



Electrofusion Joining for Polyethylene Pipe

SOP

Issued

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3/30/2018

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4/2/2021

Purpose and Scope

The purpose of this document is to enable the user to perform electrofusion joining of polyethylene pipe.

Responsibility

To complete this task, you must have Operator Qualification (OQ) Certification under Tasks:

- F01.4.0781 - Joining of Plastic Pipe Electrofusion
- F05.5501 – Visually Inspect Electrofusion Fittings on Polyethylene Pipe
- G02.0641 – Visually Inspect Pipe and Components Prior to Installation

Definitions

Ambient Temperature	The temperature of the surrounding environment
[Pipe] Damage	Scratches or gouges where the pipe wall thickness is compromised greater than 10% or deformations are present
FR	Flame Resistant
HDPE	High Density Polyethylene
MDPE	Medium Density Polyethylene
NGUS	Natural Gas Utility Sheet
OD	Outside Diameter
OQ	Operator Qualification
PPE	Personal Protective Equipment
QRG	Quick Reference Guide

Safety

Wear KUB standard personal protective equipment (PPE) (i.e., hard hat, safety glasses, safety toed footwear, and appropriately rated traffic vest). Per the *Flame Resistant Personal Protective Equipment for UGC Natural Gas Events* QRG, flame resistant (FR) PPE is required in an actual or potential gaseous environment. If electrofusion joint is in or near an actual or potential gaseous environment, at a minimum, the FR clothing required is as follows:

- HRC2 coveralls or HRC2 long sleeve shirts and pants
- Balaclava (sock)
- Leather gloves

Ensure all workers are cleared from the excavation during the electrofusion heating process and a manned fire extinguisher is in place.

Abnormal Operating Conditions and appropriate responses are outlined at the end of this QRG.

Equipment and Materials

- MDPE and/or HDPE pipe manufactured to ASTM D2513 and F714 dimensions
- MDPE and/or HDPE electrofusion fittings conforming to ASTM F1055, packaged in sealed plastic bags
- Measuring tape or ruler
- Pipe cutting tool
- Pipe scraping tool (peeler, or metal blade paint scraper if necessary)
- Re-rounding clamps, if needed
- Pipe restraint equipment and/or fitting clamps
- Electrofusion processor with correct leads and/or tips
- Adequate power supply (5.0 kVA with a minimum continuous output of 5,000 watts)
- Extension cord (25 foot, #10/3 wire or 50ft, #8/3), if needed
- Clean lint-free cloth
- Isopropyl alcohol (96% or greater)

- Permanent (non-greasy, non-petroleum) marker
- Fire extinguisher

References

- The Performance Pipe Field Handbook
- Central Plastics Electrofusion Installation Booklet
- MT Deason Tri Fusion Training and Installation Manual
- Plastic Pipe Institute, Municipal Advisory Board – *Generic Electrofusion Procedure for Field Joining of 12 Inch and Smaller Polyethylene Pipe*
- ASTM F1290 – Standard Practice for Electrofusion Joining Polyolefin Pipe and Fittings
- 49 CFR 192.283 – *Plastic Pipe: Qualifying Joining Procedures*
- TCHS-PPE-L03-QIK014 *Flame Resistant Personal Protective Equipment for UGC Natural Gas Events*
- *Grounding Polyethylene Pipe and Tools SOP*

Instructions

► To complete this task, follow these steps:

1. Conduct a job safety briefing and perform the following:
 - Confirm that the ambient temperature is between 14°F and 113°F.
 - Ensure that the generator is in good mechanical condition and has sufficient fuel to complete the electrofusion cycle.
 - Inspect pipe for unacceptable cuts, gouges, scratches, or other surface damage. Damaged pipe should not be used.
 - Inspect fittings for damage to connection points, fusion surfaces, and heating wires. Damaged fittings or fittings with an unknown storage history should not be installed.
 - Shield fusion equipment and surfaces from inclement weather and winds, if needed. Pipe and fitting surfaces must be clean and dry before fusing.
 - Check the pipe for out-of-round condition (see Table 1). Re-round the pipe if needed.

Table 1. Standard Pipe Dimensions and Tolerances

Pipe Size	Nominal Diameter (inches)	Tolerance ± (inches)
1¼-inch IPS	1.660	0.005
2-inch IPS	2.375	0.006
4-inch IPS	4.500	0.020
6-inch IPS	6.625	0.030
8-inch IPS	8.625	0.039
12-inch IPS	12.750	0.057

2. Take proper safety precautions when fusing to active pipe sections to reduce static electricity in accordance with *Grounding Polyethylene Pipe and Tools SOP*.
3. Prepare pipe and/or fitting surfaces.
 - a. Electrofusion Couplings:
 - i. Clean the pipe ends to be fused with water or isopropyl alcohol. An area about 2 times the length of the coupling should be cleaned.

- ii. Square cut the pipe ends. The maximum allowable measured cut angle is given below.

Pipe Size	Maximum Gap
1/2 CTS to 1 1/2 IPS	1/8"
2 IPS	3/16"
3 IPS	5/16"
4 IPS	5/16"
6 IPS	1/2"
8 IPS	3/4"
10 IPS	7/8"
12 IPS	1"

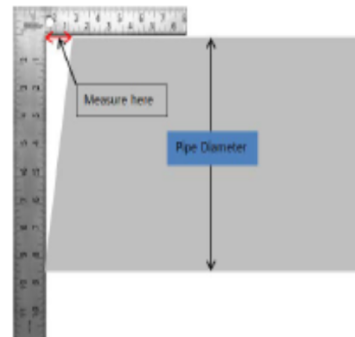


Figure 1. Pipe Cut Angle Maximum Gap

- iii. Measure and mark 1/2" beyond the stab depth on the pipe ends where the coupling will be installed.
- iv. Mark pipe surface(s) to be scraped with longitudinal or circumferential lines (Figure 1).

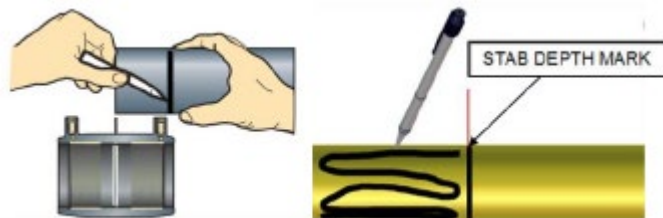


Figure 2. Sample Stab Depth and Witness Marks for Electrofusion Coupling

- b. Electrofusion Sidewall/Saddle Fittings:
 - i. Clean the pipe area to be fused with water, or isopropyl alcohol. An area about 3 times the width of the fitting should be cleaned.
 - ii. Identify the location of the fitting to be installed on the pipe and mark the area.
 - iii. Mark pipe area to be scraped with longitudinal lines (Figure 2).

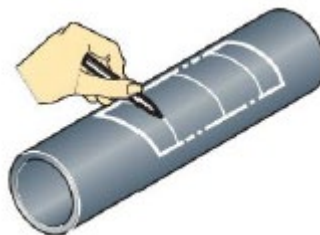


Figure 3. Sample Markings for Electrofusion Sidewall/Saddle

c. Electrofusion Branch Saddle Fittings:

- i. Clean the pipe area to be fused with water or isopropyl alcohol. An area about 3 times the width of the fitting should be cleaned.
- ii. Check the pipe for out-of-round condition. If the area to be fused is found to be out-of-round, take the appropriate steps to bring the fusion area back within the required tolerances.
- iii. Identify the location of the fitting to be installed on the pipe and mark the area.
- iv. Use marks to ensure that the alignment of the fitting is correct.



Figure 4. Sample Markings for Electrofusion Branch Saddle

4. Scrape the pipe surface(s) to expose a clean, virgin pipe material.

- a. Check the pipe surface for any embedded debris that may cause damage to scraping tools and confirm that the outer pipe surface is clean and free of any dirt or mud that could re-contaminate the scraped pipe surfaces.
- b. Using a pipe scraping tool, scrape the pipe surface(s) until at least 0.007 inch thick of the outer layer or 'skin' of the pipe has been removed.
- c. Inspect the entire scraped area to ensure total scraping coverage. Avoid touching the scraped pipe surface or the inside of the fitting. Clean the final surface thoroughly with a clean, lint-free cloth and isopropyl alcohol. For electrofusion couplings, re-mark the stab depth prior to cleaning.

Note 1: Never use abrasive materials such as sandpaper, emery cloth, wood rasp, or metal file in place of a scraping tool.

Note 2: Use caution if scraping multiple times to ensure that too much surface materials of the pipe OD is not removed. Removal of 0.020 inches on 4-inch pipe or smaller, or 0.040 inches on larger sizes is the maximum.

Note 3: Never use water to clean the pipe surfaces once the virgin material has been exposed.

Note 4: Peeler type tools that remove a continuous and measurable ribbon should be used whenever possible. Hand scrapers should only be used if absolutely necessary.

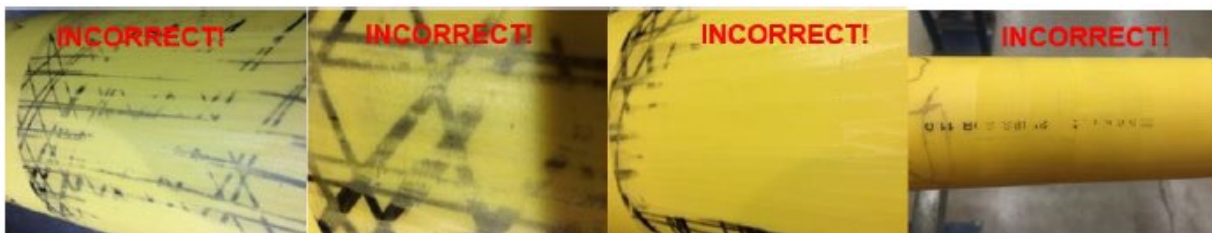


Figure 5. Incorrect Scraping



Figure 6. Correct Scraping

5. Restrain the pipes and/or fittings to be joined.
 - a. Remove fitting from its plastic bag.
 - b. Clean fitting thoroughly with a clean, lint-free cloth and isopropyl alcohol.
 - c. Place the fitting on the scraped pipe surface.
 - d. Restrain using an approved restraint device to align and secure the assembly (Figures 6 and 7). Use rubber mallet or block of wood and hammer to move coupling onto pipe, if necessary.
 - e. Ensure that electrofusion fitting marks are properly located and visible.
- Note 1:** Use only the clamps provided or required by the fitting manufacturer. Clamps from one manufacturer's fitting are not interchangeable with another manufacturer's fitting.
- Note 2:** If bolts are used in the clamping assembly, make sure they are tightened in the proper sequence and the required amount of torque/engagement per the manufacturer's instructions.



Figure 7. Restrained Electrofusion Coupling



Figure 8. Restrained Electrofusion Sidewall/Saddle Fitting with Under-Clamp

6. Apply electric current.
 - a. Connect the fitting to the control box.
 - b. Enter the fusion parameters by scanning the bar code.
 - i. Ensure the processor is ready and the display is reading "Read Data".
 - ii. Holding the barcode reader at a 15-30° angle, with the tip of the barcode reader touching the barcode label, start the scan in the white area on one side of the label and move the reader evenly across the barcode into the white area on the opposite side.
 - iii. If the barcode cannot be scanned, enter the 24-digit numerical value printed on the label into the control box (Figure 10).



Figure 9. Sample Barcode with Numerical Value

- c. Verify the fitting size, heating, and cooling times.
- d. Ensure there is no personnel in the excavation, a manned fire extinguisher is in place, and then fuse the joint.
- e. Immediately following the completion of the fusion time or "cook time", mark the time of day on or beside the fitting when the fusion cycle ends.
- f. Allow the fused pipe and fitting assembly to remain clamped and undisturbed for the minimum recommended cooling time.
- g. Allow the electrofusion joint to cool for an additional 30 minutes prior to pressure testing, performing a tap, rough handling or backfilling. The time of day the joint is ready for rough handling (end time) shall also be written on or beside the fitting.

Note 1: Electrofusion fittings can be re-fused a maximum of two times only in the event of input power interruptions (i.e. power interruption, fusion leads become detached during fusion, generator runs out of gas, processor malfunction, or improper power source).

Note 2: Prior to re-fusion, fitting must remain in the clamp position and be allowed to cool to ambient temperature. The fitting must be reconnected to the processor and fused for the entire fusion time.

7. Once the person performing the electrofusion determines the fusion is acceptable, he/she shall sign the fusion connection with company name, employee name or ID, and date fusion was performed with an easily visible permanent marker (Example: black ink on MDPE yellow pipe and silver ink on HDPE black pipe.) The pipe shall also be marked with the time the cooling time begins and when it is complete.
8. Document the fusion on the Natural Gas Utility Sheet (NGUS), if applicable.
Note: NGUS documentation is only required for repairs, service work, or main segments less than or equal to 50 feet.

Note 1: Abnormal operating conditions (AOCs) may occur as a result of incorrect operations of electrofusion machines and tap tees. They must be properly described, included in knowledge and skills qualification, and understood by the employee to the extent that proper action is taken. The following are appropriate actions to be taken in the event that the associated AOC occurs:

- a. Prior to attaching leads to resistors or scanning the barcode, read the label and write down cook and cooling times to ensure that electrofusion processor times are correct during the electrofusion process.
- b. Exit the excavation prior to electrofusion of tapping tee to natural gas main when the main is energized. (Barcode reader and/or resistors may be used to determine cook times before exiting excavation and starting the processor for fusion.)
- c. Two people are needed when using the barcode reader or connecting resistors to turn off the machine and unplug the processor in the event that the electrofusion machine starts the electrofusion process immediately after the leads are connected to the machine without the display showing start electrofusion.
- d. Match electrofusion times with labels on fittings, as electrofusion may terminate before total electrofusion is complete with no direction on how to proceed on display or screen.
- e. Match electrofusion times with labels on fittings, as the electrofusion machine may incorrectly recognize electrofusion time for tee (occurs on barcode scan, resistor recognition and manual modes) and fuse longer than required.
- f. If any issues arise during the process of electrofusion, employees must contact TCH and GSE for review of electrofusion process, electrofusion fitting, and electrofusion processor. Processor must be submitted for evaluation or recalibration after any issue occurs.

Checklists and Forms

- Natural Gas Utility Sheet, if applicable



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Document Information and Review History

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9/5/18	Ashraf El-Messidi, David Kyle	Added section on Abnormal Operating Conditions (AOCs) and appropriate responses
2/14/2020	Reviewed: B. Carey, B. Hemel, D. Kyle, A. Mann, D. Bledsoe, J. Hellard, M. Hillard, M. Bowden, B. Elmore Approved: D. Miller, J. McInturff, C. Thomas	Updated cleaning area requirements Updated marking locations for couplings Updated cut angle requirements if square cut is not achieved Updated language regarding scraper tools
5/3/2021	Reviewed: B. Carey, A. Mann, D. Bledsoe, J. Hellard, P. Thompson, M. Hillard Approved: D. Miller, J. McInturff, C. Thomas	No changes