Installation Guidelines
For Electrofusion Couplings
14” and Larger

TN-34/2009
Foreword

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The Plastics Pipe Institute
Phone: (469) 499-1044

http://www.plasticpipe.org

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A. Safety:
Jobsite safety requirements should be fully understood and observed.

Electrofusion fittings and equipment are not intended to be, and are not "Explosion Proof". If used in a volatile environment, additional ignition concerns may be present and are not addressed in this document.

When moisture at the fusion site is a safety concern, connect the leads to the fitting before the control unit is powered up. Take safety precautions to prevent exposure to electrical shock hazards.

B. Operator Experience:
Electrofusion couplings should only be installed by persons that have received training from an authorized electrofusion instructor, that have a strong working knowledge of polyethylene and heat fusion, and have qualified 14” and larger electrofusion joints through destructive testing. This document is a guide only, and should not be used in place of training by an authorized electrofusion instructor. Failure to follow all preparation steps can result in joint failure or leakage due to contamination or improper installation.

Destructive tests are described in ASTM F1055-98 (2006) and can be in the form of burst tests, bend tests, peel tests and other methods useful in determining the quality of a fusion joint. (See Job Aid Appendix A for additional information).

C. Pre-installation Requirements:

1. Pipe Diameter – Some electrofusion manufacturers have specific dimensional requirements for pipe that is to be joined using electrofusion couplers. Verify that the pipe to be joined meets the electrofusion manufacturer’s requirements for optimum fusion. In the absence of specific dimensional requirements ensure that the pipe diameter is within the tolerances, at the specified temperature, of the applicable pipe standard (ASTM F714, AWWA C906, etc.). Standard tolerances are determined at 73°F. Measure pipe diameter with a Pi tape (see Job Aid Appendix A) at 2” and 6” from the pipe end to determine diameter. Pipe toe-in or reduction in diameter, is a condition that occurs at the pipe end and should be checked to ensure that the pipe diameter is within tolerance at 2” from the end. Severe toe-in may require the removal of up to one pipe diameter or 12” from the pipe end. In preparing a pipe for electrofusion the pipe OD is reduced by at least .014" by scraping the outside surface. This OD reduction should be taken into consideration when accepting pipe extruded close to the above minimum tolerances.
1. Pipe Ovality - Determine if an ovality condition exists: Measure the pipe diameter to determine the amount of out-of-roundness. If ovality exceeds 2%, re-rounding clamps must be used.

2. Pipe ends should be squarely cut to 90° ± 5°. A 4" or wider sling or strap can be used as a guide to mark the pipe for cutting (see Job Aid Appendix B). A level and protractor can be used to determine the angle of the cut.

3. Pipe alignment – Pipe alignment should be inspected to ensure that no stresses are present in the assembly that might cause movement during fusion.

4. Power Source – An adequate power source is required. Ensure that power source is capable of delivering power for entire coupling fusion time without interruption (check generator for full fuel supply). Ensure that all connections are tight and clean. Loose connections can result in arcing or blown fuses.
   a. 110 Volt: A minimum 5000 watt continuous supply generator capable of delivering 115 volts to 135 volts at 45 Hz to 66 Hz to the control box. Minimum 30 amp breaker with “slow blow” or time delay fuse. 30 amp twist-lock Nema L5 receptacle.
   b. 220 Volt: A minimum 5000 watt continuous supply generator capable of delivering 180 volts to 300 volts at 45 Hz to 65 Hz to the control box. Minimum 30 amp breaker with “slow blow” or time delay fuse. 15 amp twist-lock NEMA L6 receptacle.

   Note: Commercially available generators capable of meeting these requirements are usually in excess of 7500 watt capacity and need to be in good working order.

5. Extension Cords – Typically, a single extension of up to 50’ is permitted between the generator and the control box. The minimum wire gauge is 10/3 awg for extension lengths up to 50’. Longer lengths may be allowed, consult the fitting and equipment manufacturer for specific recommendations.

6. Control Box – A 24 digit barcode compatible control box conforming to ISO 12716 must be used to deliver the required energy to the coupling.
   a. The control box must be capable of delivering 80 amperes at 40 volts output.
   b. The control box must be capable of reading the coupling barcode and applying the correct fusion parameters, including automatic temperature compensation, to the fitting without operator intervention.
   c. The control box must be capable of reading ambient temperatures at the fusion site.

7. Scraping Tools – PIPE PREPARATION IS VERY CRITICAL TO THE ELECTROFUSION PROCESS. CAREFUL ATTENTION MUST BE GIVEN TO PROPER CLEANING AND
SCRAPING PROCEDURES TO REMOVE CONTAMINATION AND SURFACE OXIDATION FROM THE PIPE SURFACE.

a. Ensure that only mechanical type scraping tools designed specifically for electrofusion preparation are used to prepare the pipe surface.

b. Do not use abrasives such as grinders, emery cloth, or sandpaper.

8. Markers – Ensure that insertion depth and pipe scrape area markings are made with a non-greasy, non petroleum based, fast-drying, permanent marker or paint pen.

9. Cleaning agent / wiping cloth – A clean, dry, non-dyed, lint free cloth is used to clean pipe surfaces. 96% or higher Isopropyl alcohol without additive except water is recommended as a cleaning agent. Pre-impregnated wipes without additives may also be suitable. Denatured alcohol may contain other impurities and is not suitable for use with electrofusion. Under no circumstances should a coupling fusion be made with any liquid (water, oil, sewage, etc.) flowing through the pipe or fusion area. Fusion joint failure and possible electrical hazards could occur. The fusion zone must be clean and dry before and during fusion.

10. Weather Conditions – Observe manufacturer's recommended minimum and maximum installation temperatures for electrofusion fittings.

a. The typical installation temperature range is -4°F to 120°F (-20ºC to 49ºC), but can vary above and below that range depending on the manufacturer. If ambient temperatures are outside this range, consult the equipment and fitting manufacturer for a specific recommendation.

b. Large diameter couplings may use a temperature specific fusion time or a pre-heat cycle prior to fusion.

c. Protect the fusion site in case of inclement weather such as rain or snow.

D. Installation procedure:

1. Clean pipe ends to remove dirt, mud, and other debris from pipe ends. Clean water can be used for initial cleaning prior to scraping; however, the pipe surface must be clean and dry before scraping. Check pipe surface and remove any embedded debris that may cause damage to scraping tools. PIPE PREPARATION IS VERY CRITICAL TO THE ELECTROFUSION PROCESS. CAREFUL ATTENTION MUST BE GIVEN TO PROPER CLEANING AND SCRAPING PROCEDURES TO REMOVE CONTAMINATION AND SURFACE OXIDATION FROM THE PIPE SURFACE.
2. Ensure that the pipe end has a square and even cut as close to 90° as possible. A sling or strap can be used as a guide for marking pipe ends for straight cutting.

3. Measure the total length of the coupler to be installed. Make a mark (with recommended marker) from the pipe end that is 1/2 the total length of the coupler. This mark is for stab depth purposes and will ensure that the pipe end is inserted to the center of the coupler.
4. When measuring for pipe ovality, the High/Low diameter difference should not exceed 2%. If required, place a re-round clamp immediately outside the stab depth mark. Do not scrape to remove high sides of oval pipe in order to relieve ovality.

Measure for highest and lowest diameter points, use re-round clamps if necessary.

Re-rounding devices are either commercially available (below left) or can be substituted by using full-encirclement-type metal rings (below right).
5. Scrape the outside of the pipe surface to remove oxidation and other contaminants. Use a mechanical type scraping tool designed specifically for electrofusion preparation to remove at least .014” (0.36 mm) from the pipe OD. Scrape the pipe surface until an outer layer or "skin" has been removed to expose clean, virgin pipe material. Inspect the entire circumference of the scraped area to ensure total scraping coverage. Do not touch the scraped surface you’re your hands because it may introduce surface contamination. Scraped pipe should conform to the dimensional requirements of Table 1. **Do not use abrasives** such as grinders, emery cloth, or sandpaper.

6. Do not touch the scraped pipe surface or the inside of the coupler as body oils and other contamnates will compromise fusion joint performance. If the surfaces become contaminated, clean thoroughly with a **clean** lint free towel and 96% isopropyl alcohol and allow to dry before assembling. Do not use alcohol with any additives other than water. **CAUTION: DO NOT TOUCH THE FUSION SURFACES TO AVOID ALL POSSIBLE RECONTAMINATION OF THE COUPLING AND PREPARED PIPE SURFACES.**

7. If coupler is to be pushed completely over one pipe end, scrape the pipe end for the entire length of the coupler to prevent contamination of the coupler by sliding over un-scraped pipe.
8. Install coupler onto the pipe ends so that the stab depth marks are aligned at the outer edges of the coupler. The pipe ends may be beveled to allow for easier insertion into the coupling. If necessary, use a rubber mallet (or metal hammer and wood blocks) to move coupler onto pipe. Re-round clamps can be used as anchors for pulling couplers onto pipe with mechanical assist devices such as a hand winch. Use care not to damage internal wire or terminal pins. Leave plastic bag over coupler to prevent contamination, and debris from entering the open end.

9. Check pipe end alignment to ensure that there is no bind or stress exerted on the coupling before or during fusion and until cooling time has elapsed. Support for the pipe and coupling may be necessary to prevent stresses or sagging that may develop as heat is applied during fusion.
10. Make sure the generator is operating normally before powering the control box. Connect the control box leads to the coupler. Make sure that all connections and lead adapter tips are properly sized and secure.

11. Scan the barcode to set the fusion time. Ensure that label information conforms to scanned data. Observe the manufacturer's procedure for pre-heating or temperature specific fusion time. Start the fusion process. Do not leave unattended. Depending on the coupling manufacturer, some couplings have multiple barcodes that correspond to the ambient temperature, or a separate pre-heat barcode that is used prior to fusing the coupling. Follow the manufacturer's recommendation for scanning the proper barcode. Under no circumstances should a coupling fusion be made with any substance flowing through the pipe or fusion area. Fusion joint failure and possible electrical hazards could occur. The fusion zone should be clean and dry before and during fusion.
12. After the fusion cycle is complete, verify fusion cycle completion is normal. Check melt indicators if the coupling is so equipped. Note the cooling time and mark the time when the clamping time has elapsed on the pipe. Additional information such as fusion record ID number, control box serial number, etc. should also be recorded if required. For couplers with dual fusion zones, repeat for both ends of the coupler.

- If a fusion cycle fault occurs, note the error code displayed by the control box and proceed according to the manufacturer’s recommendation. In case of power interruption, i.e. generator runs out of gas, leads are disconnected, or any other power interruption failure, consult the manufacturer’s instructions for re-fusion. Faults caused by any other circumstances should not be re-fused.

13. Backfill and handling can be completed after the recommended minimum cooling time has elapsed. The recommended cooling time is displayed by the control box after the fusion cycle completes, or can be found on the coupler label. Pressure leak testing can be conducted after the recommended cooling time plus one hour has elapsed.
The following are illustrations of acceptable and unacceptable electrofusion joints:

**Good Fusion Acceptable**

**Melt Out Unacceptable:**
Possible Causes: Pipe Ovality, Flat Spots, Undersized Pipe, and Binding
Exposed Wire Unacceptable
Possible Causes: Pipe Ovality, Flat Spots, Undersized Pipe, and Binding

Short Stab Unacceptable
Possible Cause: Failure to Mark and Monitor Stab Depth
Mis-Stab Unacceptable
Possible Cause: Failure to Mark and Monitor Stab Depth

Misalignment Unacceptable
Possible Cause: Inadequate Clamping or Restraint During Fusion
Mis-cut Unacceptable
Possible Cause: Failure to cut Pipe End Perpendicular to The Axis of The Pipe

Gouges and Scratched Unacceptable
Possible Cause: Damage During Transportation or Handling of The Pipe
Poor Scrape Unacceptable

Possible Causes: Incorrect Scraper, Poorly Maintained Scraper. Inadequate Number of Passed With Scraper, and Ineffective evaluation of Scraping
Over Scrape Unacceptable
Possible Causes: Incorrect Scraper, Poorly Maintained Scraper, Excessive Number of Passed With Scraper, and Ineffective evaluation of Scraping

Pipe Flat Spots Unacceptable
Possible Cause: Damage During Transportation or Handling of The Pipe

Pipe Out of Round Unacceptable

Possible Causes: Manufacturing Defect, or Transportation or Storage Damage
# Appendix A

## How to Measure Diameter using a Pi Tape

**Purpose**  
To accurately measure the true diameter of pipe &/or fittings

**Start**  
To determine if material is made to ASTM F-714 specifications, or to qualify pipe or fitting for Electrofusion Coupling use

**Materials**  
Correct sized Decimal Pi Tape, Pipe &/or Fitting to be measured, paper & pencil or calculator.

<table>
<thead>
<tr>
<th>Actions: Determine correct Pi Tape</th>
<th>Do this:</th>
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<tbody>
<tr>
<td>a. Locate the properly sized Pi Tape, based upon the size pipe or fitting to be measured</td>
<td></td>
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<tr>
<td>b. A decimal tape is required instead of a fractional tape, as it gives greater accuracy</td>
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<td>Actions:</td>
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| 2. Identify the area of toe-in (see gap at arrow) | a. Toe-in (Tapered end) usually takes place within the first 2”-3” from end of large diameter HDPE pipe & fittings  

b. The diameter may be smaller at this location than at any other point along the pipe or fitting |

<p>| 3. Place Pi Tape around pipe or fitting | a. The Upper Scale (Gage Member) is placed above the Thousands (Vernier) Scale |</p>
<table>
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<th>Actions:</th>
<th>Do this:</th>
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</table>
| 4. Correctly locate Pi Tape around pipe or fitting | a. To make an accurate measurement, make sure the Pi Tape is evenly placed around the circumference  

**Note:** When measuring away from the end, make sure to mark the distance at (4) locations around the circumference |

| 5. What markings on Upper Scale mean | a. 24 represents the closest diameter in inches  **Example a) = 24.000”**  

b. The 1, 2, 3, 4, 5, etc represent the .100” decimal, or 1/10th inch increments.  **Example b) = 24.100”**  

c. Broken into (4) graduations, each mark represents .025”  **Example c) = 24.225”** |

| 6. Measure diameter – Part 1 | a. Using the “0” on the Thousands (Vernier) Scale, write down the measurement on the Upper Scale to the left of the “0”  **Example: arrow measure 23.875”** |

| 7. Measure diameter – Part 2 | a. On the Thousands Scale, each indentation represents 0.001”. The range is from .001” to .025”  

b. Visually locate where the marks on the Upper Scale match up with the marks on the Thousands Scale  

c. Reading the Thousands Scale, write down the number of thousands where the lines match  **Example: .013”** |
### Actions:
8. Determine the actual diameter

### Do this:
a. Add the (2) measurements together
   
   | Example: 23.875” | .013” |
   | Actual Dia       | 23.888” |

9. For Reference only. **Same Pipe** as above, but measured 11.8” from pipe end

### Do this:
a. Since “0” on the Thousands Scale does not perfectly line up with the line above it: 1st Measurement = **24.000”**

b. An indentation on both scales match up on the Thousands Scale at .024”

c. Adding **24.000” + 0.024” = 24.024”** actual OD

### Result
True diameter accurately measured

### Task standards
- Tape measurement is read correctly
- Tape is placed on material at proper location
Appendix B

Make a Square Cut with a Pipe Wrap

**Purpose**
Make a square on HDPE Pipe by using a pipe wrap

**Start**
Use when square cut on pipe is required. Electrofusion couplings installation requires a square cut, the pipe wrap will be used to mark pipe for installation of a coupling

**Materials**
Pipe to be cut, pipe wrap for pipe size, pi tape and non-greasy marker

<table>
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<tr>
<th>Actions:</th>
<th>Do this:</th>
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| 10. Determine diameter of pipe | c. Check print line on pipe  
<p>| | d. If you can not read printline, use pi tape to determine diameter of pipe |</p>
<table>
<thead>
<tr>
<th>Actions:</th>
<th>Do this:</th>
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<tbody>
<tr>
<td>11. Based on diameter of pipe, select and pipe wrap of correct length</td>
<td><strong>a.</strong> Place pipe wrap around pipe. Pipe wrap must be long enough to reach around the pipe more than the circumference. Pipe wraps are usually 1.25 to 1.5 times the circumference of the pipe.</td>
</tr>
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</table>
| 3. Place pipe wrap around pipe | **a.** When pipe wrap is pulled tightly around pipe, will be perpendicular to the end of the pipe.  
**b.** Visually check alignment of warp. Adjust until there is no slack and wrap appears to be square. |
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<th>Actions:</th>
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<tr>
<td><strong>4.</strong> When pipe appears to be tight and square, make line around pipe with non-greasy marker pipe</td>
<td>a. Carefully mark a line around pipe with marker pin.</td>
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<tr>
<td><strong>5.</strong> Use square or tee to check that line is perpendicular.</td>
<td>a. Check line. Is line square? Is line completely around pipe?</td>
</tr>
<tr>
<td>5. Cut pipe to provide square cut using circular saw with wood cutting blade.</td>
<td>a. Follow line around pipe with saw.</td>
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<tr>
<td>6. Check cut for square cut.</td>
<td>a. Check line. Is line square?</td>
</tr>
</tbody>
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