inserted all the way or the cold ring does not bottom out, cut the joint out. Do not twist the pipe or fitting during or after the insertion, as is a practice with some joining methods for other pipe materials. The pipe and fitting must be joined within 3 seconds of removal from the iron. Inspect the melt pattern for uniformity. There should be a shiny melt pattern completely around the pipe and fitting. If in doubt, cut it out.
5. Cooling
Hold or block the pipe in place so that the pipe cannot come out of the joint while the mating surfaces are cooling. These cooling times are listed in the pipe or fitting manufacturer's instructions. Use the manufacturer's recommended times for the specific brand of pipe being joined. A typical Socket Fusion time cycle chart is listed below.

Do not “rough handle” or move the pipe until the joint has cooled to the ambient temperature.

Table 1: Socket Fusion Time Cycles

<table>
<thead>
<tr>
<th>Pipe Size IPS (inches)</th>
<th>Heating Time (seconds)</th>
<th>Cooling Time (seconds)</th>
</tr>
</thead>
<tbody>
<tr>
<td>3/4&quot;</td>
<td>12-14</td>
<td>30</td>
</tr>
<tr>
<td>1&quot;</td>
<td>15-17</td>
<td>40</td>
</tr>
<tr>
<td>1-1/4&quot;</td>
<td>18-21</td>
<td>40</td>
</tr>
<tr>
<td>1-1/2&quot;</td>
<td>18-21</td>
<td>40</td>
</tr>
<tr>
<td>2&quot;</td>
<td>24-28</td>
<td>40</td>
</tr>
</tbody>
</table>

Notes:
1. Fusion time cycles begin after the pipe and the fitting have bottomed out on the heater adapters.
2. The information above is considered a guideline only.
   Job site and temperature conditions must be taken into consideration.

Table 1: Socket Fusion Time Cycles

6. Examine
Examine the joint closely to ensure proper joining of the pipe and the fitting. A uniform melt pattern should be evident on the surface of the fitting. If in doubt cut it out.
Butt Fusion
The most widely used method (outside of the geothermal heat pump industry) for joining individual lengths of polyethylene pipe over 2" in diameter is by heat fusion of the pipe butt ends as illustrated in Figure 5. However, it may be used for smaller (e.g. 3/4") diameter pipe as well. This technique produces a permanent, economical and flow-efficient connection. Using trained operators and quality butt fusion machines in good condition produces quality butt fusion joints.

Figure 5: A Standard Butt Fusion Joint

The butt fusion machine should be capable of:

- Aligning the pipe ends
- Clamping the pipes
- Facing the pipe ends parallel with each other
- Heating the pipe ends
- Applying the proper fusion force that results in fusion

The six steps involved in making a butt fusion joint are:

1. Clean the outside of the pipe with a paper towel and alcohol.
2. Clamp and align the pipes to be joined.
3. Adjust the high/low by tightening down on the high side clamp.
4. Face the pipe ends to establish clean, parallel surfaces.
5. Re-check alignment, and if high/low is adjusted, reface the pipe. Align the pipe profile.
6. Bring the pipe together on the heater plate with moderate pressure at first until a melt pattern is seen. Then relieve pressure to a contact pressure only and observe the melt bead. Melt the pipe interfaces (refer to Table 2).
7. Check the melt pattern. It should be shiny and smooth. If concave, do not use.
8. Join the two profiles together by applying the proper fusion force.
9. Hold under pressure until the joint is cool.
10. Let the joint cool an additional 3 minutes before removing from machine.
11. Double check the joint closely to ensure proper roll back and bead size. A sample of Butt fusion cycles is shown below. Actual manufacturer times should be followed for the brand of pipe being used. NOTE: Most Butt fusion is not a timed event. It is a sight event on bead thickness.

Do not “rough handle” or move the pipe until the joint has cooled to the ambient temperature.
Most pipe manufacturers have detailed parameters and procedures to follow. In some pipe systems, engineers may elect to remove the inner or outer bead of the joint. External beads are removed with run-around planing tools, which are forced into the bead, then drawn around the pipe. Power planers may also be used, but care must be taken not to cut into the pipe’s outside surface. It is uncommon to remove internal beads (or external beads), as they have little or no effect on flow, and removal is time-consuming. Internal beads may be removed from pipes after each fusion with a cutter fitted to a long pole. Since the fusion must be completely cooled before bead removal, assembly time is increased slightly.

Table 2: Butt Fusion Time Cycles

<table>
<thead>
<tr>
<th>Pipe Size (inches)</th>
<th>Heating Time (seconds)</th>
<th>Cooling Time (seconds)</th>
<th>Bead Size (inches [mm])</th>
</tr>
</thead>
<tbody>
<tr>
<td>3/4&quot;</td>
<td>14-17</td>
<td>50</td>
<td>1/16 [1.6]</td>
</tr>
<tr>
<td>1&quot;</td>
<td>16-19</td>
<td>70</td>
<td>1/16 [1.6]</td>
</tr>
<tr>
<td>1-1/4&quot;</td>
<td>18-22</td>
<td>70</td>
<td>1/16-1/8 [1.6-3.2]</td>
</tr>
<tr>
<td>1-1/2&quot;</td>
<td>22-28</td>
<td>70</td>
<td>1/16-1/8 [1.6-3.2]</td>
</tr>
<tr>
<td>2&quot;</td>
<td>28-34</td>
<td>70</td>
<td>1/16-1/8 [1.6-3.2]</td>
</tr>
<tr>
<td>3&quot;</td>
<td>30-36</td>
<td>70</td>
<td>1/8 [3.2]</td>
</tr>
<tr>
<td>4&quot;</td>
<td>35-42</td>
<td>90</td>
<td>1/8-3/16 [3.2-4.8]</td>
</tr>
<tr>
<td>6&quot;</td>
<td>54-64</td>
<td>240</td>
<td>5/16 [7.9]</td>
</tr>
</tbody>
</table>

Note:
1. Do not attempt to establish bead size during the heat cycle!
2. The information above is considered a guideline only. Job site and temperature conditions must be taken into consideration.

Figure 6: Typical Butt Fusion Machine for Smaller Diameter Pipe
(Butt Fusion machines are available to fuse pipe up to 65 inches in diameter)
Saddle/Conventional Fusion

The conventional technique to join a saddle to the side of a pipe, illustrated in Figure 7, consists of simultaneously heating both the external surface of the pipe and the matching surface of the “saddle” type fitting with concave and convex shaped heating tools until both surfaces reach proper fusion temperature. This may be accomplished by using a saddle fusion machine that has been designed for this purpose. Every saddle fusion machine manufacturer will issue operation manuals that should be followed and kept with the machine. There are specific steps and procedures that will be specific to each brand of machine.

Figure 7: Standard Saddle Fusion Joint

Saddle fusion, using a properly designed machine, provides the operator better alignment and force control, which is very important to fusion joint quality. The Plastics Pipe Institute recommends that saddle fusion joints be made only with a mechanical assist tool unless hand fusion is expressly allowed by the pipe and/or fitting manufacturer.

There are eight basic sequential steps that are normally used to create a saddle fusion joint:

1. Clean the pipe with a clean cotton rag and 99% alcohol (never use synthetic rags).
2. Rough the pipe and fitting with a 60-grit paper.
3. Install heater saddle adapters.
4. Install the saddle fusion machine on the pipe.
5. Prepare the surfaces of the pipe and fitting.
6. Align the parts using minimum pressure and wiggling pipe to ensure proper alignment.
7. Heat both the pipe and the saddle fitting. It is critical to use manufacturer’s pressure and times for proper heat contact time and heat soak times.
8. Press and hold the parts together. Be sure to use manufacturer’s specific times and specs for the brand of pipe being used.
9. Cool the joint and remove the fusion machine.
10. A properly made saddle joint should have 3 distinct beads formed at the joint. Be sure to drill out the base pipe material before making the saddle connection.

Most pipe manufacturers have detailed parameters and procedures to follow. This is critical to assure a properly made saddle fusion. One type of procedure will not meet all brands of pipe.
**Electrofusion**
This technique of heat fusion joining is somewhat different from the conventional fusion joining thus far described. The main difference between conventional heat fusion and electrofusion is the method by which the heat is applied. In conventional heat fusion joining, a heating tool is used to heat the pipe and fitting surfaces. The electrofusion joint is heated internally, either by a conductor at the interface of the joint or, as in one design, by a conductive polymer. Heat is created as an electric current is applied to the conductive material in the fitting. Figure 8 illustrates a typical electrofusion joint, and Figure 9 illustrates an electrofusion control box and fitting. This type of fusion is mostly automatic. The times and temperatures are made by the control box and the resistance of the fitting. Electrofusion fittings tend to be more expensive due to the addition of electrical elements.

**Figure 8: Typical Electrofusion Joint**

Electrofusion is not common in ground loop installations in North America, but is popular in Europe and in other industries. Therefore, this fusion process is beyond the scope of this manual, and will not be addressed in detail.
Mechanical Connections
As in heat fusion methods, many types of mechanical connection styles and methods are available. This section is a general description of these types of fittings. Polyethylene joined by mechanical fittings must not be buried. Only fusion joints may be buried for ground loop applications.

The most popular type of mechanical connection in the geothermal industry in North America is the barbed fitting. It is common for a double O-ring by barb fitting to be used at the flow center to connect the supply/return lines from the ground loop to the flow center. Some flow centers use threaded fittings, so a thread by barb fitting is used. The fitting must be of brass construction, and must not be part of the buried ground loop system. Figure 10 shows typical barb fittings.

Figure 10: Barb by Thread and Barb by Double O-ring Fittings

Other popular fittings in the geothermal industry are socket fusion by thread or socket fusion by double O-ring for the same reason mentioned above, connection to the flow center. The socket fusion by thread fitting is common for larger applications, where a transition to copper or steel piping may be required. Figure 11 shows a typical fusion by double O-ring fitting.

Figure 11: Fusion by Double O-ring Fittings

Stab type mechanical fittings, as illustrated in Figure 12, are specially designed components including an elastomer seal, such as an "O" ring, and a gripping device to effect pressure sealing and pullout resistance capabilities. Self-contained stiffeners are included in this design. With this style fitting, the operator prepares the pipe ends, marks the stab depth on the pipe, and "stabs" the pipe in to the depth prescribed for the fitting being used. These fittings are available in sizes from 3/4" through 2" IPS. Avoid using the style fitting that is used in the gas industry due to metal supports that could rust and weaken the integrity of the fitting.
When joining to metal or to certain other piping materials, or if a pipe section capable of disassembly is required, polyethylene flange adapters, as depicted in figure 13, are available. The “Flange Adapter” and its shorter version, the “Stub End,” are designed so that one end is sized the same as the plastic pipe for butt fusion to the plastic pipe. The other end has been specially made with a flange-type end that provides structural support, which nullifies the need for a stiffener and, with a metal back-up ring, permits bolting to the non-plastic segment of a pipe line.

Another fitting becoming popular in flow center applications is the Alpreyen fitting, which works like a compression fitting used to transition between HDPE and PVC. It is available in 90 degree elbows or straight adapters, and in a reducing configuration. Figure 14 shows an installed Alpreyen fitting.
AHRI certification is shown as the Roth brand under the Enertech Manufacturing certification reference number
**Roth Industries geothermal heat pumps are shown as a multiple listing of Enertech Manufacturing’s ETL certification
*** Roth geothermal heat pumps are listed as a brand under Enertech Manufacturing’s Energy Star ratings