Basic Principles for Electrofusion Welding

1. With a permanent marker and proper measuring device, mark the pipe depth that will be inserted into the fitting.

2. Scrape the pipe along the fusion zone where the fitting will be connected.

3. Clean pipe of any shavings and/or sharp edges. Chamfer the outside edge of the pipe with a hand scraper.

4. Remark insertion depth and clamp pipe with rounder clamps.

5. Prior to installation, ensure there is no damage on the fitting by inspecting the Electrofusion wires, pins and outer casing.

6. Clean the fusion zone of the pipe ends and fittings with rubbing alcohol/acetone.

7. Insert the pipe into fitting up to the mark.

8. Ensure NO TENSION between fitting and pipe during the welding and proper cool time period. Use clamps if necessary.


10. After the weld has been completed, make sure to mark fitting with date, welding time, weld number and operators initials in permanent marker.
INSTALLATION OF ELECTR-O-FUZE™ PIPE WITH THE FRIALEN® ELECTROFUSION COUPLING SYSTEM

**QC Note:** It is mandatory that every installer complete a training course and obtain a certificate in electrofusion and underground HDPE Pipe Installations. This course shall be done through Advantage Earth Products, Inc. or its certified representatives.

- Carefully study assembly instructions on the pipe and electrofusion system, before use, as installation practices for large (>4” ID) and small (<4” ID) bore pipe differ, and these changes need to be addressed in order to have a successful installation.
- Follow instructions strictly, without taking any short cuts. Failure to do so will result in loss of the manufacturer's warranty.
- Follow the **BASIC PRINCIPLES** for electrofusion (EF) welding:

1. With a permanent marker and proper measuring device, mark the pipe depth that will be inserted into the fitting
   
   **QC Note:** Markings are used as a guide to ensure complete surface is scraped.

2. Scrape off the fluorinated layer on the pipes where the fittings will be connected
3. Clean pipe of any shavings and/or sharp edges. Chamfer the inside and outside edge of the pipe with a hand scraper.

4. Remark the insertion depth and clamp pipe with rounder clamps.

5. Prior to installation, ensure there is no damage on the fitting by inspecting the EF wires, pins and outer casing.

6. Clean pipe ends, welding area and fitting with a high alcohol-based liquid such as rubbing alcohol or acetone using a clean white lint free cloth.
7. Slide pipe into fitting right up to the depth marker on the pipe.

8. Ensure there is no tension between fitting and pipe during the welding and proper cool time period. Use clamps if necessary.

9. Connect EF machine to the fitting and scan barcode using reader wand.

**QC Note:** Ensure EF machine displays correct size fitting and weld time before continuing.

10. After the weld has been completed, make sure to mark fitting with date, welding time, and operators initials in permanent marker.
Installation Checklist for the Electr-O-Fuze™ Piping System

Prior to arriving at site:

- Obtain drawings and be sure contractor understands semi rigid piping and series installation.
- Be certain contractor is aware of all of the materials required for the job.
- Quantities of entry boots, test boots, connector and test tubes & fittings should be verified.
- Be certain all materials have been ordered and have been delivered to site.
- Hole saws, mandrels, pipe cutter, Fusion machine, test gauge(s) and all pertinent templates should be verified.
- Be certain contractor knows trenching requirements and site has been trenched.
- Make sure contractor knows bedding and backfill requirements and prepares trenches accordingly.
- For overseas jobs, verify pipe threads

Arriving at site:

- Unpack Electr-O-Fuze™ equipment and match against packing list.
- AEP has processes that ensure the product leaves the warehouse in good condition. Inspect pipe and fittings for damage during transport. If damage is visible then report in detail on Proof of Delivery (POD) form provided by driver.
- Group items together.
- Inspect trenching and modify as needed. * Remember to include the bend radius of the pipe which is found in the table on page 16 of this manual. This is measured from the face of the sump to the inside of trench.
- Ensure that you have the minimum working space to accommodate the required fittings within the dispenser sump.
- Show contractors the components of the system and demonstrate their use.
- Briefly summarize procedure to contractor prior to commencing work.

Installation of Flexible Entry Boots:

- Contractor should install all necessary piping (risers, shear valves, plumbing trees, etc.) in sumps keeping in mind orientation of pipe exit from sump.
- Entry boot must be on face of sump and be aligned with sump piping. Do not rely on pipe flexibility.
- When installing Entry boots in dispenser sumps for tee fittings, opposing holes must be aligned to facilitate installation. Do not rely on pipe flexibility.
- **Very Important**: Be sure to use the appropriate hole saw for drilling of entry boots.
- Once installed, be sure to tighten nuts around compression rings and tighten band clamps around piping when installation is completed.
Installation Checklist for Electr-O-Fuze™ Piping System

Measuring and cutting pipe:

- Measure length of pipe needed using a flexible tape measure. To accurately measure the length of piping needed, measure the distance between the face of the first fitting and the face of the second fitting and add fusion zones. *Allow for elongation or shrinkage due to temperature.
- When moving pipe on site, cover pipe ends to be sure no debris enters the piping.
- Dry fit pipe through entry boots to make sure pipe is proper length.
- Mapping out cuts ahead of time can minimize scrap at the end of the job.
- Use the AEP pipe cutter to cut the primary pipe and to cut back secondary pipe.
- Examine pipe to be sure blade has not pierced primary pipe.

Coupling Pipe:

- Prepare fusion machine by checking that the unit has the correct voltage.
- Mark the depth of pipe to go into the fitting then scrape both ends of the pipe.
- Clean the ends of the pipe with alcohol.
- Insert both ends of the pipe into the fitting.
- Connect the electrodes onto the fitting.
- Ensure fitting is not under any stress.
- Scan the barcode, and start the machine.
- Mark the fitting with weld time, operator and date.
- Allow full cool down time.

Install Piping:

- Push piping through entry boot. Use soapy water as needed to facilitate installation.
- Place test boots and secure with band clamps. Use soapy water as needed.
- Install extension tubes and connector tubes on test boots as required.
- Be sure trench bedding is flat, compacted, and level with bottom of piping at sump.
- If the pipe is crossing another line then refer to AEP Electr-O-Fuze™ Underground Pipe Installation Instruction pg 20, diagram 1 for proper separation.

Testing Pipe:

- With all primary joints secured, pressurize primary piping to according to Table 5.2 on pg 29
- Soap all joints to check for leaks in fittings.
- De-pressurize primary and install test gauge on tank sump extension tube. Plug tube in terminating sump. Use Teflon tape to seal both gauge and plug in test tubes.
- Pressurize secondary pipe according to table 5.2 found on pg 29.
- Soap all joints and check for leakage. Tighten band clamps as required.
- Note: Gauges and contractors equipment are the cause of many leaks.
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For

Electr-O-Fuze™
Underground Double Wall Pipe
## AMENDMENT RECORD

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1. PIPE

1.1. FIELD OF APPLICATION

1.1.1. These instructions are written to detail the correct procedure for installing the Electr-O-Fuze™ system in service stations, standby generator and boiler facilities, fuel terminals, marinas and harbors. The Electr-O-Fuze™ piping system includes the following key elements:

- Pipe and Fittings – Description and specification
- Correct trenching and pipe laying technique
- Electrofusion fittings

The instructions will further detail the correct way of storing, loading and unloading the pipe and fittings.

1.1.2. These instructions pertain to the installation of underground pipelines made of semi-rigid Electr-O-Fuze™ fluorinated high density polyethylene (HDPE) in accordance with ISO 4427, ANSI/NFPA 30A, ANSI/NFPA 37, State and county requirements and the Electr-O-Fuze™ Installation Manual, where pipe connections and pipeline elements must correspond to the maximum allowable working pressure and requirements applicable.

1.2. Electr-O-Fuze™ Pipe - Description

1.2.1. Electr-O-Fuze™ is a high performance, high density semi-rigid polyethylene pipe, for use as an Integral Primary/Secondary Pipe System, designed and manufactured in the USA specifically for the transfer of Motor Vehicle Fuels, High Blend Fuels, Concentrated Fuels, Aviation and Marine Fuels in service stations, retail and commercial installations.

1.2.1.1. The Electr-O-Fuze™ system resists permeation and UV light. It is manufactured from high performance - high density polyethylene (HDPE) according to ISO 4427 and has a fuel and chemical barrier layer integral to the chemical matrix of the HDPE.

1.2.1.2. The Electr-O-Fuze™ pipe system may only be installed by a qualified person, who has been trained by Advantage Earth Products, Inc or its certified representatives. The pipe system has been perfected to satisfy concerns regarding the harmful emissions of volatile organic compounds into the environment and, in particular, protect ground water against contamination often associated with corroded and leaking steel pipe and the delaminating of barrier layers that are laminated on to the surfaces of other HDPE pipe.

1.2.1.3. Electr-O-Fuze™ has a 30 year design life which meets and/or exceeds the requirements of the UL971 Specification revision of 2005 for Motor Vehicle Fuels, High Blend Fuels, Concentrated Fuels and Aviation & Marine Fuels, and Institute of Petroleum Performance Specification for Underground Pipe work Systems at Petrol Filling Stations. The Electr-O-Fuze™ pipe system offers:
• Resistance to permeation
• Dimensional stability
• Corrosion resistance
• Resistance to abuse
• Smooth bore (negligible friction loss)
• Easy to install, leak-tight fusion welded or mechanical jointing
• 30 year product design life

1.2.1.4. Because Electr-O-Fuze™ is of a lightweight material, it is easy to handle and install on site with minimum labor. It comes in standard pipe sizes of 1.25”, 1.5”, 2”, 3” and 4” ID, however, due to the ease of manufacture of the product can be made to any other size required when ordered up to and including 30” ID.

All UL listed Electr-O-Fuze™ pipe will carry the following markings on the pipe:

50/63mm; 63/75mm; 90/110mm and 110/169mm Integral Primary/Secondary Pipe

All UL listed Frialen® fittings will carry the following markings on the fitting:

All UL listed Electr-O-Fuze Transition fittings will carry the following markings on the fitting:
Pipe/Fitting Prefixes:

Type of piping and fittings:

UGN = Underground Nonmetallic
PS = Integral Primary/Secondary
NV = Normal Vent
VR = Vapor Recovery

Type of fuels:

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<td>MV</td>
<td><strong>Motor Vehicle Fuels</strong> – Petroleum based hydrocarbon fuels typically found in consumer dispensing stations, such as gasoline or diesel, including blended fuels with max 15% MTBE, 15% Methanol, or 30% Ethanol (as identified in table 15.1 of UL 971)</td>
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<td><strong>High Blend Fuels</strong> – Motor Vehicle Fuels with higher than normal gasoline blends with max 50% Methanol, or 50% Ethanol (as identified in table 15.1 of UL 971)</td>
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<td><strong>Concentrated Fuels</strong> – Motor Vehicle and alternate unblended fuels for up to 100% concentrations of Toluene, Methanol or Ethanol (as identified in table 15.1 of UL 971)</td>
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<td>A&amp;M Fuels</td>
<td><strong>Aviation &amp; Marine Fuels</strong> – Motor vehicle and specialty aviation or marine use fuels for up to 100% kerosene or leaded gasoline (as identified in table 15.1 of UL 971)</td>
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Pressure varies for the different pipe systems as per the table below:

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<th>Manufacturer’s Minimum Recommended Bending Radius (in)</th>
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**QC Note:** It is a requirement that only fully trained and competent personnel install Electr-O-Fuze™, and that the use of non-qualified personnel or any deviations from these recommended procedures could result in damage or leakage of the system and the loss of the Manufacturer’s warranty. Installation training and certification can be arranged through Advantage Earth Products, or by contacting your local Manufacturers Rep or Electr-O-Fuze™ Distributor. All personnel should be set aside for training after which a test of competence will be issued and taken in for grading. After processing the test you will be sent a numbered and dated certificate of competence which needs to be renewed every 18 months. On-site training can be arranged, however, this will need to be followed up with an in classroom session to reinforce this type of training before the certificate will be issued.

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2. FITTINGS

2.1. Frialen® Electrofusion Fittings – Jointing System

2.1.1. Matched electrofusion fittings are utilized throughout the pipeline system in order to join the various pieces. Deep sockets and ‘safe’ low voltage operation (48V), applied through dedicated ancillary equipment ensures maximum joint integrity. Fusion indicators monitor the joint melt pressure, while absolute security of the weld is ensured using the fittings bar code feature in conjunction with the fully automatic Electr-O-Fuze™ Control Box Unit.

2.1.2 Spigot flanges and NPT/BSP threaded transition fittings enable the Electr-O-Fuze™ pipe to be directly connected to metal equipment. These fittings allow for easy dismantling for inspection access.

2.1.3. Frialen® Safety Fittings are subject to constant quality checks under stringent inspection regulations, which are part of the comprehensive Quality Management System certified to DIN EN ISO 9001

2.1.3.1. Frialen® Safety Fittings are licensed for use with Gas, Petroleum Products and Water. The Frialen® fittings are also tested for and found suitable for the transfer of Motor Vehicle fuels, High Blend Fuels, Concentrated Fuels, Aviation & Marine Fuels in service stations, retail and commercial installations according to UL971. Exact prefixes for the fittings are found on page 15.

2.1.3.2. The fittings can be fused to pipe of SDR stages 17.6 to 7.4 in accordance with DIN 8074 (E), ISO 4437, pr EN 1555 and DIN EN 12201 (E).

2.1.4. Pipe made of raw material types PE-LD, PE 50, PE 63, PE 80, PE 100 and PE-X in melt index groups 005 to 050 can be fused, and can be worked with temperatures between –20°C and +50°C (-4°F to 122°F).

- The pressure loading capacity of Frialen® safety fittings will be printed in SDR stages.
  SDR (Standard Dimension Ratio) is the ratio of the pipes’ outside diameter divided by the pipes’ wall thickness, taking into account the new design factor C (calculation coefficient for components made of PE) = 1.25
- The cooling time is given in the bar code and identified by the letters (C.T.). The fused joint should not be moved during this time. Longer cooling times should be allowed before pressurization. These are found on the instruction card in the fusion machine.
Barcode information on Frialen® Fitting

- Fitting information barcode, scanned into machine before welding, supplies fitting type, welding time and resistance
- Fitting size and type
- Pipe SDR range where the fitting is safe to use
- Cooling time before movement of the fitting, and 1/2 rated pressure
- Emergency barcode information (manual input)
- Fitting traceability information
- Molded lettering denoting the fittings
3. ONSITE

3.1. PIPE INSTALLATIONS

3.1.1. Pipe Trenches:
There are various ANSI/NFPA 30A specifications which give guidance on principles to be observed in any underground pipe installation, irrespective of the type of pipe work used. These specifications however, should be read in conjunction with the Advantage Earth Products, Inc. instructions detailed below. The Electr-O-Fuze™ system must follow these guidelines and any other instructions issued by the Country, State and/or the Local Area Licensing Authority and/or the Clients Installation Specification.

3.1.1.1 General Requirements:

- The pipe trench must be constructed to enable perfect installation of pipelines at a depth sufficient to prevent damage imposed by earth pressure, traffic, and major temperature changes. The pipe wall thickness must be calculated accordingly. The minimum cover depth for normal road traffic loads is 1½ foot above the crest of the pipe, however, should there be special circumstances this burial depth could be changed.

- Excavation of all trenches must be at least 6” deeper than the required depth. The trench is then brought back to the correct depth by placing a stone free layer. e.g. river sand, or pea gravel number 89.

- When pipes are to be installed in steep areas, appropriate safe guarding measures should be taken to avoid the bedding material used to cover the pipes from being washed away, therefore exposing the pipe. This is achieved by either using a geotextile membrane surrounding the bedding material or by stabilizing the bedding using a cement bond. In sloping or steep areas the pipe should be protected from sliding down, e.g. concrete anchor blocks.

- Changes in geological structure resulting in differing load bearing capacities of the trench base must be compensated for by respective measures in the transition areas in order to prevent super imposed stresses. This is achieved by reinforcing the layer of sand using a cement bond. e.g. soilcrete (3 to 4% cement in soil) or covering the trenches with concrete slabs or using a concrete dome over the Pipe work.

- All pipe work must be laid with a continuous fall back to the nearest drainage point, with a minimum gradient generally not less than 1:200 but preferably 1:100 (1/8” per foot). Changes of gradient are permitted, but dips or sagging in the pipe is not acceptable.

- All pipe work must be installed so as to provide adequate protection against mechanical damage during the operational lifetime of the installation. Using the appropriate back filling, or anchoring of the pipe in appropriate areas normally achieves the desired effect.
• Where scars or scratches are 10% or more of the wall thickness of the pipe, the pipe should NOT be used as this will impact on the performance of the pipe.

• Electr-O-Fuze™ pipe is laid on a 6 inch bed of river sand, or pea gravel number 89. The pipe is finally covered with another 6 inch of the same granular material, as depicted in PIPE SEPARATION DIAGRAM 1.

• All Electr-O-Fuze™ pipes buried underground are either single lengths of pipe or formed from short lengths of pipe electrofusion welded together to form a single homogenous pipe.
3.1.2. Pipe Laying
ELECTR-O-FUZETM pipe can be laid in a simple and economical way. Drawings – EFuze 001/P & EFuze 001/NP- show both the preferred and non-preferred installation practice for primary lines, but the general principles apply to all lines. The installation must however take into account the following main points:

- Ground Movement
- Thermal Effects
- Fall Back
- Pipe Separation
- Tools and unwinding of pipe coils
- Jointing Methods
- Transport and storage of pipe and fittings
- Workmanship

3.1.2.1 Ground Movement:
Correctly laid Electr-O-FuzeTM pipe work will not be affected by small amounts of ground movement provided the pipe is laid in the manner required in this specification, and contained within a layer of granular material. Some soil conditions may require a geotextile membrane to prevent migration of the granular material.

3.1.2.2. Thermal Effects:
The coefficient of linear thermal expansion is greater for the HDPE pipes than for steel pipes. Due allowance must be made in the pipe work design for thermal expansion where significant temperature variations are expected on the pipe work. (More than 18°F is considered a significant temperature variance - expansion rate 0.08” per 39” per 18°F). The installed pipe should be buried according to specifications by a minimum 18” which will reduce the effects of temperature variances. Generally any expansion is adequately accommodated for by laying the pipe using a sinusoidal curve (snake like) in the trench or by changes in direction and the ability of the pipe to move within the granular bed. (Drawing EFuze 001/P and EFuze 003)

3.1.2.3. Fall Back (slope) of piping:
All primary pipes must have a fall back or slope to the tanks. For Electr-O-Fuze™ it is recommended that a fallback of 1:100 be applied. For Vent and Vapor return piping, these must have a minimum of 1/8” per foot slope, while a slope of 1/4” per foot is recommended wherever feasible.

3.1.2.4. Pipe separation in trenches:
Pipe separation in three dimensions is necessary to allow the pipes to move within the surrounding granular matrix. All pipes must be separated from each other by at least one pipe diameter, for example, a space of 2” should be left between 2 pipes of OD 2”. Where two pipes of different OD sizes are laid next to each other, say 2” and 3”, or cross, the largest pipes OD takes precedence with regard to the spacing dimension requirement. i.e. 3” between the two pipes. See Diagram 1 on Page 20.
3.1.2.5. Backfilling of the Pipe Trench
If, due to direct exposure to sunlight, the temperature of the pipe line will exceed that of the trench, the pipe line must be covered by a layer of sand 4” before the final filling of the pipe trench in order to limit the stress to a minimum. Filling and consolidation must be done by hand; suitable earth should be obtained if not available on site.

Final filling must be carried out according to the applicable leaflet for filling up pipeline trenches, (Research Association for Road and Traffic. Underground Substructure.) Mechanical devices may be used, provided that the permissible filling height is observed. Final compaction on top of trench should be equivalent to ASTM D-1557 95%.

3.1.2.6. Jointing Method
Electrofusion is the second corner stone of the Electr-O-Fuze™ system, however, mechanical fittings are also available in the smaller more popular OD’s, ¾”, 1¼”, 1½” and 2” (see basic principles of electrofusion), for all larger fittings, 5” and above, electrofusion fittings is the only jointing method. Because the jointing is as important to the integrity of the system as a whole, correct preparation of the pipe and fittings is ESSENTIAL, and therefore the basic principles of electrofusion must be followed explicitly. (PAGES 34 to 36)

Using coils, pipe laying is best done during the warmest part of the day, however, this is not necessarily true for lengths of Electr-O-Fuze™ Pipe. (The reason for this is that the pipe is more flexible when warm). **Care should be taken when laying a warm pipe, as shrinkage will take place when the pipe cools down again**, this expansion and contraction is due to the thermal coefficient of expansion of polyethylene, which is higher than steel, the pipe therefore fluctuates in length with varying temperature.

Taking the above into account, pipe is preferably snaked, however, one could design the layout to allow for loose laying, with wider trenches in the corners (bends) allowing for the expansion of the pipes in those areas.

In case of outdoor temperatures being lower than 32°F, it is recommended to lay the pipes under the special cold weather instructions on the following page.
3.1.2.6.1. Cold Weather Instructions
For cold conditions (up to -40°F (-40°C)), a Salamander Indirect oil fired heater may be connected to a specially fabricated box or trailer able to contain the pipe. See Diagram 2. The pipe may be heated until more flexible, taking care not to exceed the maximum temperature of 140°F (60°C). Under no circumstances may exhaust gas emissions be used to heat the pipe. Temperature changes cause alterations in pipe length and this must be taken into account when cutting and installing pipelines.

Pipe ends and fittings must be cleaned prior to installation, damaged parts must be removed. Cuts are to be executed vertically to the pipe axis with the aid of a pipe cutter, which is recommended for plastic pipes. Burrs and uneven areas are to be smoothed down using suitable tools e.g. shaver or scraper. The pipe ends are then prepared for the jointing method to be used. (Full details of the basic principles of electrofusion on pages 34 to 36).

3.1.2.7. Interstitial Space Termination
The Electr-O-Fuze™ pipe system has been tested and certified to be used as a closed system. As such the interstitial space between the coaxial pipe and primary pipe is measured by insulating the space with either a Termination or Test boot. These two boots allow for any differential movement which could occur between the primary and the secondary pipe. The diagram below best depict this arrangement.
Diagram A - showing the entry and exit of the co-axial pipe into a sump in “open condition”

Enlargement showing the penetration through the DPM test boot

DPM Test Boot with test port used for open system
3.1.2.8. Tools:
Over and above the normal tools required for an installation, the following specialist tools would be required:

- Electr-O-Fuze™ Welding Unit
- Plastic pipe cutter
- Rounder Clamps
- Fastening clamps for holding the pipe in place until joint has cooled down
- Pipe Scraping Kit
- Acetone/Rubbing Alcohol
- Clean wiping materials, such as clothes or toilet paper
3.1.3. Uncoiling Instructions for HDPE pipe

When unwinding pipe from coils, it is essential to ensure that the pipe end cannot spring outwards when loosening the fastening, as considerable forces are released particularly from larger diameter pipes. Take all necessary precautions, always unwind from the top.

Unwinding of pipe coils can be carried out by various methods. Pipe with an outside diameter up to 3” can be unwound from the coil held in a vertical position while securing one of the ends and releasing coil restraints one at a time. For diameters larger than 4” it is recommended to use an unwinding mechanism. The coils can for instance, be laid flat on a rotating wooden or steel cross and be unwound manually or with the aid of a slow moving vehicle. The pipe must be unwound in such a way so as to avoid any buckling. Spiral unwinding must be avoided at all cost, as this will cause the pipe to buckle.

When unwinding pipe, note that the flexibility of HDPE pipe is subject to the ambient temperature. At temperatures near freezing point, pipe exceeding 2” OD can be warmed up by pumping warm water, or warm air through the coil (maximum temperature 120°F). Pipe coils could also be placed in a hot box and allowed to heat as shown on diagram 2 on page 22.

Note: CONNECTING THE END OF THE PIPE TO THE END OF A VEHICLE’S EXHAUST PIPE IS NOT PERMITTED.

Temperature changes cause alterations of length and this must be taken into account when cutting and installing pipe lines.

Note: 1 meter (39”) of HDPE pipe will elongate by 2 millimeters (0.08”) per 10°C (18°F) of increase in temperature, and will shorten by the same margin in decrease of temperature.

Directional changes of the pipeline profile are achieved by installing pipe bends. To a limited degree the elasticity of the pipe material can be used to bend the pipe without pre-warming. The smallest permissible bending radius must, however, not fall below the values given in the following table:

<table>
<thead>
<tr>
<th>Pressure Class (PN)</th>
<th>Smallest permissible bending radius at 68°F</th>
</tr>
</thead>
<tbody>
<tr>
<td>6 (87psi)</td>
<td>30 X Diameter of inner pipe</td>
</tr>
<tr>
<td>10 (145 psi)</td>
<td>25 X Diameter of inner pipe</td>
</tr>
</tbody>
</table>

Overnight the pipe is allowed to relax / contract due to lower temperatures. The following morning the pipe should be buried under the sand, and restrainers such as bricks, blocks or steel saddles on the pipe removed. Following this procedure will eliminate expansion /contraction generated by subsequent temperature changes and 300 foot lengths could be welded (joined) together without undue stress on the actual weld.
3.1.4. Transport and Storage of Pipe and fittings

3.1.4.1. Pipe:
The pipe comes in both coils and straight lengths, the storage and transport procedure for lengths and coils is the same, in that the pipe should not be deformed or damaged, this is achieved by observing the following steps:

- Coils stacked on site must not exceed a stacking height of 6 feet. Lengths of pipe should be stacked in a beehive form not exceeding 3 foot in height.
- The storage area must be flat (no sharp objects) and preferably to support the complete area of the pipe.
- Pipe coils should also be stored on flat surfaces, having suitable protection for the bottom coil. Individual coils should also be stored flat, however, if stored on the edge, they must be secured properly against an anchored support, and should remain in this position for only a short period of time.
- Dragging of pipe, straight lengths or coils along the ground must be avoided. Scratches or striations greater than 10% of wall thickness on the wall of the pipe are not permitted, and according to ISO 4427, would nullify the pressure rating of the pipe.
- Although the pipes have a UV stabilizer which gives protection against sunlight for an extended period of time, pipes should be stored under cover.

During transport of pipe, the following should be observed:

- Pipes should be transported by a suitable vehicle (flatbed truck) and loaded and unloaded under trained and experienced supervision.
- When lifting pipe bundles by crane, non-metallic band slings should be used, do not use hooks, chains or hawsers. Both sticks and coils can be offloaded using a forklift, provided the forks sharp edges are suitably covered.
- Avoid kinking of the pipe
- If possible, sticks should be supported throughout their total length during transport.

3.1.4.2. Fittings
During the storage and transport of fittings, the following should be observed:

- Fittings must have a bar code affixed to them
- They must be stored inside their individual plastic bags and boxes
- Fittings should not be thrown around
- Fittings should be stored in dry conditions and under cover
- Fittings to remain in their packaging until ready for use
- Under no circumstances should the electrofusion surface be touched
3.1.4.3. Summary of basic rules for handling and storage

**YOU MUST NEVER:**
- Drag or roll individual sticks, bundles, or coils.
- Toss or drop pipes from the delivery vehicle.
- Use metal slings, hooks or chains when handling pipes.
- Stack pipe coils more than 6 foot high.
- Stack pipe lengths more than 3 foot high.

**YOU MUST ALWAYS:**
- Store pipes on firm, level ground able to withstand the weight of the pipe.
- Keep pipe/fittings well away from sharp objects.
- Use wide non-metallic slings when lifting pipe.
- Keep protective packaging intact until pipes/fittings are ready to be used.
- Keep pipe and fittings away from intense heat, except when jointing.
- Ensure lifting points are evenly spaced.

3.2 Workmanship

The Electr-O-Fuze™ system is tested according to international standards, however, a system is only as good as the people that are installing it, therefore it is the intention of Advantage Earth Product, Inc. and it’s certified representatives intention to assist in the installations if need be to ensure the continued high level of workmanship.

3.2.1 COUPLING SYSTEM

- Check that each fitting has a bar code attached to it.
- If the bar code of a fitting is damaged or lost, just read the bar code of the exact same fitting for the weld.
- Fittings on site must be stored properly, as per section 3.1.4.2.
- Each fitting should be checked as it is removed from its packaging for any defects.
- Do not mishandle fittings.
- Do not touch fitting inside with dirty or greasy hands.
- Scrape the pipe to remove the fluorination layer in the fusion zone.
- Fittings should be cleaned with a solvent such as acetone/ rubbing alcohol and a clean white lint free cloth before the pipe is inserted into it.
- Use appropriate fitting for correct application - consult supplier for information on available range.
- HDPE fittings must only be used on HDPE pipe.
- **Do not thread HDPE pipe** and use as a transition fitting or stub flange for plastic to metal connections.
- Prevent adaptor connections from getting dirty.
- After welding the fitting, it is compulsory to write welding time taken, date, name of welder, as well as number of weld (if using printer facility) on fitting (For this purpose, Advantage Earth Products, Inc. supply a special marker).
- In the case of power failure while welding, give the full recommended cooling time, and then re-weld the fitting.
• Over and above these instructions, it is important to follow the supplier’s assembly instructions.
• Consult supplier if uncertain in order to save time and costs.
• Do not use plastic compression fittings for both fuel and gas installations.

3.2.2. PRESSURE TESTING THE ELECTR-O-FUZETM SYSTEM
There are two means of pressure testing the Electr-O-Fuze™ system, Pneumatic Pressure Test, and Hydrostatic Pressure Test. The use of these two tests can be used independently of each other or in conjunction with each other. The exact test procedures will be dependent upon requirements of the owner, consulting engineer or project manager meeting local/state/federal regulations.

3.2.2.1. Hydrostatic Method
• The pipe is filled with water from the highest point of the installation.
• All air is to be purged from the system, by opening all valves until the water level reaches the top of the valve at which point the valve is shut.
• Once all the air has been removed from the system, and the pipe is completely filled to the highest point, the pipe is connected to a pressure pump, using the required metal fittings and ensuring that these are sealed to a watertight fit.
• The water in the pipe is pressurized to the rated pressure of the pipe. Pressure ratings can be found on Table 5.2 pg. 30.
• Vent lines are pressurized according to ratings on Table 5.2
• Vapor recovery lines are pressurized according to ratings on Table 5.2
• As water is not compressible, leaks will show up immediately as the pressure gauge does not maintain its static pressure reading.
• Once the rated pressure has been attained, this pressure test must be maintained for a period of at least 1 hour.

3.2.2.2. Pneumatic Method
• Either air or nitrogen are pressurized in the line to the rated pipe pressures
  • Air should only be used in new installations before any hydrocarbon solvent has been introduced inside the pipe.
  • Where Hydrocarbons have passed in the pipe, or in a situation where maintenance on the pipe system needs to be performed ONLY NITROGEN should be used as the pressurizing gas.
• The gas in the pipe is pressurized to the rated pressure of the pipe. Pressure ratings can be found below on Table 5.2
• Vent lines are pressurized according to ratings on Table 5.2
• Vapor recovery lines are pressurized according to ratings on Table 5.2
• Once the lines have been pressurized, a soap and water test should be performed on each fitting of the pressurized line.
  • A soap and water solution is mixed.
  • Due to the fact that gas compresses it is difficult to see small leaks. The soap will cause bubbles to form at the leak making it easier to see.
  • The solution is applied at the pipe to fitting interface. Picture 1 (page 30)
- Look for any bubbles forming, if any, then there is a leak.
- As gas is very susceptible to temperature change, and expands and contracts proportionally, it is very important to note that there will be a pressure variance (positive or negative) on the gauge.
- The most ideal situation would be leaving the pipe system test under pressure for 24 hours, start and finish at the same time of the day.

<table>
<thead>
<tr>
<th>Pipe Size</th>
<th>Primary Pipe max. (PSI)</th>
<th>Primary Pipe min. (PSI)</th>
<th>Secondary with Electrofusion fitting</th>
<th>Secondary with Rubber Boot</th>
<th>Vent Line Max. (PSI)</th>
<th>Vent Line min. (PSI)</th>
<th>Vapor Line Max. (PSI)</th>
<th>Vapor Line Min. (PSI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>50mm (1½”)</td>
<td>145</td>
<td>60</td>
<td>50</td>
<td>5</td>
<td>145</td>
<td>60</td>
<td>145</td>
<td>60</td>
</tr>
<tr>
<td>63mm (2”)</td>
<td>130</td>
<td>60</td>
<td>50</td>
<td>5</td>
<td>130</td>
<td>60</td>
<td>130</td>
<td>60</td>
</tr>
<tr>
<td>90mm (3”)</td>
<td>75</td>
<td>60</td>
<td>50</td>
<td>5</td>
<td>75</td>
<td>60</td>
<td>75</td>
<td>60</td>
</tr>
<tr>
<td>110mm (4”)</td>
<td>75</td>
<td>60</td>
<td>50</td>
<td>5</td>
<td>75</td>
<td>60</td>
<td>75</td>
<td>60</td>
</tr>
<tr>
<td>32/40mm (1/1 ¼ ”)</td>
<td>150</td>
<td>60</td>
<td>50</td>
<td>5</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>40/50mm (1¼ /1½”)</td>
<td>150</td>
<td>60</td>
<td>50</td>
<td>5</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>50/63mm (1½/2”)</td>
<td>145</td>
<td>60</td>
<td>50</td>
<td>5</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>63/75mm (2/2½)</td>
<td>130</td>
<td>60</td>
<td>50</td>
<td>5</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>90/110mm (3/4”)</td>
<td>75</td>
<td>60</td>
<td>50</td>
<td>5</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>110/169mm (4/6”)</td>
<td>75</td>
<td>60</td>
<td>50</td>
<td>5</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

**Table 5.2: Showing Pressure rating of pipe**

Applying the soap solution to the pressurized line at the pipe/fitting interface

**Picture 1**
QC NOTE: BOTH PRESSURE TEST METHODS ARE VALID AND WIDELY USED. IT IS THEREFORE UP TO THE END USER TO DECIDE WHICH PRESSURE TEST TO USE. IN ORDER TO GIVE ACCURATE RESULTS, ALL TESTS MUST BE CONDUCTED CORRECTLY ACCORDING TO THE ABOVE PROCEDURE.

3.2.3. ELECTROFUSION MACHINE

- The use of a fully automatic machine with report print out capabilities is compulsory, as it prevents most human errors that could be made, which gives a certain guarantee to the quality of the weld. Using an electrofusion machine approved by Advantage Earth Products, Inc. is required. Such machines are provided by Advantage Earth Products, Inc. for sale or rental. The electrofusion machine must be able to measure ambient temperature and to adapt welding times accordingly, for that has a direct influence on the quality of the weld.
- The machine must have a memory and printer output capability, providing full welding documentation. It is compulsory that this printout be handed in to the project manager for quality control every 50 welds.
- A complete error facility must be available on the machine.

The Ritmo Elektra 400 and Elektra Light machines have an Error Facility, Memory and Documentation
3.3. Pipe Monitoring

Electr-O-Fuze™ secondary co-axial pipe can be monitored in 2 ways, namely,

1. Active monitoring
2. Passive monitoring

Descriptions of these methods can be found below:

3.3.1. Active Monitoring (constant vacuum or pressure)
This method is used for installed pipe where the secondary containment is sealed, and either pressure or vacuum is applied to the interstitial space. The pressure, positive or vacuum negative is constantly monitored using pressure sensors and a smart panel to measure any loss in the vacuum or pressure in the line.

3.3.2. Passive Monitoring (visual, low point in the line)
This method is used for installed pipe where the secondary containment is sealed, and no pressure or no vacuum is applied. The pipe is sloped to a single or multiple low points, allowing any leaking product to drain to the low point. At the low point, the presence of product is checked visually at regular intervals or with the aid of a passive leak sensor. The pipe is sloped to a single or multiple low points, allowing any leaking product to drain to the low point. At the low point, a leak sensor measuring device is installed either in the interstice or in a sump. These monitoring devices need to have the appropriate approvals from authority such as Pneumercator LS 600 LDBN or ES825 sensor or another manufacture’s equivalent. Veeder Root or Omtec. These sensors would be wired to the manufacturers alarm panel. If an alarm is given, that means that the sensors are in contact with product (water or fuel). This is achieved by having a small liquid collection sump which one is able to open easily to do the inspection, but when sealed is able to withstand any leaking from the inside to the environment.

4. Record Keeping

Contractors are required to submit via email, an electronic warranty card containing the details of completed or repaired installations. The cards, in PDF format, are available on the AEP website and should be returned to the designated email recipient no later than 30 days after an installation or repair has been completed in order to validate the warranty.

The following information will be required on the warranty cards:

- Responsible contractor
- Site name, site number and location
- Date site-work commenced
- Date when installation was completed
• Accredited Electr-O-Fuze™ Installation Personnel used and the designated initials as marked on all electrofusion welds
• Electr-O-Fuze™ pipe used in the installation with batch and fluorination numbers
• Number of electrofusion welds completed on the site
• Site inspector
• Appointed engineer

Contractors may also be required upon request, to furnish for any installation or repair:

• The original electrofusion machine Memo slips or records
• The approved site plans and working drawings
• The dated and signed Quality Control inspection sheet

It is important to emphasize that, the information noted on joints where electrofusion has been completed, form an integral part of the record keeping requirements.
INSTALLATION OF ELECTR-O-FUZE™ PIPE WITH THE FRIALEN® ELECTROFUSION COUPLING SYSTEM

**QC Note:** It is mandatory that every installer complete a training course and obtain a certificate in electrofusion and underground HDPE Pipe Installations. This course shall be done through Advantage Earth Products, Inc. or its certified representatives.

- Carefully study assembly instructions on the pipe and electrofusion system, before use, as installation practices for large (>4” ID) and small (<4” ID) bore pipe differ; changes need to be addressed in order to have a successful installation.
- Follow instructions strictly, without taking any short cuts. Failure to do so will result in loss of the manufacture’s warranty.
- Follow the **BASIC PRINCIPLES** for electrofusion welding:

| 1. | With a permanent marker and proper measuring device, mark the pipe depth that will be inserted into the fitting |
| QC Note: | Markings are used as a guide to ensure complete surface is scraped. |

<p>| 2. | Scrape off the fluorinated layer on the pipes where the fittings will be connected |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>3.</strong> Clean pipe of any shavings and/or sharp edges. Chamfer the inside and outside edge of the pipe with a hand scraper</td>
<td><img src="image1.png" alt="Image" /></td>
<td><img src="image2.png" alt="Image" /></td>
</tr>
<tr>
<td><strong>4.</strong> Remark the insertion depth and clamp pipe with rounder clamps</td>
<td><img src="image3.png" alt="Image" /></td>
<td></td>
</tr>
<tr>
<td><strong>5.</strong> Prior to installation, ensure there is no damage on the fitting by inspecting the EF wires, pins and outer casing.</td>
<td><img src="image4.png" alt="Image" /></td>
<td></td>
</tr>
<tr>
<td><strong>6.</strong> Clean pipe ends, welding area and fitting with a high alcohol-based liquid such as rubbing alcohol or acetone using a clean white lint free cloth.</td>
<td><img src="image5.png" alt="Image" /></td>
<td><img src="image6.png" alt="Image" /></td>
</tr>
</tbody>
</table>
7. Slide pipe into fitting right up to the depth marker on the pipe.

8. Ensure there is no tension between fitting and pipe during the welding and proper cool time period. Use clamps if necessary.

9. Connect EF machine to the fitting and scan barcode using reader wand.

QC Note: Ensure EF machine displays correct size fitting and weld time before continuing.

10. After the weld has been completed, make sure to mark fitting with date, welding time, and operators initials in permanent marker.
5. INSTALLATION MANUAL

5.1. INSTALLATION MANUAL - ELECTR-O-FUZE™ PIPE CUTTING AND INSTALLATION BETWEEN SUMPS

5.1.1. Description:
Cutting and installation of Electr-O-Fuze™ pipe between sumps is an important step, and consideration must be taken to possible pipe movement while the trenches are still uncovered, while also ensuring that enough pipe is allowed for the installation of electrofusion fittings, test boots and entry boots in the sumps. In order to achieve this, one should always cut the pipe the distance between the 2 centers which are being measured plus 10% (if center is 35’, the cut should be 35’+3.5’= 38.5’). When laying the pipe the excess should be snaked in the trench, as per the picture on pg. 41 step 12.

5.1.2. Tools:
Basic tools are required to install Electr-O-Fuze™ splice Kits on site, in addition to the common tools used in the trade, these are:

- Permanent markers
- Pipe cutter

Other tools required are tape measure, electric drill, water level, steel ruler, rounder clamp and scraper.

5.1.3. Installation:
Installation, use, and maintenance of all Electr-O-Fuze™ and rubber boot products shall be in accordance with the manufacturer’s recommendations, State and county approvals. In event of conflicts, the stricter requirement shall govern. (AEP installation manual available directly from AEP)

Prior to starting the installation of the Electr-O-Fuze™ pipe and cutting, the installer needs to ensure that he has contacted the dispenser manufacturer and obtained the correct footprint of the dispenser that will be used. This is extremely important as each dispenser has its own individual footprint and product centers. It is the responsibility of the Oil Company, the distributor and contractor to ensure that the pipe sizing to be used is correct for the application prior to installation.
**Step 1**  
**Roll out pipe and allow to relax**

Rolling out the pipe and allowing it to relax will help during the measuring process. The pipe can be pinned down during this process, being careful not to scratch or damage the pipe.

**Step 2**  
**Measure the width of the sump and distance between islands**

Using a tape measure and water level, identify the center of the sump where the pipe penetration has to pass to achieve correct fall back to the tank for the pipe. Measure center to center between the islands and add 10%, this will be the amount of pipe to cut.

**Step 3**  
**Measure**

Once the pipe has been laid out, with a tape measure along the side of the pipe, ensuring that you take any sweeps in the pipe into consideration thus ensuring that you are measuring correctly, mark the pipe with a marker.

**Step 4**  
**Cut pipe**

Cut both the primary and secondary pipe equally at the measured mark.

**Step 5**  
**Install the pipe into the measured area**

Insert pipe between the islands into the sumps to ensure that the pipe has been cut correctly.
**Step 6**
Measure space in the sump from center to wall

Measure the sump from wall to wall on the inside and divide by 2, to get the center. That measurement is equal to the amount of pipe that needs to penetrate the sump.

**Step 7**
Cut back the secondary pipe (scrape in case of EF boot use)

Cut back the secondary pipe ensuring that you have enough primary pipe exposed to insert primary fitting, test boot, and enough secondary pipe to enter the sump. (NOTE: For electro fusion boots, the secondary pipe is terminated at the outside of the sump and electrofused on the outside of sump onto the boot).

**Step 8**
Measure the fitting

Measure the fitting from the inside center (at the stopper pin) to the outside edge to determine how much of the primary pipe needs to be scrapped. Alternatively, measure the length of the fitting and divide by 2 to find the length of your fusion zone.

**Step 9**
Mark the pipe and scrape

Mark the pipe and scrape the primary pipe

**Step 10**
Pass pipe into sumps and assemble

Pass the pipe through the entry boots, insert the test boots, and insert electrofusion fitting (NOTE: When putting on the fittings refer to Installation Manual for correct instruction and follow the “Basic Principles”). Do one side and repeat operation for the other side of the Tee.
Step 11
Insert pipe onto second side of tee

Insert the outgoing pipe into the second side of the tee. (NOTE: When putting on the fittings refer to Installation Manual for correct instruction and follow the “Basic Principles”). Beware not to weld the fitting under stress.

Step 12
Peg down the pipe

When pipe is welded on both sides and at two adjacent sumps, peg the pipe down in a sinusoidal curve to take up the excess.

NOTE: Boots installed with pipe penetrating the boot at angles greater than 15° from the perpendicular could have both short term and long term damage. In these cases the manufacturer’s warranty will not be valid.
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INSTALLATION MANUAL

COAXIAL ELBOW (45° or 90°)
5.2. INSTALLATION MANUAL-COAXIAL ELBOW (45° or 90°)

5.2.1. Description:
Coaxial Elbows are used for sharp changes in direction. Pipe splicing is an important procedure as this allows the user of Electr-O-Fuze™ pipe the opportunity of a short change in direction with either 2 coils, a coil and a stick, or two sticks of pipe, while maintaining the integrity of both the primary and secondary pipes. A further advantage is that the Coaxial Elbows are a direct bury part and therefore there is no need for a transition sump.

These instructions will show the correct way of installing a Coaxial Elbow.

5.2.2. Installation:
Installation, use, and maintenance of all Electr-O-Fuze™ and rubber boot products shall be in accordance with the manufacturer’s recommendations, State and county approvals. In the event of conflicts, the stricter requirement shall govern. *(AEP installation manual is available directly from AEP)*

5.2.3. Tools:
Basic tools are required to install Electr-O-Fuze™ Elbows on-site. Failure to use these specified tools will result in the warranty being voided. These tools are in addition to the common tools used in the trade:

- **Permanent markers**: AEP part #’s: SP39100
- **Pipe cutter**: AEP part #’s: T-PC1, T-PC2 or T-PC3 depending on pipe outside diameter
- **Hand Scrapper**: AEP part #’s: TPSH
AEP Part #’s:
T-PS1, or T-PS2, or T-PS3

5.2.4. Coaxial Elbow Parts:
A Coaxial Elbow comprises of two reducers to match a pipe; a Coaxial Elbow Piece with a Primary Elbow. Its primary use is to join two pieces of pipe (primary and secondary) in order to form a continuous joint which is testable to required pressures for both the primary and secondary pipe. The joint is a direct bury joint.

(4) Coaxial elbow - 45° or 90°
(5) Electrofusion reducer (secondary)
(3) Primary electrofusion Elbow - 45° or 90°
5.2.5. Installation Procedure:
Prior to starting the installation of the Electr-O-Fuze™ pipe, cutting and installing an elbow, the installer needs to ensure that he has enough pipe and fittings to conduct the operation. The installer also needs to ensure that he has the correct fitting sizes to match the pipe. Keep in mind that when adding an elbow, ensure that the added friction losses in the longer pipe still provide the desired flow rate to the end point. A simple calculation can be performed by the on-site engineer to confirm that this is indeed the case before any pipe is installed. It is the responsibility of the Oil Company, the distributor and contractor to ensure that the pipe sizing to be used is correct for the application prior to installation.

- **Step 1**: Align both ends of the pipe being joined where the Coaxial fitting will be placed.

- **Step 2**: Make sure pipe ends are cut square using the appropriate sized pipe cutter. *(both primary and secondary pipe)*

- **Step 3**: Using the tape measure, pull back from the face of the primary pipe and mark the secondary pipe which needs to be cut back on both ends of the pipe.

- **Step 4**: Cut the secondary pipe at the marks, ensuring that the cutter blade does not score, puncture or damage the primary pipe.

- **Step 5**: Using your tape measure, measure the fusion zone of the larger side of the reducer to be used.

- **Step 6**: Transfer the measurement obtained in step 5, using your tape measure pull back from the end of the secondary elbow and mark – repeat this step for both ends of the elbow.
Step 7

Thoroughly scrape the fusion zone on either side of the Coaxial Elbow Secondary sleeve to the marks.

Step 8

Using the tape measure, pull back from the face of the secondary pipe to mark the scrape stopping point for the slide over reducers.

(Refer to appendix for all dimensions)

Step 9

Scrape back to the marking point on the secondary pipe. Ensure that the secondary reducer slides easily up and down the length of the pipe. The reducer MUST NOT be forced onto the pipe as this could damage the wires.

Step 10

Using the hand scraper, remove all sharp edges that may have been created while using the mechanical scraper. This is achieved by scraping these edges at 90° to the direction in which they run.

Step 11

After scraping the secondary pipe, place the Slide Over Reducer on the pipe in the final fusion position and mark the circumference of the pipe on the outside edge of the reducer (on the smaller side). Once marked, slide back the reducer to the end of the scrape zone. (if stops are in the fitting, make sure to knock out using the end of the pipe for that particular size) Be sure not to damage the wires during this process.

At this point you should have your secondary containment fittings in place on both ends.

Step 12

Measure the fusion zone of the primary fitting required, transfer this measurement onto both ends of the primary pipe, mark and scrape the pipe ends.
**Step 13**

Attach the Crocodile clamps provided onto the electrodes of the primary elbow, and connect the other end to the electrofusion machine.

Follow the BASIC PRINCIPLES for electrofusion.

**Step 14**

Pressure test and soap test the primary fitting before sealing the secondary containment. (MAKE SURE not to get any excess soap or water in the secondary containment fittings)

Appendix B has a list of approved soap solutions to be used. (NOT MEGABUBBLE).

**Step 15**

Slide the secondary containment fittings to the marks made in Step 6 and push up to the marks on the Coaxial fitting (follow the BASIC PRINCIPLES).

**Step 16**

Pressure test and soap test the secondary fitting.

Appendix B has a list of approved soap solutions to be used. (NOT MEGABUBBLE).
**INSTALLATION OF ELECTR-O-FUZE™ PIPE WITH THE FRIALEN® ELECTROFUSION COUPLING SYSTEM**

**QC Note:** It is mandatory that every installer complete a training course and obtain a certificate in electrofusion and underground HDPE Pipe Installation. This course shall be done through Advantage Earth Products, Inc. or its certified representatives.

- Carefully study assembly instructions on the pipe and electrofusion system, before use, as installation practices for large (>4” ID) and small (<4” ID) bore pipe differ and these changes need to be addressed in order to have a successful installation.
- Follow instructions strictly, without taking any short cuts. Failure to do so will result in loss of the manufactures warranty.
- Follow the **BASIC PRINCIPLES** for electrofusion welding:

<table>
<thead>
<tr>
<th>Step</th>
<th>Instruction</th>
</tr>
</thead>
</table>
| 1.   | With a permanent marker and proper measuring device, mark the pipe depth that will be inserted into the fitting.  
**QC Note:** Markings are used as a guide to ensure complete surface is scraped. |
| 2.   | Scrape off the fluorinated layer on the pipes where the fittings will be connected. |
3. Clean pipe of any shavings and/or sharp edges. Chamfer the inside and outside edge of the pipe with a hand scraper.

4. Remark the insertion depth and clamp pipe with rounder clamps.

5. Prior to installation, ensure there is no damage on the fitting by inspecting the EF wires, pins and outer casing.

6. Clean pipe ends, welding area and fitting with a high alcohol-based liquid such as rubbing alcohol or acetone using a clean white lint free cloth.
<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>7.</strong></td>
<td>Slide pipe into fitting right up to the depth marker on the pipe.</td>
</tr>
<tr>
<td><strong>8.</strong></td>
<td>Ensure there is no tension between fitting and pipe during the welding and proper cool time period. Use clamps if necessary.</td>
</tr>
<tr>
<td><strong>9.</strong></td>
<td>Connect EF machine to the fitting and scan barcode using reader wand.</td>
</tr>
<tr>
<td>QC Note:</td>
<td>Ensure EF machine displays correct size fitting and weld time before continuing.</td>
</tr>
<tr>
<td><strong>10.</strong></td>
<td>After the weld has been completed, make sure to mark fitting with date, welding time, and operators initials in permanent marker.</td>
</tr>
</tbody>
</table>
### 5.2.6. APPENDIX A

<table>
<thead>
<tr>
<th>Diameter</th>
<th>Elbow Type</th>
<th>Instructions</th>
</tr>
</thead>
</table>
| 1 1/2”    | Coaxial 90° Elbow | - Cut Back 5 1/2” on Both Ends of Secondary Pipe  
- Scrape Back 7” on both ends of the pipe |
| 1 1/2”    | Coaxial 45° Elbow | - Cut Back 4 3/4” on Both Ends of Secondary Pipe  
- Scrape Back 7” on both ends of the pipe |
| 2”        | Coaxial 90° Elbow | - Cut Back 4” on Both Ends of Secondary Pipe  
- Scrape Back 7” on both ends of the pipe |
| 2”        | Coaxial 45° Elbow | - Cut Back 3 3/4” on Both Ends of Secondary Pipe  
- Scrape Back 7” on both ends of the pipe |
| 3”        | Coaxial 90°45° Elbow | - Cut Back 4 1/2” on Both Ends of Secondary Pipe  
- Scrape Back 7” on both ends of the pipe |
5.3. INSTALLATION MANUAL- COAXIAL TEE

5.3.1. Description:
Coaxial Tees are used for sharp changes in direction. Pipe splicing is an important procedure as this allows the user of Electr-O-Fuze™ pipe the opportunity of a short change in direction with either 2 coils, a coil and a stick, or two sticks of pipe, while maintaining the integrity of both the primary and secondary pipes. A further advantage is that the Coaxial Tees are a direct bury part and therefore there is no need for a transition sump.

These instructions will show the correct way of installing a Coaxial TEE.

5.3.2. Installation:
Installation, use, and maintenance of all Electr-O-Fuze™ and rubber boot products shall be in accordance with the manufacturer’s recommendations, State and county approvals. In the event of conflicts, the stricter requirement shall govern. *(AEP installation manual available directly from AEP)*

5.3.3. Tools:
Basic tools are required to install Electr-O-Fuze™ Tees on site, in addition to the common tools used in the trade, the following are:

- **Permanent markers**
  - *AEP part #’s:*
  - SP39100

- **Pipe cutter**
  - *AEP part #’s:*
  - T-PC1, T-PC2 or T-PC3 depending on pipe outside diameter

- **Hand Scrapper**
  - *AEP part #’s:*
  - TPSH

- **Mechanical Scrapper**

- **Tape Measure**

- **Rouder Clamps**
  - *AEP Part #’s:*
  - T-PS1, or T-PS2, or T-PS3
5.3.4. Coaxial Tee Parts:
A Coaxial Tee comprises of three reducers to match pipe, a Coaxial Tee Piece, and Primary Tee. Its primary use is to join three pieces of pipe (primary and secondary) in order to form a continuous joint which is testable to required pressures for both the primary and secondary pipe. The joint is a direct bury joint.

![Coaxial Tee Parts Diagram]

- **Coaxial Tee Piece:** Describes the connection point between the primary and secondary pipes.
- **Primary electrofusion Tee:** The main tee used to connect the primary and secondary pipes.
- **Electrofusion reducer (secondary):** Reduces the diameter of the secondary pipe.
- **Secondary Coaxial Pipe for Tee:** The pipe that connects to the secondary side of the tee.

5.3.5. Installation Procedures:
Prior to starting the installation of the Electr-O-Fuze™ Coaxial Tee, the installer needs to ensure that he has enough pipe and fittings to conduct the operation. The installer also needs to ensure that he has the correct fitting sizes to match the pipe. When adding a tee, ensure that the added friction losses in the longer pipe still provide the desired flow rate to the end point. A simple calculation can be performed by the on-site engineer to confirm that this is indeed the case before any pipe is installed. It is the responsibility of the Oil Company, the distributor and contractor to ensure that the pipe sizing to be used is correct for the application prior to installation.
Step 1
Align the ends of the pipe being joined where the COAXIAL TEE fitting will be placed.

Step 2
Make sure pipe ends are cut square using the appropriate pipe cutter – (both Primary and Secondary Pipe).

Step 3
Using your tape measure pull back from the face of the primary pipe and mark the secondary pipe which needs to be cut back (See appendix A for measurements).

Step 4
Cut secondary pipe at the marks, ensuring that the cutter blade does not score, puncture or damage the primary pipe.

Step 5
Using your tape measure, measure the fusion zone of the larger side of the reducer to be used.

Step 6
Transfer the measurement obtained in step 5, using your tape measure pull back from the end of the secondary Tee and mark – repeat this step for both ends of the Tee.

Step 7
Thoroughly scrape the fusion zone on either side of the Coaxial Tee Secondary sleeve to the marks.

Step 8
Using your tape measure, pull back from the face of the secondary pipe to mark the scrape stopping point for the slide over reducers. (see appendix A for measurements).
Scrape back to the marking point on the secondary pipe. Ensure that the secondary reducer slides easily up and down the length of the pipe. The reducer **MUST NOT** be forced onto the pipe as this could damage the wires.

Ensure to smoothen all sharp edges that may have been created while using the mechanical scraper. This is achieved by scraping these edges at 90° to the direction in which they run using a hand scraper.

After scraping the secondary pipe, place the slide over reducer on the pipe in the final fusion position and mark the circumference of the pipe on the outside edge of the reducer *(on the small side)*. Once marked, slide back the reducer to the end of the scrape point. *(if stops are in the fitting, make sure to knock out using the end of the pipe for that particular size)* Be sure not to damage the wires during this process.

At this point you should have your secondary containment fittings in place on both ends.

Measure the fusion zone of the primary fitting required, transfer this measurement onto both ends of the primary pipe, mark and scrape the pipe ends.
Step 13
Attach the Alligator clips provided onto the electrodes of the primary TEE, and connect the other end to the electrofusion machine. Follow the BASIC PRINCIPLES FOR ELECTROFUSION.

Step 14
Ensure that the coupler on the branch of the TEE is well inserted and that all the marks on the primary pipe line up with the end of the coupler.

Step 15
Attach the Alligator clips provided onto the electrodes of the primary coupler on the branch of the TEE, and connect the other end to the electrofusion machine. Follow the BASIC PRINCIPLES for electrofusion - Below

Step 16
Ensure to pressure test and soap test the primary fitting before sealing the secondary containment. (MAKE SURE not to get any excess soap or water in the secondary containment fittings).

Appendix B has a list of approved soap solutions to be used (NOT MEGABUBBLE)

Step 17
Slide the secondary containment fittings to the marks made in Step 6 and push up to the marks on the COAXIAL fitting (follow the BASIC PRINCIPLES FOR ELECTROFUSION).

Step 18
Pressure test and soap test the secondary fitting. Appendix B has a list of approved soap solutions to be used (NOT MEGABUBBLE).
**INSTALLATION OF ELECTR-O-FUZE™ PIPE WITH THE FRIALEN® ELECTROFUSION COUPLING SYSTEM**

*QC Note:* It is mandatory that every installer complete a training course and obtain a certificate in electrofusion and underground HDPE Pipe Installation. This course shall be done through Advantage Earth Products, Inc. or its certified representatives.

- Carefully study assembly instructions on the pipe and electrofusion system, before use, as installation practices for large (>4” ID) and small (<4” ID) bore pipe differ; and these changes need to be addressed in order to have a successful installation.
- Follow instructions strictly, without taking any short cuts. Failure to do so will result in loss of the manufacturers warranty.
- Follow the **BASIC PRINCIPLES** for electrofusion welding:

<p>| | |</p>
<table>
<thead>
<tr>
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</thead>
</table>
| **1.** | With a permanent marker and proper measuring device, mark the pipe depth that will be inserted into the fitting  
*QC Note:* Markings are used as a guide to ensure complete surface is scraped. |
|   |   |
| **2.** | Scrape off the fluorinated layer on the pipes where the fittings will be connected |
3. Clean pipe of any shavings and/or sharp edges. Chamfer the inside and outside edge of the pipe with a hand scraper.

4. Remark the insertion depth and clamp pipe with rounder clamps.

5. Prior to installation, ensure there is no damage on the fitting by inspecting the EF wires, pins and outer casing.

6. Clean pipe ends, welding area and fitting with a high alcohol-based liquid such as rubbing alcohol or acetone using a clean white lint free cloth.
7. Slide pipe into fitting right up to the depth marker on the pipe.

8. Ensure there is no tension between fitting and pipe during the welding and proper cool time period. Use clamps if necessary.

9. Connect EF machine to the fitting and scan barcode using reader wand.

**QC Note:** Ensure EF machine displays correct size fitting and weld time before continuing.

10. After the weld has been completed, make sure to mark fitting with date, welding time, and operators initials in permanent marker.
### 5.3.6. APPENDIX A

<table>
<thead>
<tr>
<th>Size</th>
<th>Operations</th>
</tr>
</thead>
</table>
| 1 ½” Coaxial TEE | • Cut Back 5 ½” on Both Ends of Secondary Pipe  
                  • Scrape Back 7” on both ends of the pipe |
| 2” Coaxial TEE  | • Cut Back 4” on Both Ends of Secondary Pipe  
                  • Scrape Back 7” on both ends of the pipe |
| 3” Coaxial TEE  | • Cut Back 4 ½” on Both Ends of Secondary Pipe  
                  • Scrape Back 7” on both ends of the pipe |
5.4 INSTALLATION MANUAL- SPLICE KIT

5.4.1. Description:
Pipe splicing is an important procedure as this allows the user of Electr-O-Fuze™ pipe the opportunity of joining 2 coils, or a coil and a stick, or two sticks of pipe together, while maintaining integrity of both the primary and secondary pipes. A further advantage is that the splice kit is a direct bury part and therefore there is no need for a transition sump. These instructions will show the correct way of installing a splice kit.

5.4.2. Installation:
Installation, use, and maintenance of all Electr-O-Fuze™ products shall be in accordance with the manufacturer’s recommendations, State and county approvals. In the event of conflicts, the stricter requirement shall govern. (AEP installation manual is available directly from AEP.)

5.4.3. Tools:
Basic tools are required to install Electr-O-Fuze™ Splice Kits on site, in addition to the common tools used in the trade, the following are:

- Permanent markers
  - **AEP part #’s:** SP39100

- Pipe cutter
  - **AEP part #’s:** T-PC1, T-PC2 or T-PC3 depending on pipe outside diameter

- Hand Scrapper
  - **AEP part #’s:** T-PSH
AEP Part #'s:
T-PS1, or T-PS2, or T-PS3

5.4.4. Splice Kit Parts:
A splice kit comprises of two reducers to match pipe, a spool piece and primary coupler. Its primary use is to join two pieces of pipe (primary and secondary) in order to form a continuous joint which is testable to required pressures for both the primary and secondary pipe. The joint is a direct bury joint.

(2) Secondary Pipe spool piece
(4) Electrofusion reducer (secondary)
(3) Primary electrofusion coupler
5.4.5. Installation Procedures:
Prior to starting the installation of the Electr-O-Fuze™ pipe, cutting and splicing, the installer needs to ensure that he has enough pipe and fittings to conduct the operation. The installer also needs to ensure that he has the correct fitting sizes to match the pipe. Another very important point to keep in mind is that when splicing pipe together one has to ensure that the added friction losses in the longer pipe still provide the desired flow rate to the end point. A simple calculation can be performed by the on-site engineer to confirm that this is indeed the case before any pipe is installed. It is the responsibility of the Oil Company, the distributor and contractor to ensure that the pipe sizing to be used is correct for the application prior to installation.

**Step 1**
Align the two pieces of pipe which are being spliced, and butt them together ensuring that they line up

**Step 2**
Make sure pipe ends are cut square using the appropriate pipe cutter – (both Primary and Secondary Pipe)

**Step 3**
Using your tape measure pull back from the face of the primary pipe and mark the secondary pipe which needs to be cut back (See appendix A for measurements)

**Step 4**
Cut secondary pipe at the marks, ensuring that the cutter blade does not score, puncture or damage the primary pipe
Step 5
Using your tape measure, measure the fusion zone of the larger side of the reducer to be used

Step 6
Transfer the measurement obtained in step 5, using your tape measure pull back from the end of the spool piece and mark – repeat this step for both ends of the spool piece

Step 7
Thoroughly scrape the fusion zone on either side of the spool piece to the marks

Step 8
Using your tape measure, pull back from the face of the secondary pipe to mark the scrape stopping point for the slide over reducers. (See appendix A for measurements). There will be a longer scraped side for the spool piece and reducer
Scrape back to the marking point on the secondary pipe. Ensure that the secondary reducer slides easily up and down the length of the pipe. The reducer MUST NOT be forced onto the pipe as this could damage the wires. Ensure to smoothen all sharp edges that may have been created while using the mechanical scraper. This is achieved by scraping these edges at 90° to the direction in which they run using a hand scraper.

After scraping the secondary pipe, place the slide over reducer on the pipe in the final fusion position and mark the circumference of the pipe on the outside of the smaller side of the reducer with a permanent marker. Once this operation is complete, slide back the reducer to the stopping point. (If there are stoppers in the reducer, knock these out using the end of the pipe on which it is fitted. Be careful not to damage any of the wires). At this point you should have your secondary containment fittings in place on both ends.

Place the second reducer with the scrapped side and marked spool piece on the longer scrapped side of the secondary pipe.
**Step 12**

Measure the fusion zone of the primary fitting required, transfer this measurement onto both ends of the primary pipe, mark and scrape the pipe ends.

**Step 13**

Follow the BASIC PRINCIPLES for electrofusion.

**Step 14**

Ensure to pressure test and soap test the primary fitting before sealing the secondary containment. (MAKE SURE not to get any excess soap or water in the secondary containment fittings) Appendix B has a list of approved soap solutions to be used (NOT MEGABUBBLE)

**Step 15**

Slide the secondary containment fittings to the marks made in Step 9 and push up to the marks on the spool piece (follow steps 12 & 13)
INSTALLATION OF ELECTR-O-FUZE™ PIPE WITH THE FRIALEN® ELECTROFUSION COUPLING SYSTEM

**QC Note:** It is mandatory that every installer complete a training course and obtain a certificate in electrofusion and underground HDPE Pipe Installation. This course shall be done through Advantage Earth Products, Inc. or its certified representatives.

- Carefully study assembly instructions on the pipe and electrofusion system, before use, as installation practices for large (>4” ID) and small (<4” ID) bore pipe differ, and these changes need to be addressed in order to have a successful installation.
- Follow instructions strictly, without taking any short cuts. Failure to do so will result in loss of the manufacturer's warranty.
- Follow the **BASIC PRINCIPLES** for electrofusion welding:

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
</table>
| 1. | With a permanent marker and proper measuring device, mark the pipe depth that will be inserted into the fitting  

**QC Note:** Markings are used as a guide to ensure complete surface is scraped.  

<p>| | |</p>
<table>
<thead>
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</table>
| 2. | Scrape off the fluorinated layer on the pipes where the fittings will be connected  

Note: specifications subject to change without notice 08/15
### 3. Clean pipe of any shavings and/or sharp edges. Chamfer the inside and outside edge of the pipe with a hand scraper.

### 4. Remark the insertion depth and clamp pipe with rounder clamps.

### 5. Prior to installation, ensure there is no damage on the fitting by inspecting the EF wires, pins and outer casing.

### 6. Clean pipe ends, welding area and fitting with a high alcohol-based liquid such as rubbing alcohol or acetone using a clean white lint free cloth.
7. Slide pipe into fitting right up to the depth marker on the pipe.

8. Ensure there is no tension between fitting and pipe during the welding and proper cool time period. Use clamps if necessary.

9. Connect EF machine to the fitting and scan barcode using reader wand.

*QC Note:* Ensure EF machine displays correct size fitting and weld time before continuing.

10. After the weld has been completed, make sure to mark fitting with date, welding time, and operators initials in permanent marker.
### 5.4.6. APPENDIX A

<table>
<thead>
<tr>
<th>Splice Kit</th>
<th>Requirements</th>
</tr>
</thead>
</table>
| **1 ½”** Splice Kit | - Cut Back 5” on Both Ends of Secondary Pipe  
- Scrape Back 7” on one of the ends of the pipe  
- Scrape Back 12” on the other end |
| **2”** Splice Kit | - Cut Back 5” on Both Ends of Secondary Pipe  
- Scrape Back 4” on one of the ends of the pipe  
- Scrape Back 11” on the other end |
| **3”** Splice Kit | - Cut Back 8” on Both Ends of Secondary Pipe  
- Scrape Back 18” on one side and 10” on the other |
INSTALLATION MANUAL

Transition Sump
5.5. INSTALLATION MANUAL- TRANSITION SUMP

5.5.1. Description
Electr-O-Fuze™ Sumps use a combination of proven technologies for its success, these are: Split sump principles for easy access during installation, safe and reliable proven electrofusion technology using closed wire principles for sealing when the installation is complete. Electr-O-Fuze™ Sumps also come with a fluorination option of the sump bottoms for extra protection against hydrocarbon leaks such as gasoline and diesel. When used with an approved electrofusion welder, it provides an installation with a 30 year life span.

Sump covers are made of Aluminum for strength and corrosion prevention. Sumps all come with a level adjustable feature, ensuring level optimization on site. The bottom of the sump offers a large flat face that allows a wide range of options for penetration of the sump.

5.5.2. Specifications:
The sump top and bottom are made of a roto molded polyethylene with ¼” thick walls. The sump top is made of aluminum offering a robust non corrosive top with a steel frame which offers concrete anchors and a watertight seal.

The sump offers the option of having a relatively low bottom, this makes it easy to work with as the installer is able to easily access the components that are being installed in the sump bottom. Once the installation is complete, the sump top is welded and adjusted for grade.

The EF welding technology used to connect the top and bottom is designed to be permanent, providing a watertight seal. Under no circumstances should this seal be breached as the sump will lose its watertightness and also all of its warranties.
Sump dimensions are:  
Base 42” long, 28” wide, 17.5” high (external)  
Top: fixed section 42” long, 28” wide and 10.5”  
Top: **adjustable section** 36” long, 17” wide and 13” adjustable height

### 5.5.3 Installation:
Installation, use, and maintenance of all Electr-O-Fuze™ products shall be in accordance with the manufacturer’s recommendations, State and county approvals. In the event of conflicts, the stricter requirement shall govern.
All sump penetrations must be done on the flat sections of the sump bottom which has 4 faces which can be penetrated, the dimensions of those faces are described above “sump specifications”.

At no time can the electrofusion joint between the sump top and bottom be breached as the fusion is recessed and there is no way to seal it once it has been breached creating leaks.

The bottom and the tops have a lot of play in them to allow for grade adjustments on both long and short side of the sumps as per pictures below.
Once the installation of the components has been completed, the two sides of the sump can be welded together. This procedure requires for the two lips of the sump top and sump bottoms be scraped to remove any oxidation and/or fluorination, the faces are then cleaned with Acetone/alcohol. Once cleaned the top and bottom are lined up, pressure points are set on the sump lips and the machine is connected. Using the welding parameters supplied with the sump, the EF machine is programmed to the correct time and amperage thereafter started. A 15 minute cool down is given before the sump is moved again.

Testing is conducted with water. The sump is filled to ¾ of the sump height with water, but well above the EF joint line and allowed to stand for a 3 hour period to look for any leaks along the weld or at the entry boots. Should a leak be found either re-weld the sump or refit the entry boots, depending where the leak was found.

For any assistance do not hesitate to contact AEP.