Saddle Fusion Joining for Polyethylene Pipe

	SOP	Issued	Effective: 3/30/2018	Reviewed: 4/2/2021

Purpose and Scope

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

This procedure is applicable for saddle fusion joining MDPE to MDPE and HDPE to HDPE pipe greater than or equal to 1¼ inch.

Responsibility

To complete this task, you must have the following Operator Qualification (OQ) Certification:

- F01.3.0771 – Joining of Plastic Pipe: Sidewall Heat Fusion
- F05.5031 – Visually Inspect Sidewall Fused Polyethylene Pipe
- G02.0641 – Visually Inspect Pipe and Components Prior to Installation

Definitions

Ambient Temperature	The temperature of the surrounding environment
(Pipe) Damage	Scratches, gouges, and deformations present where the pipe wall thickness is compromised greater than 10%
FR	Flame Resistant
HDPE	High Density Polyethylene
MAOP	Maximum Allowable Operating Pressure
MDPE	Medium Density Polyethylene
NGUS	Natural Gas Utility Sheet
OQ	Operator Qualification
PPE	Personal Protective Equipment
QRG	Quick Reference Guide
RPR	Gas Systems Engineering Representative

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 saddle fusion 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

Equipment and Materials

- MDPE and/or HDPE pipe manufactured to ASTM D 2513, with the exception of Uponor Aldyl A MDPE products or Driscopipe 7000/8000 HDPE products
- MDPE and/or HDPE service saddle, branch saddle, or tapping tee
- McElroy Saddle Fusion Machine (Sidewinder) or KUB-approved equivalent
- Main bolster or support for 6” IPS and smaller mains
- 50-60 grit utility or emery cloth
- Heating tool with appropriate McElroy heater adapter (plate)
- Pyrometer
- Timing equipment (i.e. a watch with a second hand timer)
- Clean lint-free cloth
- Isopropyl alcohol (96% or greater)
- Permanent (non-greasy, non-petroleum) marker

References

- Plastic Pipe Institute TR-41/2002 – Generic Saddle Fusion Joining Procedure for Polyethylene Gas Piping
- Performance Pipe Manual PP-750 Heat Fusion Joining Procedures and Qualification Guide
- ASTM F2620 – Standard Practice for Heat Fusion Joining of Polyethylene 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:
    - Inspect pipe and fittings for unacceptable cuts, gouges, scratches, or other surface damage. Damaged products should not be used.
    - Confirm that the pipe is not curved tighter than 100 pipe diameters bending radius.
    - Check electrical cord for any damages. If any damages are present, take equipment out of service until repairs are made.
    - Shield fusion equipment and surfaces from inclement weather and winds, if needed. Tool, pipe, and fitting surfaces must be clean and dry before fusing.
    - Check heating tool surface for cleanliness and temperature. Do not use the heat plates if they are damaged.
    - Determine pressures as indicated on the fitting label (initial heat [XXX], heat soak [0], and fusion [ZZZ]).

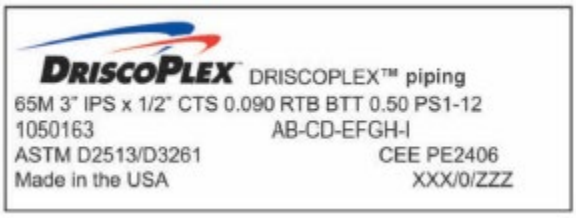


Figure 1. Example Fitting Label

2. Take proper safety precautions when fusing to active pipe to reduce static electricity in accordance with *Grounding Polyethylene Pipe and Tools* SOP.

3. Prepare the heating tool.
    a. Attach the proper size heater faces to the heating tool per the McElroy chart.
    b. Visually inspect heating tool to ensure that the correct heater plates are attached and that it is clean, oil-free, and coated with a nonstick coating as recommended by the manufacturer to prevent molten plastic from sticking to the heater surfaces.
    c. If heater plates do not pass visual inspection due to contamination, they shall be cleaned with alcohol and a lint free cloth. If heater plates have coating damage, they shall be removed from service.
    d. Bring the surface temperature of the tool faces to 500 ± 10°F.
    e. Using a pyrometer, verify the temperature of the tool face surfaces within the pipe or fitting contact area.

4. Prepare the pipe and fitting.

a. Clean the inside and outside of the component (pipe or fitting) by wiping with a clean lint-free cloth and isopropyl alcohol, as needed.
b. Install the saddle application tool on the pipe, centered at the location where the fitting will be fused.
c. Abrade the fusion surface of the fitting base and the mating fusion surface of the main with 50-60 grit utility cloth. The abraded area on the main should be ½-inch larger per side than the area covered by the fitting base. Brush residue away with a clean, dry lint-free cloth. Do not touch abraded and cleaned surfaces with your hands.
d. Hand-tighten caps on tapping tees.
e. Install and lightly clamp the fitting in the saddle application tool. Move the fitting base against the pipe and apply about 100-lbs force to seat the fitting.
f. Secure the fitting in the saddle application tool. The fitting must be completely seated and squarely aligned against the pipe.
g. Move the fitting away from the pipe.

5. Heat the pipe and fitting.
   a. Using a pyrometer, verify that the heating adapters are between 500 ± 10°F.
   b. Place the heating tool on the pipe, centered beneath the fitting base, and immediately lower the fitting against the heater face.
   c. Quickly apply the initial heat force and begin timing.
   d. At the first visual indication of melt between heating tool face and the crown of the pipe, reduce force to heat soak force (zero force) and continue timing.
   e. Heat the pipe and fitting until the indicated total heating time expires or a melt bead of 1/16-inch is visible around the fitting base (Table 1).

   Note: Do not interrupt heating to inspect the melt pattern on the pipe. When fusing to a pressurized main, this can overheat the pipe and cause a blowout.

Table 1. Saddle Fusion Parameters

Sequence	Parameters
Heater Adapter Surface Temperature	500 ± 10°F
Initial Interfacial Force	See fitting label
Heat Soak Interfacial Force	See fitting label (0 psi)
Fusion Interfacial Force	See fitting label (± 5 psi)
Total Heating Time on Pressure Main – 1¼-inch IPS	15 seconds max
Total Heating Time on Pressure Main – 2-inch IPS	25-35 seconds max
Total Heating Time on Pressure Main – 3-inch IPS and larger	Look for 1/16-inch bead around fitting base
Total Heating Time on Non-Pressure Main	Look for 1/16-inch bead around fitting base

6. Join the fitting against the pipe.
    a. When the heating time ends, separate the heating tool from the fitting and the pipe and remove the heating tool.
    b. Quickly inspect the melt on the pipe and fitting base.
    c. Press the fitting onto the pipe (within 3 seconds) and apply the fusion force.

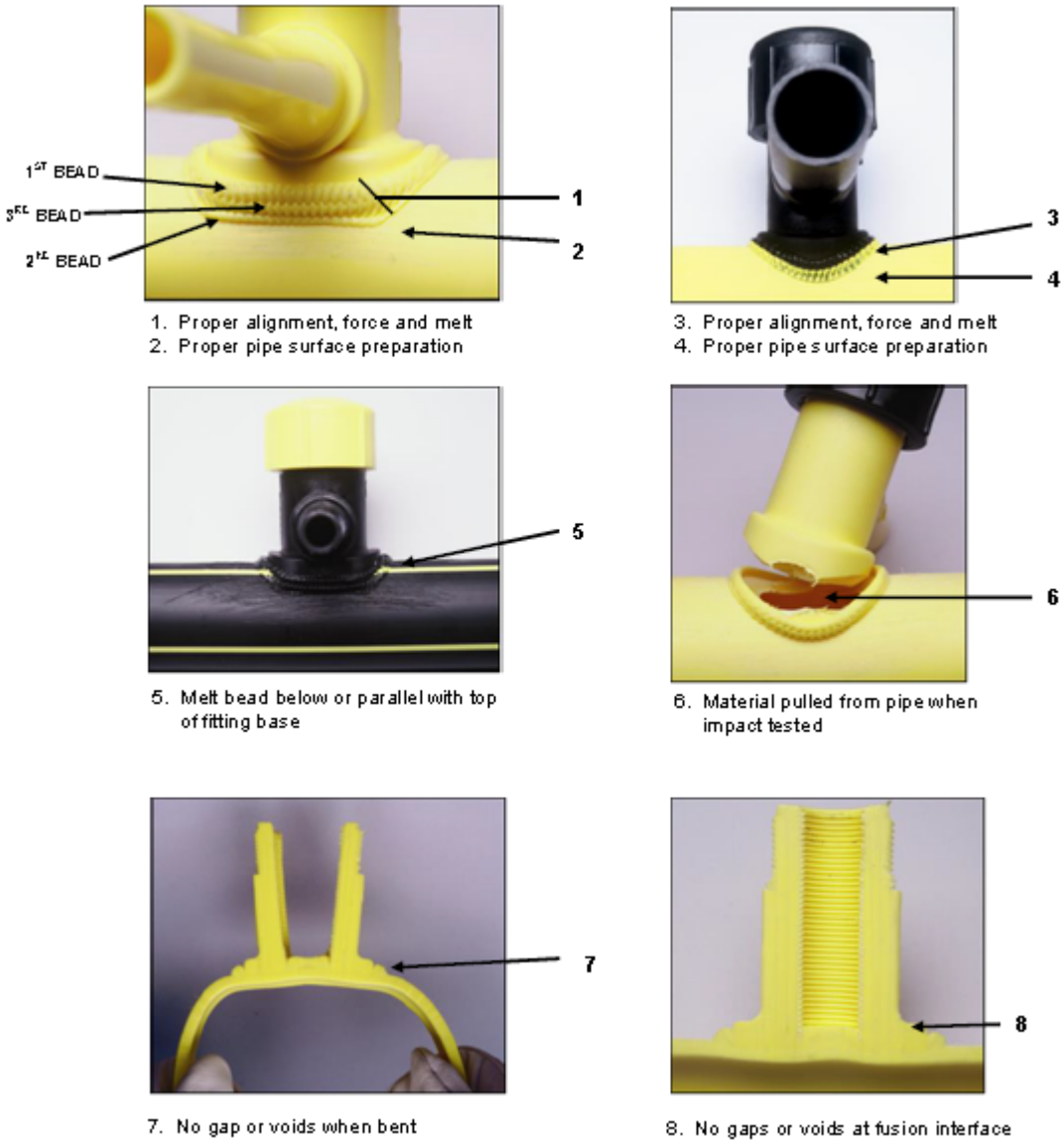
7. Hold the joint immobile under fusion force until the joint has cooled adequately to develop strength.
    a. Maintain the fusion force for 5 minutes on 1¼-inch IPS and for 10 minutes on larger sizes.
    b. Remove the saddle fusion machine.
    c. Cool undisturbed for an additional 30 minutes. During the time avoid pressure testing, rough handling, tapping, and connecting the branch outlet.

    Note 1: Always join the fitting to a pressurized pipe after heating. If the fitting is not joined to the pipe immediately after heating, the pressurized main may rupture.
    Note 2: Never reduce the fusion force until the first cooling time period has ended.

8. Visually inspect the fusion bead around the entire fitting base at the pipe and compare the joint against the manufacturer's recommended appearance guidelines (see Figures 2 and 3).
    a. The fusion bead should be uniformly sized all around the fitting base and should have a characteristic "three-bead" shape. The first bead is the fitting base melt bead. The second or outmost bead is produced by the edge of the heating tool face on the pipe. The third or center bead is the main melt bead. The first and third beads should be about the same size all around the fitting base.
    b. If the melt on the pipe or the fitting base is unacceptable, notify the RPR assigned to the site. The RPR will provide instructions on how to proceed. Possible causes for unacceptable joints are provided in Table 2.

9. Once the person performing the saddle fusion 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.)
    Note: Signing a visually unacceptable fusion will result in an investigation for qualification by the KUB OQ Program Administrator.

10. 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.



1. Proper alignment, force and melt
2. Proper pipe surface preparation
3. Proper alignment, force and melt
4. Proper pipe surface preparation
5. Melt bead below or parallel with top of fitting base
6. Material pulled from pipe when impact tested
7. No gap or voids when bent
8. No gaps or voids at fusion interface

Figure 2. Acceptable Fusions

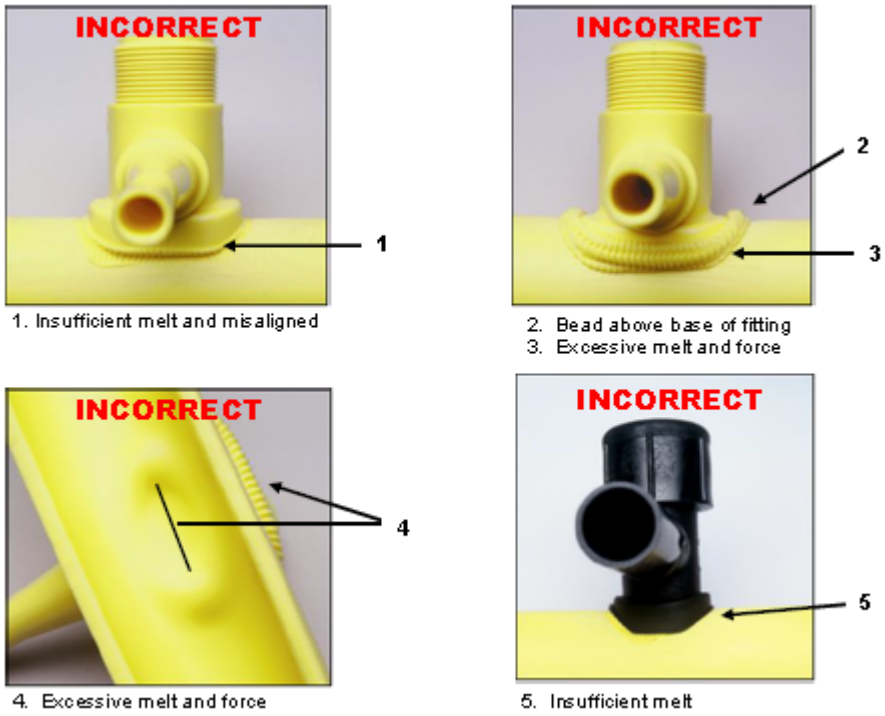


Figure 3. Unacceptable Fusions

Table 2. Saddle Fusion Bead Trouble Shooting Guiding

Observed Condition	Possible Causes
Non-uniform bead size around fitting base	Misalignment; defective heating tool; loose or contaminated heating tool saddle faces; worn equipment; fitting not secured in application tool; heating tool faces not within specified temperature
One bead larger than the other	Misalignment; component slipped in clamp; worn equipment; defective heating tool; loose or contaminated heating tool saddle faces; heating tool faces not within specified temperature
Beads too small	Insufficient heating; insufficient joining force
Beads too large	Excessing heating time; excessive force
No second (outermost) bead	Incorrect pipe heating tool face
Serrated bead appearance	Normal for serrated heating tool faces
Smooth bead appearance	Normal for smooth heating tool faces
Pressurized main blowout (beside base or through fitting center)	Overheating; incorrect heating tool faces; heating tool faces not within specified temperature; taking too much time to start heating or to remove the heating tool and join the fitting to the main pipe
Rough, sandpaper-like, bubbly, or pockmarked melt bead surface	Hydrocarbon contamination
No third (center) bead	Insufficient joining force

Checklists and Forms

- Natural Gas Utility Sheet, if applicable

Document Information and Review History

Owner	072 – Gas Systems Engineering
Utilities	<table><tr><td>Electric</td><td>Gas</td><td>Water</td><td>Wastewater</td></tr><tr><td>No</td><td>Yes</td><td>No</td><td>No</td></tr></table>
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