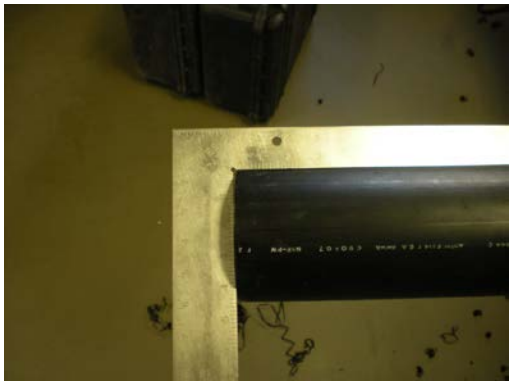
I. GENERAL

This Construction Standard covers the procedures for electrofusion of couplings on HDPE water pipe and corporation saddles on 6", 8" and 12" HDPE water pipe using the Central Electrofusion Processor. All electrofusion corporation saddles shall be installed by MUD crews. ***Note to MUD Crews: Before attempting coupling installation, confirm that the size of electrofusion couplings and required power are compatible with the District's processor and generator.*** MUD crews shall be trained and certified to install electrofusion couplings and corporation saddles by MUD training personnel designated by the Construction Superintendent. Contractors shall install electrofusion couplings in accordance with this standard, by persons certified with qualifications listed in MUD 120 and/or contract specifications.

Electrofusion is a heat fusion process for joining polyethylene fittings to polyethylene pipe. Electrofusion fittings are manufactured with heating coils imbedded in the joining surfaces. During the fusion process, current flows through the coils and fuses the fittings to the pipe.

II. ELECTROFUSION - COUPLINGS

A. PIPE PREPARATION



1. When installing a coupling it is necessary for the pipe ends to have a square and even cut. This can be accomplished by various methods. (e.g. a blade type of pipe cutter, a wood saw and a clamp to use as a guide, or a chain saw without bar oil for larger pipe sizes) Remove any burrs or shavings from the pipe ends.

2. Clean the pipe ends, inside and out including the entire area to be fused, with a clean lint free cloth. Remove dirt, mud, and other debris from pipe ends. Clean water can be used for initial cleaning of pipe surfaces prior to peeling and isopropyl alcohol is recommended after peeling.

3. Check pipe for out-of-round condition. If fusion area is found to be out-of-round, take appropriate steps to bring fusion area back within required tolerances.

4. Make a mark (with a non-grease marker) from the pipe end that is 1/2 the total length of the coupling. This mark is for stab depth purposes and will ensure that the pipe end is inserted to the center of the coupling.

5. Mark the fusion area with a non-greasy marker. Make some squiggly marks over the area to be peeled. ***Note: The reason for the squiggly marks is that after peeling, if the marks are gone, it indicates that the entire area has been peeled.***

6. Check the pipe surface for any embedded debris that may cause damage to peeling tools, and once more make sure that the outer pipe surface is clean and free of any dirt or mud that could re-contaminate the peeled pipe surfaces. Check for scratches or gouges. If scratch or gouge is found and is deeper than 10% of pipe wall, contact the Field engineer or Engineering.

Ritmo Peeler

7. Peel the outside of the pipe surface to remove oxidation and other contaminants with a Ritmo peeler or approved equal. Peel the pipe surface until the outer layer or "skin" of the pipe has been removed, usually 1 to 2 times, to expose a clean, virgin pipe material. **Do not peel the pipe to round it in order to get the coupling to fit. Use clamps to re-round.** Inspect the entire peeled area to ensure total peeling coverage.

NOTE: If a coupling is to be pushed completely over one pipe end, mark the area as in Step 5 and peel the pipe end for the entire length of the coupling to prevent contamination of the coupling by sliding over un-peeled pipe.

NOTE: The purpose of peeling is to remove material from the pipe surface. Simply roughing or scraping the fusion area will not allow an acceptable bond to take place. Do not use abrasives, grinding wheels, or other devices that do not cleanly remove the contaminated material.

8. Avoid touching the peeled pipe surface or the inside of the coupling as body oils and other contaminants can affect fusion joint performance. If the surfaces become contaminated, clean thoroughly with a clean, lint free towel and a **minimum 70%** concentration of isopropyl alcohol and allow to dry before assembling. **Do not use alcohol with any additives other than water.**

NOTE: AVOID ALL POSSIBLE RECONTAMINATION OF THE PREPARED SURFACE.

9. Place the coupling on the area to be fused. If necessary, restrain or support the pipe to keep the pipe and coupling straight and aligned.

NOTE: Use rubber mallet (or metal hammer and wood blocks) to move coupling onto pipe, if necessary. Ensure that stab depth marks are properly located and visible.

10. Attach processor leads to the coupling and proceed with fusion. When the fusion cycle is complete, **allow the coupling to cool according to the recommended cooling time that will appear on the display.**

NOTE: Do not pressurize the system until the joints have cooled to ambient temperatures.

III. ELECTROFUSION SADDLES

A. PIPE PREPARATION

1. Identify the location of the saddle to be installed on the pipe and clean the joining surface with a clean lint free cloth to remove any dirt or contaminates. If the pipe is sweating due to temperature and humidity, wipe it dry and keep it dry using a blower from Water D. Wait a few hours to see if the condensation stops or use a sidewall fusion corporation saddle per construction standard 11.7.1.

Note: For 1" copper water service, install water corp. saddles at a 45° angle. For 1-1/2" and 2" water services, install the water corp. saddles at top-dead-center or at 90° from top-dead-center. Taps should be a minimum of 18" apart. Taps do not need to be staggered on HDPE pipe.

2. Mark the area with a non-greasy marker. Make some squiggly marks over the area to be scraped. ***Note: The reason for the squiggly marks is to identify areas that have not been scraped. Scraping to just remove the marker lines is not adequate material removal for fusion. See paragraph 5 for adequate material removal.***

3. If the pipe is out-of-round use re-rounding devices on both sides of the area to be fused before proceeding.

4. Check the pipe surface for any embedded debris that may cause damage to peeling tools. Check for scratches or gouges. If scratch or gouge is found and is deeper than 10% of pipe wall, contact the Field engineer or Engineering.

5. Scrape the area to be fused with an S & D adjustable range scraper or rasp. Make sure that the appropriate amount of material is removed approx. .007" to .010".

Note: The purpose of scraping is to remove material from the pipe surface. Simply roughing up the fusion area will not allow an acceptable bond to take place. Do not use abrasives, grinding wheels, or other devices that do not cleanly remove the contaminated

material.

6. Thoroughly clean the peeled area with a clean, lint free towel and a minimum 70% concentration of isopropyl alcohol. Allow the pipe surface to dry before mounting the saddle on the main. ***Note: Avoid touching the peeled pipe surface or the inside of the fitting as body oils and other contaminants can affect fusion joint performance. If the surfaces become contaminated, thoroughly clean the area again. Do not use alcohol with any additives other than water.***

7. Remove the fitting from the bag and place it within the marked fusion area.

   a. **Central Saddles for 6" Pipe:**

      1) Without moving the fitting, slide the Under-Clamp onto the base of the fitting. Do not use the handle to carry or adjust the clamp position.

      2) Make sure the fitting is centered in the Under-Clamp and then pivot the handle into the secured position.

   b. **Central Saddles for 8" and 12" Pipe:**

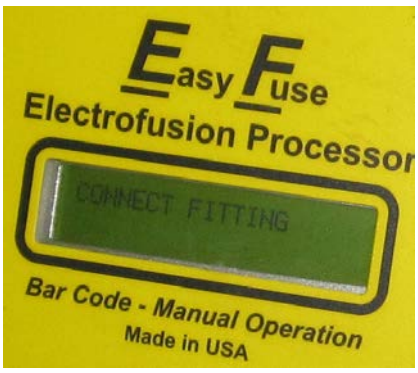
      1) Taking care not to contaminate the peeled pipe surface, attach the Top Load Clamp and fitting to the pipe. Hold the fitting in place and lower the cross bar. Then lock in place. ***Note: Clamp weight may need to be supported if fusing to areas other than the 12 o'clock position on the pipe.***

      2) Begin applying pressure to the fitting by turning the handle clockwise.

      3) Tighten until indicator post located in the center of the handle is flush with the top of

the handle. ***Note: Over/Under tightening could result in defective joints.***

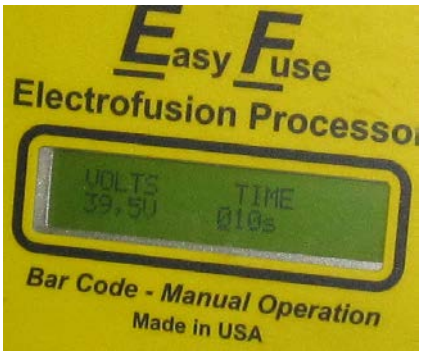
IV. FUSION CYCLE



1. The processor should be connected to a 110 volt AC power source such as an inverter, generator, or wall outlet. If using an inverter, it must be engaged before plugging in the processor.

2. The processor will automatically run a self-diagnostic check. "Connect Fitting" will appear on the display when the diagnostic check is complete and the processor is ready for a fusion cycle.

3. Attach the leads from the processor to the fitting terminals. The processor automatically determines the fitting size by sensing its internal resistance. Also, the "Fusion Cycle Time", the count-down time, and "Press Start" will appear on the display.



4. Press the start button. The proper voltage range readout will be displayed and the fusion cycle time will begin to countdown.

   "Fusion Complete" and "Recommended Clamped Cooling Time" will appear on the display when the fusion cycle is complete.

5. Disconnect the leads from the fitting.

V. RE-FUSION OF ELECTROFUSION FITTINGS

Electrofusion fittings can be re-fused only in the event of an input power interruption, i.e. fusion leads were detached during fusion, generator runs out of gas, processor malfunction, or other circumstance that results in processor *input power interruption*. ***Note: This re-fusion procedure should be used for fusions that terminated due to input power reasons only. Fittings that fault for any other reason should be cut out and replaced.***

1. Fitting should remain in clamped position and be allowed to cool to ambient temperature.

2. The fitting should be reconnected to the processor and fused for the entire fusion time.

VI. COOLING TIME

1. Leave the clamps in place during "Recommended Clamped Cooling Time" displayed on processor.

IMPORTANT NOTE: Proper installation of an electrofusion saddle requires the saddle to remain secured in the clamp until the clamping time shown on the saddle label has been completed.

2. With a felt-tip marker, note the time on the pipe when the cooling times will be complete.

3. As a safety precaution leave the bottom clamp in place on 6" water mains until the tap has been completed.

4. Remove the top loading clamps on 8" and 12" mains. As a safety precaution install two cinch straps between the electrofusion pins and the corporation body to hold the electrofusion saddle to the main until the tap is complete.

NOTE: Do not bend or bury until the joints have cooled to ambient temperatures.

NOTE: If inspection reveals the fusion is not complete, do not tap the main. Abandon the fusion saddle in place but strip the threads so there won't be any attempt to use it again.

5. Install corporation, leak test, and tap according to Construction Standard 6.0.6.

VIII. EXAMPLES OF INCORRECT ELECTROFUSION JOINTS

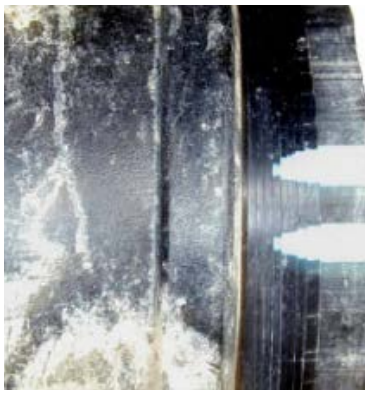
The most common cause of joint failure for an electrofusion fitting falls into a category of failure classified as *improper pipe preparation*. Most issues associated with improper pipe preparation can be controlled by the installer and with adherence to proper installation techniques. Improper pipe preparation is avoidable .

NO PIPE PEELING

The radial depressions are created by the wire-heating element of the fitting and indicate that the fitting achieved the proper temperature for fusion. This pipe section has many grooves and scratches from its insertion into a steel main. These defects along with the dirt that has been melted into the surface

make it apparent that no peeling or other pipe preparation was done.

PIPE OVER-PEELED



The complete removal of the co-extruded stripes on this pipe indicates that more than .060 of an inch was removed from the outside diameter of the pipe. This required 12 – 15 passes with a rotary peeler. Removing this much material from the pipe creates a gap between the pipe and fitting that is too great to seal during the fusion process.

PIPE UNDER-PEELED

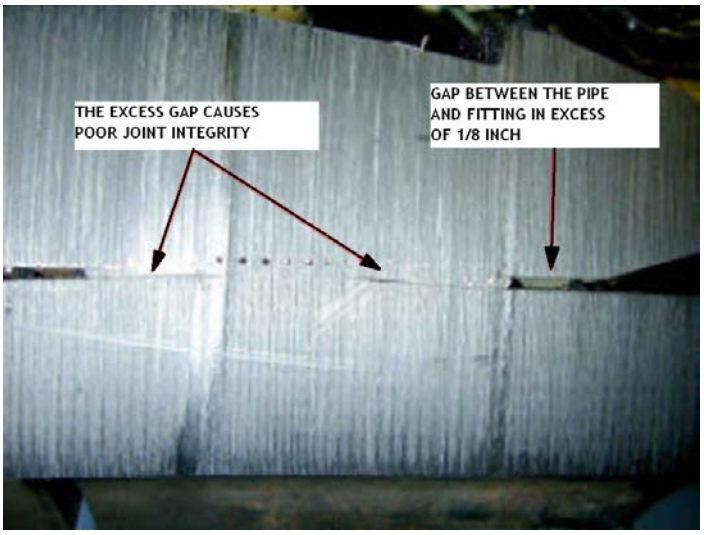
The visible tool marks show that some effort was made to peel the pipe. Unfortunately there was not enough material removed to allow a proper fusion. While most of the fitting did not fuse to the pipe, a small section did. When the joint failed, the stress on the section that did fuse was too great, causing the coupling to break.

PIPE MIS-STAB

The combination of a crooked cut on the end of the pipe, and the pipe ends not being centered in the pipe, have created a condition known as a mis-stab or a short-stab. When this occurs the pipe does not create a adequate seal in the center cold zone. This causes molten material to flow toward the center of the fitting. The loss of material and pressure at the joint interface result in poor joint integrity.

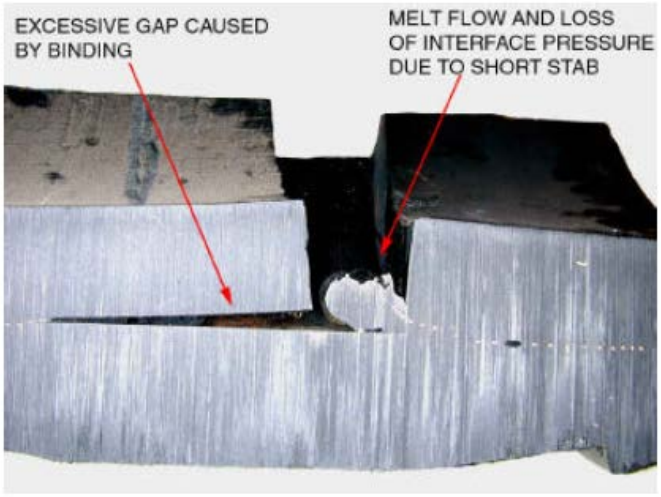
EXCESS GAP

When the gap between the pipe and fitting is excessive the expansion of molten polyethylene cannot completely fill the space for a successful fusion. This can be caused by undersized pipe, over peeling, or severely out of round pipe.



SHORT-STAB / BINDING

A short-stab is the result of not centering the pipe ends in the fitting. Binding is caused by a severe mis-alignment or excessive lateral forces on the joint. The result of either of these situations is excess flow of molten material, loss of pressure at the fusion interface, and poor joint integrity.



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