



## Socket Fusion Joining for Polyethylene Pipe

SOP

Issued

Effective:  
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 socket fusion joining of polyethylene pipe.

This procedure is applicable for socket fusion joining MDPE to MDPE, HDPE to HDPE, and MDPE to HDPE pipe less than or equal to 2 inch.

### Responsibility

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

- F01.2.0791 – Joining of Plastic Pipe: Socket Heat Fusion
- F05.5021 – Visually Inspect Socket Fused Polyethylene Pipe
- G02.0641 – Visually Inspect Pipe and Components Prior to Installation

### Definitions

|                            |   |
|----------------------------|---|
| <b>Ambient Temperature</b> | The temperature of the surrounding environment  |
| <b>[Pipe] Damage</b>       | Scratches, gouges, and deformations present where the pipe wall thickness is compromised greater than 10% |
| <b>FR</b>                  | Flame Resistant   |
| <b>HDPE</b>                | High Density Polyethylene   |
| <b>MAOP</b>                | Maximum Allowable Operating Pressure  |
| <b>MDPE</b>                | Medium Density Polyethylene   |
| <b>NGUS</b>                | Natural Gas Utility Sheet   |
| <b>OD</b>                  | Outside Diameter  |
| <b>OQ</b>                  | Operator Qualification  |
| <b>PPE</b>                 | Personal Protective Equipment   |
| <b>QRG</b>                 | Quick Reference Guide   |
| <b>RPR</b>                 | 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 socket 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
- Cutting tool
- Combination chamfering tool/depth gauge
- Cold ring clamp
- Heating tool with male and female socket faces that meets ASTM F1056
- Pyrometer
- Timing equipment (such as a watch with a second hand)
- Clean lint-free cloth or paper towel
- Isopropyl alcohol (96% or greater)
- Permanent (non-greasy, non-petroleum) marker

### References

- Performance Pipe Heat Fusion Joining Procedures and Qualification Guide
- ASTM F2620 – Standard Practice for Heat Fusion Joining of Polyethylene Pipe and Fittings
- ASTM F1046 – Socket Fusion Tools for Use in Socket Fusion Joining Polyethylene Pipe or Tubing 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 cleanliness and temperature. Do not use the heat plates if they are damaged.
2. Take proper safety precautions when fusing to active pipe to reduce static electricity in accordance *Grounding Polyethylene Pipe and Tools SOP*.
3. Cut the pipe.
  - a. Use a plastic pipe cutter and cut the pipe end squarely, as needed.
4. Chamfer the pipe end to remove the sharp outer edge on the outside diameter (OD).
  - a. Remove all burrs from inside of pipe ends.
  - b. Wipe with a clean, dry, lint-free cloth or paper towel. Make sure the pipe end is clean, dry, and free of foreign substances.
5. Round the pipe end.
  - a. Place the depth gauge snugly over the chamfered end of the pipe and clamp the cold ring clamp on the pipe OD immediately behind the depth gauge.
  - b. Remove the depth gauge.
6. Clean the pipe and fitting.
  - a. Clean the inside and outside of the components (pipe and fitting) by wiping with a clean, lint-free cloth and isopropyl alcohol.
7. Heat the pipe end and the socket fitting.
  - a. Using a pyrometer, verify that the heating tool is between 490-510°F.
  - b. Push the socket fitting onto the male socket face. The socket fitting must bottom out completely and be held against the back surface of the male heater face.

- c. Push the pipe end into the female socket face. The cold ring clamp must be completely against the female socket face and held in place.
- d. Start the heating time when the cold ring is against the female heater face and the pipe and fitting are fully inserted.
- e. Heat the pipe end and the socket fitting for the time provided in Table 1.

**Note 1:** Do not twist the pipe or fitting.

**Note 2:** When joining MDPE to HDPE, the pre-heat time can be found by subtracting the shorter heating time (MDPE) from the longer heating time (HDPE), i.e. 1-inch HDPE component is heated for 5 seconds longer than the MDPE component.

**Note 3:** MDPE couplings may be heated the same amount of time as HDPE pipe.

**Table 1. Socket Fusion Heating & Cooling Times**

| Pipe Size   | PE 2406 / PE 2708      |                        | PE 3408 / PE 4710      |                        |
|-------------|------------------------|------------------------|------------------------|------------------------|
|             | Heating Time (seconds) | Cooling Time (seconds) | Heating Time (seconds) | Cooling Time (seconds) |
| ½-inch CTS  | 6 – 7                  | 30                     | 6 – 10                 | 30                     |
| ½-inch IPS  | 6 – 7                  | 30                     | 6 – 10                 | 30                     |
| ¾-inch IPS  | 8 – 10                 | 30                     | 8 – 14                 | 30                     |
| 1-inch IPS  | 10 – 12                | 30                     | 15 – 17                | 30                     |
| 1¼-inch IPS | 12 – 14                | 45                     | 18 – 21                | 60                     |
| 2 inch IPS  | 16 - 19                | 45                     | 24 - 28                | 60                     |

8. Join the fitting against the pipe.
  - a. When the heating time ends, quickly remove the pipe and fitting from the heating tool simultaneously using a snap action.
  - b. Quickly inspect the melt on the pipe and socket fitting. The surfaces should be 100% melted with no cold spots.
  - c. Within 3 seconds, firmly push the pipe end and the socket fitting straight together until the cold ring clamp makes firm contact with the end of the socket fitting.

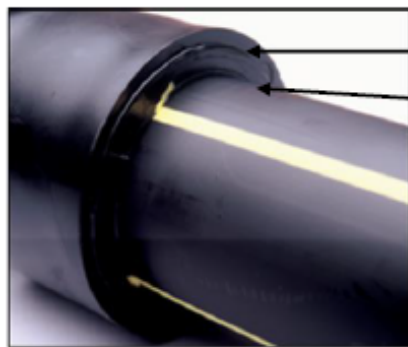
**Note 1:** Do not twist the pipe or fitting. If the pipe or fitting are removed at an angle or twisted, the melt will be displaced, and the joint will leak and fail.

**Note 2:** If the melt is not complete, do not continue with the joint. Cut off the melted pipe end, use a new fitting, and start over. Do not re-use a melted fitting.
9. Hold the pipe and socket fitting firmly together until the Table 1 cooling time has been met.
  - a. Remove the cold ring clamp and inspect the end of the socket fitting at the pipe for a complete impression of the cold ring clamp in the melt surface.
  - b. Allow the joint to cool for an additional 5 minutes before exposing the joint to any type of stress (e.g., burial, testing or fusing the other end of the fitting, etc.).

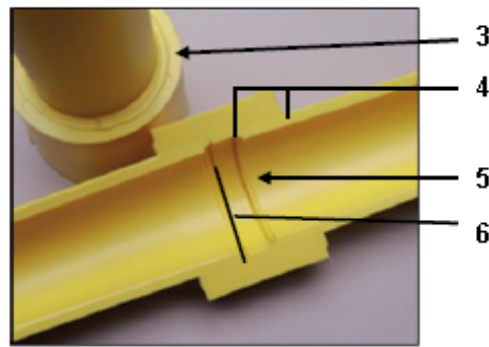
**Note 1:** Do not twist the pipe or fitting.

**Note 2:** For ambient temperatures 100°F and higher, additional cooling time may be needed.
10. Visually inspect the end of the socket fitting at the pipe and compare the joint against the manufacturer's recommended appearance guidelines (see Figures 2 and 3).
  - a. There should be a clear impression of the cold ring clamp into the melt ring at the end of the fitting with no visible gaps or voids around the pipe at the socket melt ring.

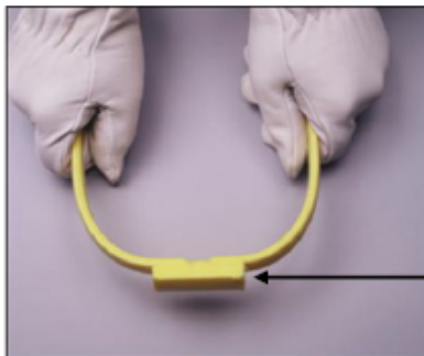
- b. The pipe and fitting should be aligned straight with each other.
  - c. If flaws are observed in the joint, deem the joint to be unacceptable, find the cause of the flaw, cut out the unacceptable joint, and repeat the procedure to prepare a new joint.  
Possible causes for unacceptable joints are provided in Table 2.
11. Once the person performing the socket fusion determines the fusion to be 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.
12. 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.



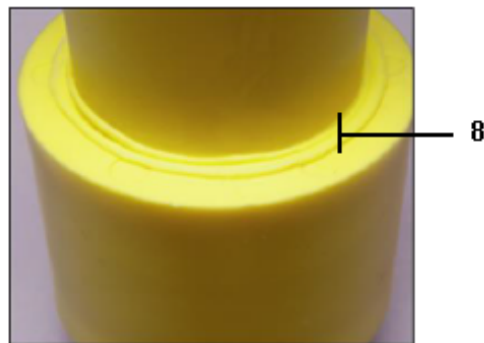
1. Melt bead flattened by cold ring
2. No gaps or voids



3. No gap or voids
4. Proper insertion depth
5. Acceptable internal fusion bead
6. Complete internal melt bead

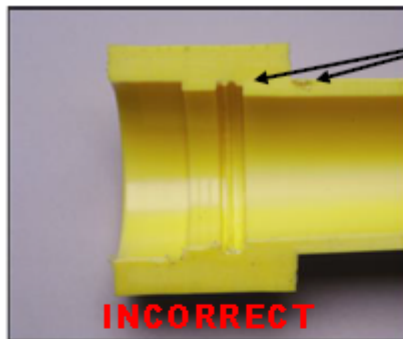


7. No gap or voids

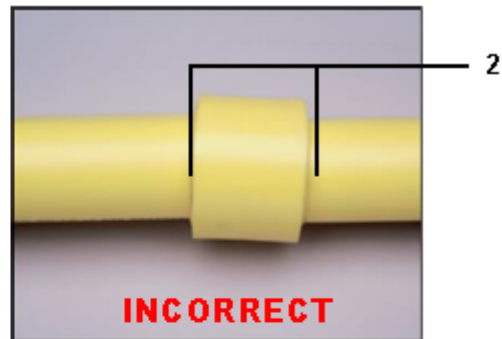


8. Melt bead flattened by cold ring

**Figure 2. Acceptable Fusions**



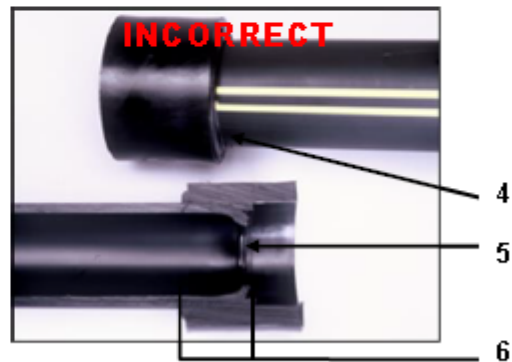
1. Improper insertion depth/short stab depth



2. Misalignment



3. Excessive heating



4. Melt bead not flattened against fitting/no cold ring  
5. Improper insertion depth/no cold ring  
6. Excessive heating

**Figure 3. Unacceptable Fusions**

**Table 2. Saddle Fusion Bead Troubleshooting Guide**

| <b>Observed Condition</b>  | <b>Possible Causes</b>   |
|--|--|
| No cold-ring impression in socket fitting melt bead  | Depth gauge not used; cold ring not used, or set at incorrect depth; insufficient heat time  |
| Gaps or voids around the pipe at socket fitting edge   | Pipe or fitting not removed straight from the heater face (twisting or removing from heater face at an angle); pipe or fitting not inserted straight into each other when fusing; joining together at an angle; twisting while joining pipe and fitting together; cold ring not used or set too deep |
| Wrinkled or collapsed pipe end (when viewed from inside or when qualifying lengthwise cut joint) | Incorrect heating sequence – always push the pipe into the heater after the fitting has been pushed on the heater (inserting the pipe first heats the pipe too long); cold ring set too deep; cold ring not used   |
| Voids in fusion bond area (when qualifying lengthwise cut joint)                                 | Pipe or fitting not removed straight from heater face (twisting or removing from heater face at an angle); pipe or fitting not inserted straight into each other when fusing; joining together at an angle; twisting while joining pipe and fitting together; cold ring not used or set too deep     |
| Unbonded area on pipe end (when qualifying lengthwise cut joint)                                 | Cold ring not used or set too deep   |
| Socket melt extends past end of pipe (when qualifying lengthwise cut joint)                      | Cold ring set too shallow  |
| Rough, sandpaper-like, bubbly, or pockmarked melt bead surface                                   | Hydrocarbon contamination  |

## Checklists and Forms

- Natural Gas Utility Sheet, if applicable



## Socket Fusion Joining for Polyethylene Pipe

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

### Document Information and Review History

|                            |  |          |            |       |            |    |     |    |    |  |  |  |
|----------------------------|--|----------|------------|-------|------------|----|-----|----|----|--|--|--|
| <b>Owner</b>               | 072 – Gas Systems Engineering  |          |            |       |            |    |     |    |    |  |  |  |
| <b>Utilities</b>           | <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> | Electric | Gas        | Water | Wastewater | No | Yes | No | No |  |  |  |
| Electric                   | Gas  | Water    | Wastewater |       |            |    |     |    |    |  |  |  |
| No                         | Yes  | No       | No         |       |            |    |     |    |    |  |  |  |
| <b>Program Category</b>    | Natural Gas Construction   |          |            |       |            |    |     |    |    |  |  |  |
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| <b>Preparer</b>            | Rebecca Rogers (Strata-G), Leslie Emison, Wes Marine, David Kyle, Dustin Tindell   |          |            |       |            |    |     |    |    |  |  |  |
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| <b>Review Cycle</b>        | 1 Year(s)  |          |            |       |            |    |     |    |    |  |  |  |

| Revision Date | Reviewer   | Modifications                   |
|---------------|--|---------------------------------|
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| 5/3/2021      | <b>Reviewed:</b> B. Carey, A. Mann, D. Bledsoe, J. Hellard, P. Thompson, M. Hillard<br><b>Approved:</b> D. Miller, J. McInturff, C. Thomas                             | Updated OQ task number and name |
|               |  |                                 |
|               |  |                                 |