

# Electrofusion Installation Procedure Manual



**It is important to read and understand all instructions before attempting a fusion. Permanent field installations should be done only by operators who have been properly trained and certified as qualified. Should you have any questions or need installation training, please contact**

**Central Plastics Company at 1-800-654-3872  
or  
Your Local Central Plastics Representative.**

The following procedures were written to assist trained field personnel in the use of the Central Plastics Electrofusion system and Central Electrofusion Fittings. While technical data and advice contained herein is based upon tests and information believed to be reliable, user should not rely upon it absolutely for specific applications. All data is given and accepted at user's risk and confirmation of its validity and stability in particular cases should be obtained independently. Central Plastics makes no guarantee of results and assumes no obligation or liability in connection with its advice. The integrity of the piping system is the ultimate responsibility of the installer. This publication is not to be taken as a license to operate under, or recommendation to infringe any patents.

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## **Before You Start**

The following is an installation guide for the purpose of assisting the installer in adequately preparing an electrofusion fitting and pipe for fusion. This document is a guide only, and should not be used in place of training by an authorized electrofusion instructor. The recommended joining procedures for the Central Electrofusion System detailed in this manual have been qualified in accordance with D.O.T. 192.283

Central Plastics Company strongly recommends that electrofusion fittings be installed only by persons that have received training from an authorized instructor, that have a strong working knowledge of polyethylene and heat fusion, and have qualified electrofusion joints through destructive testing. Persons responsible for the joining of polyethylene pipe by fusion methods must qualify according to the requirement of the Title 49 Code of Federal Regulations, Section 192.285.

The installer of the electrofusion fittings for pressure applications should have knowledge of the intended application and is responsible for any fitting that is installed into a system that is not suitable for electrofusion fittings. Central Plastics electrofusion fittings are designed for use on pipe conforming to ASTM standard D2513 & F714 dimensions and with fittings conforming to D3261. All pipe to which these fittings are installed should meet the dimensional requirements of these standards.

Whether the installer is in a controlled environment or in the field making electrofusion fitting joints, Central Plastics recommends that you have the following equipment:

1. PIPE PREPARATION EQUIPMENT
  - Pipe Cutting Tools
  - Pipe Scraping Tools
  - Pipe Cleaning Material
  - Pipe re-rounding tools (on larger pipe sizes)
2. PIPE RESTRAINT EQUIPMENT
3. FUSION EQUIPMENT
  - Fusion Processor with correct leads and/or tips
  - Adequate power supply

### **IMPORTANT NOTE:**

***Pipe preparation and contamination are very important considerations in the electrofusion process. Careful attention must be given to proper scraping and cleaning procedures.***

# ELECTROFUSION POWER REQUIREMENTS

## GENERATORS

For the installation of electrofusion fittings in field applications, it will be necessary to have a reliable source of AC power for the Electrofusion Processor to work properly in supplying the fitting with the right amount of energy. Generators used as an AC power source should conform to the following;

- **Be well maintained and subjected to a periodic maintenance schedule;**
- **Provide an output voltage in the range that meets the specifications of the applicable processor model;**
- **Operate within a frequency range of 45 Hertz minimum to 75 Hertz maximum;**
- **A minimum wattage capacity of;**

Minimum KVA	Fitting Range
5.0 KVA	Will fuse all Central Plastics fittings including 24" DIPS / 630 mm couplings
3.5 KVA	Will fuse Couplings up to 8"/ 225 mm and all Tapping Tees, High Volume Tapping Tees, Branch Saddles and Reducers
2.0 KVA	Will fuse Couplings up to 1 1/4", and all Tapping Tees, High Volume Tapping Tees, Branch Saddles and Reducers

A matching outlet is needed to mate with the plug equipped with the unit by Central:  
120V models — 30 Amp, 125 Volt, NEMA L5, twist-lock;

## INVERTERS

*Inverters can be used as an acceptable AC power source* but with the continuing changes in inverter technologies, earlier processor models may not be compatible to the quasi-sine waveform produced by some inverters. Central recommends performing compatibility tests using the lightest and heaviest anticipated loads before approving an inverter system. Feel free to contact Central to discuss issues regarding the use of inverters.

## EXTENSION CORDS

Due to the amperage draw of electrofusion fittings, use of extension cords are not encouraged but in the event it becomes necessary to use one the following lengths and wire gages are recommended:

Cord Length	Wire Gage
25 ft.	#10/3 wire (6 mm <sup>2</sup> )
50 ft.	# 8/3 wire (10 mm <sup>2</sup> )

**NO EXTENTION CORDS SHOULD BE USED ON 14" IPS & LARGER COUPLINGS**

## PIGTAILS - (30 Amp Twist Lock to 15 Amp Standard Plug Adapter)

The use of pigtails for in field applications of electrofusion fittings is not recommended except on fitting sizes 2" and smaller.

## POWERING UP

Prior to beginning the electrofusion sequence, it is important that you ensure the following:

- **The generator has enough fuel to complete the electrofusion cycle**
- **The throttle is opened all the way (in anticipation of power draw)**

## IMPORTANT NOTE FOR COLD WEATHER INSTALLATIONS:

Cold weather affects both fittings and equipment. Electrofusion fittings require more energy at the beginning of the fusion cycle, this requirement is increased in cold weather situations. Make sure that your generator is in good mechanical condition and that it meets the minimum wattage output.

## Proper Pipe Preparation for Electrofusion Fittings

For a pipe surface to be properly prepared for electrofusion the outer layer or “skin” of the pipe should be removed to expose a clean, virgin pipe material. This can be achieved by using one of several types of approved scraping tools. “Approved” scraping tools can vary widely between electrofusion manufacturers and they may not necessarily be a tool that is manufactured by the fitting manufacturer. A few examples of scraping tools that Central Plastics classifies as “approved” are; a rasp type tool (Stanley Surform Model 21-296 or equivalent), a metal blade paint scraper, or tools manufactured specifically for electrofusion scraping. “Approved” simply indicates that the tool has been qualified by the manufacturer and has been found to perform in a satisfactory manner under the joining conditions established by the manufacturer.

**Wood rasps or metal files are not considered acceptable.**

It is very important to note that abrasive materials, such as sandpaper or emory cloth, should never be used in place of a scraping tool. Abrasive materials have been proven to be ineffective in the removal of sufficient amounts of surface material needed to achieve an electrofusion bond and in fact, they have actually been shown to impede the electrofusion process. This is due to the grit or grit like residue they imbed into the pipe area being scraped, which in turn acts as a barrier between the pipe and fitting. The electrofusion process significantly differs from conventional heat fusion. In the electrofusion process there is very little material movement or melt displacement (i.e. melt beads). For this reason, any contaminant that is present on the surface of the pipe will remain sandwiched between the pipe and fitting interface and will ultimately prevent the two materials from joining. It is also recommended that the “Metal File” type of rasp not be used as a pipe scraper; as the pipe material is removed with this type of tool, tends to ball up and roll around on the pipe surface instead of being cleanly removed and directed away.

Central Plastics Company recommends that a minimum of .007” to .010” of the pipe’s surface material be removed during the scraping process in order to expose a clean virgin material. This is approximately the thickness of two sheets of paper. It is important that the pipe surface be clean and free from any type of contaminants that may be spread before scraping begins. Should the pipe surface be contaminated with dirt, mud or drilling fluids before scraping, plain water may be used to remove the surface level of these contaminates. It should be noted however, that water cannot be used to clean the pipe surfaces once the virgin material has been exposed. In those instances a **minimum 70%** isopropyl alcohol concentration, **with no additional additives**, has been found to be highly effective in removing these type of contaminates and is recommended by Central Plastics as a cleaning agent that can be used before and after scraping. For applications where a fitting will be moved around on the pipe, such as a repair application where a coupling will be pushed completely over one end of the pipe, it is recommended that pipe be scraped for the entire length of the coupling to prevent a clean fitting from being contaminated by unscraped pipe.

## Markers

Marks can be made on the outer surface of the pipe as a visual aid to help indicate the required scraper coverage. Marks made on the pipe should not be made with a “grease pencil” or other type of petroleum based marker that will leave a contaminate behind. **Central Plastics Company’s only requirement for markers used on PE pipe during electrofusion preparation is that the marker be non-petroleum based.** Grease pencils are generally petroleum based and therefore should not be used on PE pipe prior to electrofusion joining.

We have found many different types and brands of markers to be acceptable and recommend that any permanent marker of a color that will show on the pipe material can be used. The permanent type markers, such as the, “Sharpie”, “Marks-A-Lot” and “Magic Marker” by Avery are adequate for marking yellow or light colored pipe. Fast drying paint pens, such as those manufactured by PENTEL and Faber Castell, also work well and are available in colors that will show well on black pipe; it is sometimes necessary to allow for drying when using paint type pens. We have also found that a wax based “China Marker”, although not permanent, works well for marking black pipe. We have found no advantage of one type of marker, permanent or paint, over the other.

# Re-Rounding

The non-brittle and flexible material characteristic of polyethylene makes it ideal for many pressure and non-pressure applications. But this material characteristic alone brings with it an important consideration that must be taken into account when using polyethylene pipe.

***“Care must be taken to ensure that the polyethylene pipe is not out-of-round before attempting the electrofusion process.”***

## HOW DOES POLYETHYLENE PIPE BECOME OUT- OF- ROUND?

- 1. FROM THE MANUFACTURER:** It is important for the installer to confirm that the polyethylene pipe meets all dimensional requirements of ASTM 2513 and F714 and that the pipe does not exceed 5% ovality. If ovality is greater than 5% (see chart below), the installer must take steps to re-round the pipe.

IPS SIZES			
PIPE SIZE	NOMINAL DIAMETER	MINIMUM DIAMETER	MAXIMUM DIAMETER
4	4.500	4.480	4.520
5	5.563	5.538	5.588
6	6.625	6.595	6.655
7	7.125	7.091	7.159
8	8.625	8.586	8.664
10	10.750	10.702	10.798
12	12.750	12.693	12.807
14	14.000	13.937	14.063
16	16.000	15.928	16.072
18	18.000	17.919	18.081
20	20.000	19.910	20.090
22	22.000	21.901	22.099
24	24.000	23.892	24.108
26	26.000	25.883	26.117
28	28.000	27.874	28.126
30	30.000	29.865	30.135
32	32.000	31.865	32.144
34	34.000	33.347	34.153
36	36.000	35.838	36.162
42	42.000	41.811	42.189
48	48.000	47.784	48.216

DIPS SIZES			
PIPE SIZE	NOMINAL DIAMETER	MINIMUM DIAMETER	MAXIMUM DIAMETER
4	4.800	4.778	4.822
6	6.900	6.869	6.931
8	9.050	9.009	9.091
10	11.100	11.050	11.150
12	13.200	13.141	13.259
14	15.300	15.231	15.369
16	17.400	17.322	17.478
18	19.500	19.412	19.588
20	21.600	21.503	21.697
24	25.800	25.684	25.916
30	32.000	31.886	32.114
36	38.300	38.128	38.472
42	44.500	44.300	44.700
48	50.800	50.571	51.029

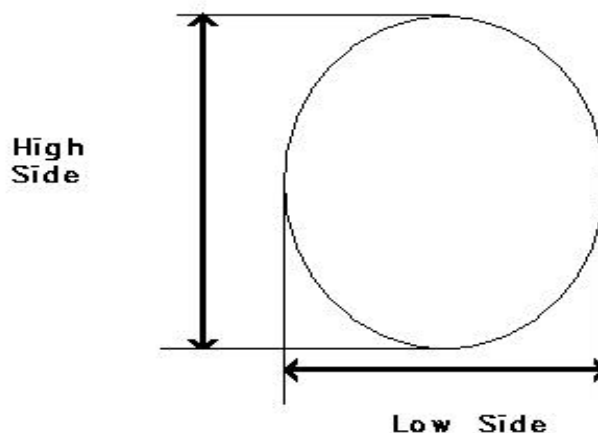
- 2. IN THE WAREHOUSE:** Polyethylene pipe that is warehoused for a period of time or stacked on top of each other can experience ovality related issues (this is more pronounced with large diameter pipe).
- 3. OVER TIME:** Large Diameter Polyethylene pipe will tend to relax a little during storage due to a combination of its weight and its natural flexibility.
- 4. DURING INSTALLATION:** Mechanical forces experienced during some trenchless installation techniques such as Pipe Bursting or Directional Drilling can temporarily leave the Polyethylene pipe elongated and out-of-round.
- 5. PREVIOUSLY INSTALLED:** Polyethylene pipe that has been underground for awhile is subjected to earth loads. These earth loads can cause the pipe to sag and/or become out-of-round.

## **WHY IS IT IMPORTANT TO ADDRESS THE OUT-OF-ROUND ISSUE FOR ELECTROFUSION INSTALLATIONS?**

One of the most critical functions of the electrofusion process is to close the gap between the pipe and the fitting and to build up interfacial pressures for the fusion process to take place. If this gap is not closed and the interfacial pressures cannot be built up, there is no way for the electrofusion joint to effectively achieve the high level of fusion integrity for which it was designed. If a pipe is out-of-round the initial concern is that the surface area of the pipe may not adequately come in contact with the fusion zone of the electrofusion fitting. This could result in the electrofusion fittings cold zones, that are designed to contain the material generated in the melt pool, to simply allow the molten material to escape out of the fusion area without producing any melt penetration. This is a particularly important concern when installing tapping tees and branch saddles since they do not fully encircle the pipe as will an electrofusion coupling.

## **HOW DO YOU CORRECT AN OUT-OF ROUND CONDITION?**

First, determine if out-of-round conditions exists. This can be done visually for the more extreme cases or it can be done by measuring the pipe diameter with tape measure to determine the High/Low points of the pipe (see Figure A). If the High/Low measurements exceed the maximum pipe O.D. tolerance, a re-rounding clamp or device must be used to bring the pipe back to a round condition. (see Table1 for equipment examples)



<b>Product Specific Clamping Devices (e.g. saddle clamps, t-clamps, etc)</b>
<b>Clamp Kits (multi-clamp kit for 4" and under)</b>
<b>Pipe Clamps from butt-fusion machines</b>
<b>Full-encirclement clamps (i.e. Victaulic Clamps)</b>
<b>Porta-Power Tools</b>

Table 1



# **FITTING RESTRAINT**

## **ELECTROFUSION COUPLINGS**

### **Important Note:**

All Electrofusion Couplings (regardless of manufacturer) require the pipe to be restrained or sufficiently supported on each side of the pipe to; *a) restrict movement during the fusion and cooling process, and b) alleviate or eliminate sources of stress and/or strain* until both the fusion cycle and the cooling cycle are completed.

Central Plastics recommends the use of some form of pipe restraint and/or support for the primary purpose of controlling and eliminating any movement of the fitting due to fusion pressures generated during the fusion process and/or any external forces exerted on the pipe or the fitting. The basis for using pipe restraint and/or support when joining two pieces of PE pipe with an electrofusion coupling is to:

- Minimize potential short-stab, mis-stab or binding situations
- Ensure proper cold-zone contact with the prepared fusion area so that sufficient interfacial pressure is built up.
- Eliminate unwanted loss of molten material from the fusion zone *(resulting loss of interfacial pressure can be a source of voiding or a defective and unsatisfactory joint)*

A properly prepared and assembled joint that is kept stationary and free from stresses and strains during the fusion process and recommended cooling time should have good joint integrity.

## **ELECTROFUSION SADDLES**

Electrofusion Saddle fittings (*Tapping Tees, Branch Saddles, Corp Saddles, etc.*) Installation of an electrofusion saddle requires the use of recommended restraint systems for the purpose of;

- Holding the fitting in place during the fusion process
- Eliminating fitting movement due to material expansion
- Ensuring proper cold-zone contact with the prepared fusion area so that sufficient interfacial pressure is built up.

## **Note: Barcode Scanning Instructions**

Be sure the processor is ready and the display is reading “Read Data”. It is critical that the tip of the barcode reader be touching the barcode label. While holding the reader at a 15 to 30 degree angle start the scan beginning 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. Move the reader in a smooth quick motion, without stopping, all the way across the label. The label can be read in either direction, front to back or back to front. The processor should make an audible signal when the barcode has been accepted.

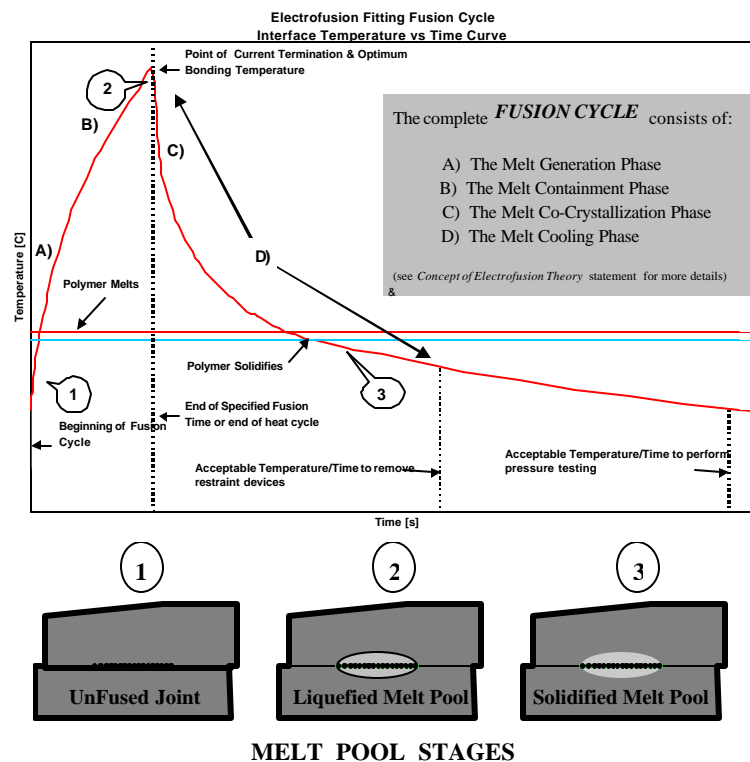
Most difficulties experienced in barcode scanning are simple problems involving technique. Ensure that the display reads “Read Data” before attempting to scan a barcode label. Make sure the tip light is illuminated on the reader. If not, check cable connections. Be sure the reader tip is clean and free from dirt and debris. Move the reader pen across the barcode from white area to white area without stopping.



# Electrofusion Fitting Cooling

One of the most misunderstood and often ignored components of the entire electrofusion process is the *cooling phase*. It is often assumed that if the fitting is cool enough to touch it must be cool enough to remove the restraint device or even pressure test the connections. The cooling phase is critical to the success of the electrofusion process and careful attention should be given to insure that the stated cooling times are properly adhered to.

The importance of the cooling phase can be illustrated in the actions of the *melt pool*. Using the following Figure we will look closer at the melt pool stages created during the electrofusion process.



When current is applied to the fitting, the plastic in the fitting and on the pipe surface begins to melt and form a melt pool (A & B). With continued application of current, the melt pool deepens at the pipe and fitting interface which in turn forces internal pressures to build up. This process is known as co-crystallization between the melted pipe and fitting material (C). The cooling phase (D) (combined with the design of the fitting) provides a controlled environment between the pipe and the fitting where re-solidification can effectively take place. This cooling phase begins immediately following the termination of current being supplied to the fitting and continues for a period of time beyond the point where the PE polymer re-solidifies (also known as clamping time). This allows ample time for the fusion area to regain the strength and flexibility it exhibited prior to fusion. Any movement or external stresses (binding, pulling, etc.) applied to the fused area during this cooling phase may result in a compromised fusion joint.

## **Re-Fusion of Electrofusion Fittings**

Central Plastics 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.

The recommended procedure for re-fusing fittings is:

Fitting should remain in clamped position and be allowed to cool to ambient temperature. The fitting should be reconnected to the processor and fused for the entire fusion time. 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.

## Hydrostatic Testing of Electrofusion Fittings

This technical note deals with the procedures and requirements for pressure testing Central Plastics Company's electrofusion fittings prior to placing the fitting in service.

Unless otherwise noted, all fittings subject to this technical note are pressure rated to an SDR 11 equivalent of 160 psi for water at 73°F (PE3408) or 125 psi for water at 73°F (PE2406). Pressure ratings for electrofusion fittings, as with pipe, are a function of wall thickness and operating temperature combined with a design safety factor specific to the media, in this case water.

Pressure testing of Central Electrofusion fittings is recommended to conform to guidelines set forth by the pipe manufacturer to include pressure ratings equal to or less than SDR 11. It is the responsibility of the installer to ensure that appropriate safety precautions are observed during pressure tests. Pneumatic pressure testing, due to safety reasons, is not recommended.

Most pipe manufacturers have adopted the hydrostatic pressure test recommendations listed in Plastics Pipe Institute (PPI) Technical Report TR 31. Test pressures should not exceed 1.5 times the rated operating pressure of the pipe or lowest rated component of the system for an average of 1 to 3 hours. The total time under test should not exceed 8 hours. Retests should not be performed within 8 hours of the prior test.

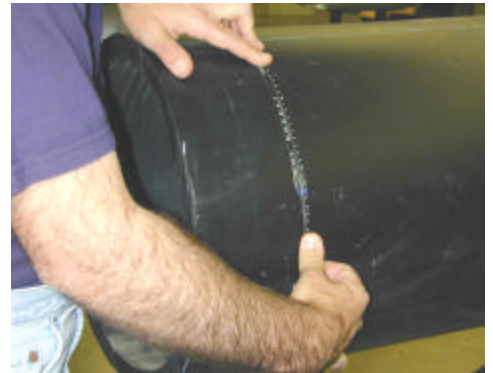
Under these guidelines the recommended maximum test pressure for an electrofusion fitting is 240 psig (PE3408) or 187.5 psig (PE2406) for an average duration of 1 to 3 hours, not to exceed 8 hours. The fitting should be visually examined for leakage when possible; if pressure monitoring is used to determine if leakage exists, allowances should be made for pipe expansion by adding water until equilibrium is established. Allowable amounts of "make up" water are shown in PPI Technical Report TR 31.

## Electrofusion Joining Procedures for Couplings

1.) Clean the pipe ends, or the area to be fused, by removing dirt, mud, and other debris from pipe ends. Clean water can be used for initial cleaning of pipe surfaces prior to scraping and isopropyl alcohol is recommended after scraping.



2.) 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.



3.) 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, a tubing cutter, or a chain saw without bar oil for larger pipe sizes)



4.) Identify the location of the fitting to be installed on the pipe and mark the area with a non-greasy marker. (See "Markers" page 4)

**If installing a coupler**, measure the total length of the coupler to be installed. Make a mark (with a non-grease marker) from the pipe end that is  $\frac{1}{2}$  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.



5.) Check the pipe surface for any embedded debris that may cause damage to scraping tools, and once more make sure that the outer pipe surface is clean and free of any dirt or mud that could recontaminate the scraped pipe surfaces.



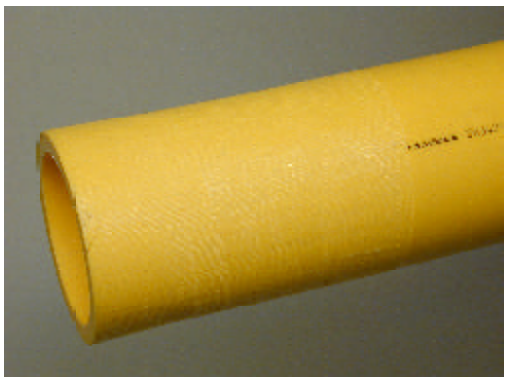
6.) Scrape the outside of the pipe surface to remove oxidation and other contaminants. Use an appropriate scraping tool as recommended by Central Plastics. Scrape the pipe surface until the outer layer or “skin” of the pipe has been removed to expose a clean, virgin pipe material. Inspect the entire scraped area to ensure total scraping coverage. If a 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. **Do not use abrasives, grinding wheels, or other devices that do not cleanly remove the contaminated material.**



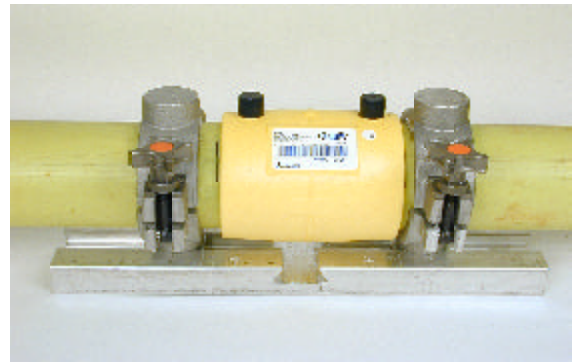
**NOTE: The purpose of scraping is to remove material from the pipe surface. Simply roughing the fusion area will not allow an acceptable bond to take place.**



7.) Avoid touching the scraped pipe surface or the inside of the coupler 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.** **CAUTION: AVOID ALL POSSIBLE RE-CONTAMINATION OF THE PREPARED SURFACE.**



8.) Place the fitting on the area to be fused and restrain using an approved restraint device .(See “Restraint” page 7)



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



9.) Attach processor leads to the fitting and proceed with fusion as described for standard joining. (If using a Bar-Code Processor see “Scanning Instructions” page 8)



10.) Disconnect and remove processor leads when fusion cycle is complete. It is a good practice to note the time required before clamp removal and mark it on the fitting if necessary.

11.) Allow fitting to cool in accordance with recommended cooling time before pressure testing or rough handling. (See “Electrofusion Cooling” page 9)





## Electrofusion Joining Procedures for Sidewall/Saddle Fittings (for use with under-clamp on 1-1/4" - 6" fitting bases)

1.) Identify the location of the fitting to be installed on the pipe and mark the area with a non-greasy marker.

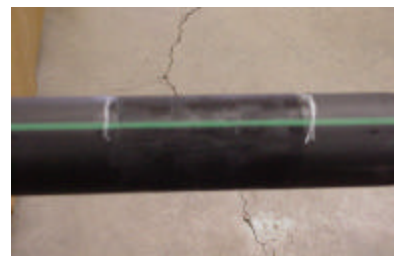


2.) Check the pipe surface for any embedded debris that may cause damage to scraping tools making sure that the outer pipe surface is clean and free of any dirt or mud that could recontaminate the scraped pipe surfaces.

3.) Scrape the area to be fused with an approved scraping tool. Make sure that the appropriate amount of material is removed approx. .007" to .0010".

**Do not use abrasives, grinding wheels, or other devices that do not cleanly remove the contaminated material.**

**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. (see "Proper Pipe Preparation" page 3 )**



4.) Avoid touching the scraped pipe surface or the inside of the fitting 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.**

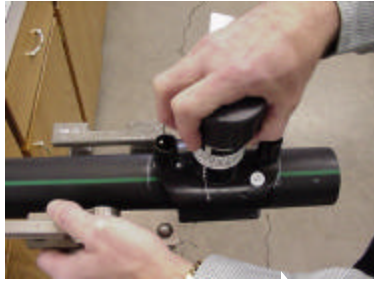
### **CAUTION:**

AVOID ALL POSSIBLE RECONTAMINATION OF THE PREPARED SURFACE.

5.) Remove the fitting from the bag and place it on the area to be fused



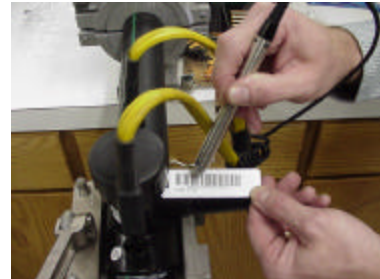
6.) Without moving the fitting, slide the Under-Clamp onto the base of the fitting.



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



8.) Attach processor leads to the fitting and proceed with fusion as described for standard joining. (If using a Bar-Code Processor see "Scanning Instructions" page 8)



### **IMPORTANT NOTE:**

***Proper installation of an electrofusion side-wall fitting requires the fitting to remain secured in the clamp until the clamping time shown on the fitting label has been completed! Outlets may be prepared prior to the Tapping Tee installation or at least 10 minutes after the Tapping Tee has been fused to the pipe.***

## Electrofusion Joining Procedures for Sidewall /Saddle Fittings (for use with Top-Load Clamp on 8", 10" & 12" fitting bases)

### 1) Equipment Needed:

1. Top Load Clamp
2. Top Load Clamp Fitting Adapters
3. Electrofusion Processor
4. Sure-Form Scraper
5. 8", 10" or 12" Electrofusion Saddle Fitting
6. Permanent Marker
7. Re-Rounding Clamps (if necessary)



2) Place fitting on pipe and mark area to be scraped. If the pipe is out-of-round use re-rounding devices on both sides of the area to be fused before proceeding.



3) Using a scraping tool, remove the outer layer of pipe in order to reach virgin material.

4) If installing a Tapping Tee, remove the cap from fitting.

5) Taking care not to contaminate the scraped 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.**

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

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

**CAUTION: Over/Under tightening could result in defective joints.**

8) Attach leads and verify fusion time.

9) Press Start button on Electrofusion Processor

10) Upon completion of the fusion cycle, allow the fitting to cool for recommended cooling time. DO NOT remove the clamp until the fusion cycle and the cooling cycle are complete.

**NOTE: Tapping Tees must remain immobile until it has properly cooled. Outlets may be prepared prior to the Tapping Tee installation or at least 10 minutes after the Tapping Tee has been fused to the pipe.**



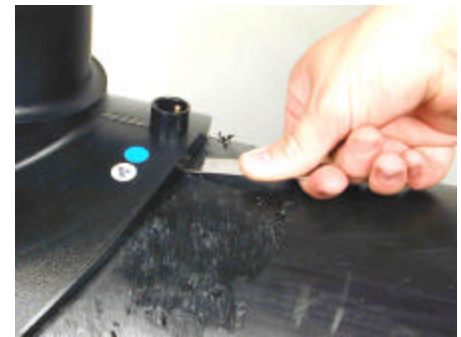
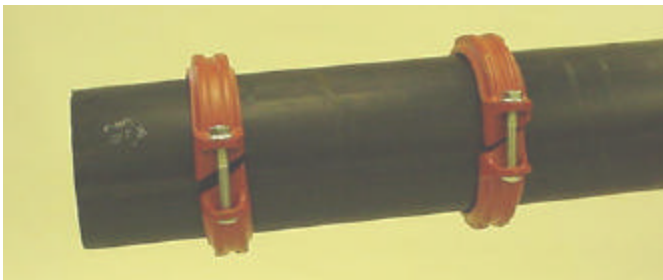
**NOTE: Procedures for installing 8", 10" and 12" Electrofusion Saddle Fittings can be accomplished at a temperature range of -10° F to 120° F**

## Electrofusion Joining Procedures for Branch Saddle Fittings (for use with T-Clamp )

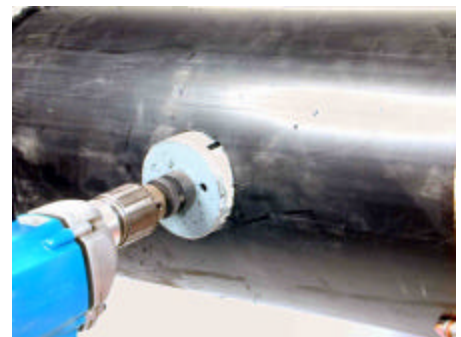
1.) Clean the area to be fused by removing dirt, mud, and other debris from pipe ends (pay close attention to the drill mud residue in trenchless applications). Clean water can be used for initial cleaning prior to scraping and isopropyl alcohol is recommended after scraping if necessary.



2.) 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. Use a .015" feeler gauge to check interface gap



3.) Before placing the fitting use a hole saw and cut an entrance hole that is smaller than the inside diameter of the branch saddle for the T-Clamp to be inserted through.

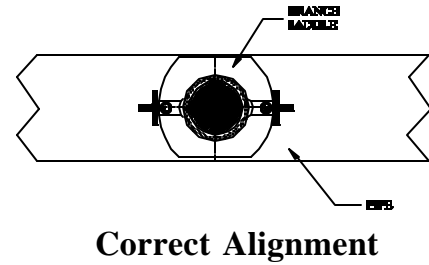
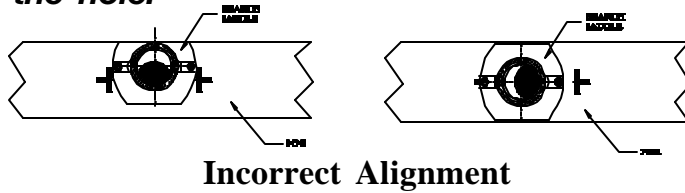


4.) Identify the location of the fitting to be installed on the pipe and mark the area with a non-greasy marker.



5.) Use your marks to make sure the alignment of the fitting is correct.

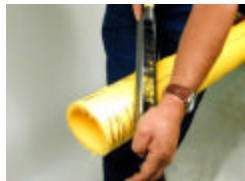
**CAUTION: Fusion zone cannot be located over the hole.**



6.) Check the pipe surface for any embedded debris that may cause damage to scraping tools making sure that the outer pipe surface is clean and free of any dirt or mud that could recontaminate the scraped pipe surfaces.



7.) Scrape the area to be fused with an approved scraping tool. Make sure that the appropriate amount of material is removed (approx. .007" to .010")



← Sure Form Rasp  
(Stanley Model #21-296  
or equivalent)

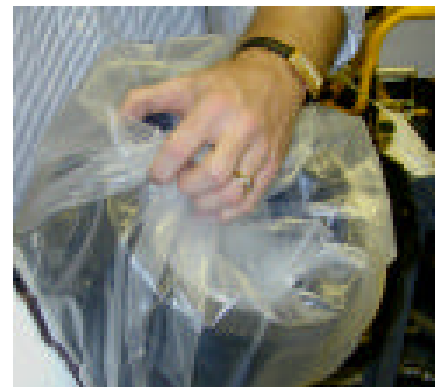
Paint Scraper →



**Do not use abrasives, grinding wheels, or other devices that do not cleanly remove the contaminated material.**

**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. (see "Proper Pipe Preparation" page 3 )**

8.) Avoid touching the scraped pipe surface or the inside of the fitting 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.**



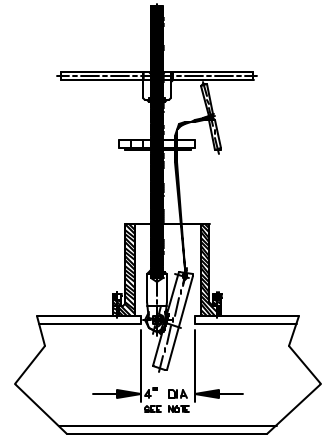
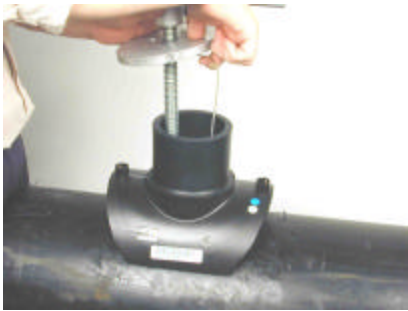
**CAUTION:**

**AVOID ALL POSSIBLE RECONTAMINATION OF THE PREPARED SURFACE.**

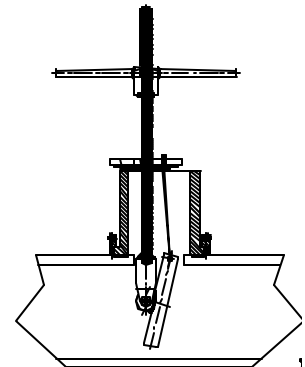
9.) Place the fitting on the area to be fused and restrain using the T-Clamp.



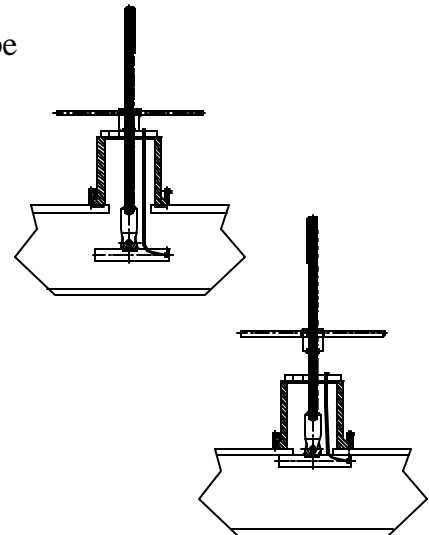
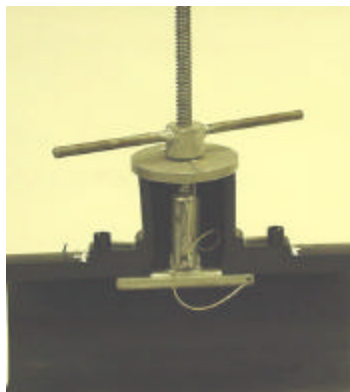
10.) Insert the T-Clamp through the top of the Branch Saddle and into entrance hole.



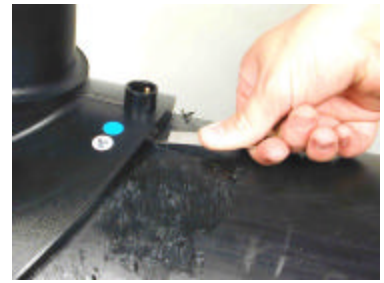
**NOTE:**  
CUT A 4" DIA. HOLE FOR SIZES LARGER THAN 4" TO MAKE AN EASIER FIT.



11.) Tighten T-Clamp down until it is snug on the pipe surface then turn handle 1/4 turn more.



12.) Check to make sure there is no excessive gap between the pipe and the fitting. Use a .015" feeler gauge to check interface gap

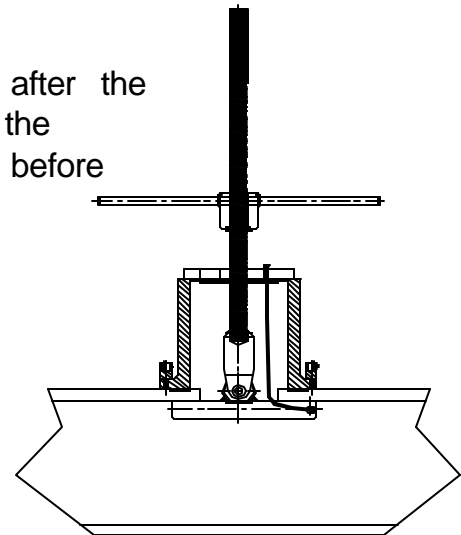


13.) Attach processor leads to the fitting and proceed with fusion as described for standard joining. (If using a Bar-Code Processor see "Scanning Instructions" page 8)



14.) Disconnect and remove the processor leads when the fusion cycle has been completed.

15.) Keep the pipe and the fitting restrained until after the fitting has completed the entire fusion cycle and the recommended cooling time. Note the time required before clamp removal and mark it on the fitting if necessary.



16.) Reverse the installation process to remove T-Clamp.



## Electrofusion Joining Procedures for Flex Restraints (for use with Ratchet Strap Clamp )

(1) Identify the desired location for the Flex Restraints

(2) Pipe must be clean. Remove all sources of contamination. A **minimum 70%** concentration of Isopropyl Alcohol and a lint free rag should be used to clean the surface area to be fused.



(3) For the purpose of insuring a good scrape of the fusion area, use an appropriate marker to randomly mark over the outlined fusion area. This will provide a visual gage while scraping.



(4) A thin layer of the pipe surface area must be removed in the area that is to be fused in order to assure a quality fusion joint. (**Do not use emory cloth - see "Proper Pipe Preparation" page 3**) Scrape the fusion area until all of the marks have been removed.



### **NOTE:**

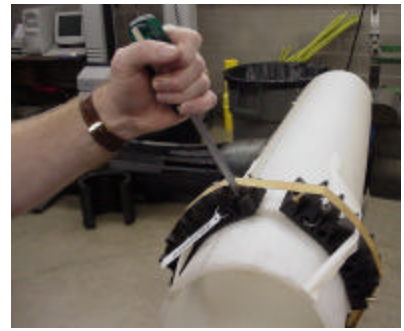
*Make sure the fusion area remains clean and free of moisture during the installation of the saddle. If contamination of the area occurs after scraping, Isopropyl alcohol should be used to removed contamination. Re-scrape if necessary*

(5) The Flex Restraint must be secured to the scraped area of the pipe surface. This can be accomplished in a variety of ways (i.e. wormgear clamps, c-clamps or nylon ratchet straps), ratchet straps are the recommended application tool due to the ease of use.





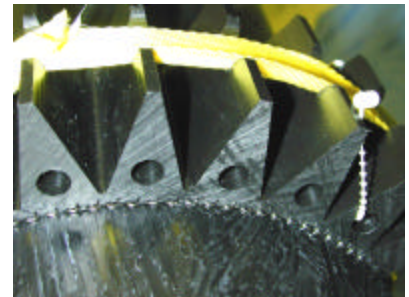
(6) Tighten the strap until the restraints are conformed to the pipe wall. Make sure the Flex Restraint makes contact with the pipe over the entire fusion area. If more than one restraint is to be used, make sure that all fittings are in place before fully tightening the ratchet straps.



**NOTE:**

*If multiple restraints are to be used, it is helpful to place the fitting over the scraped area and to secure it in place with masking tape or duct tape until the strap can be applied.*

(7) Connect the processor leads to the Flex Restraint. The fusion data is entered into the processor in either manual mode or bar-code mode. The Flex Restraint is a temperature compensated fitting. If the data is entered in manual mode, make sure to set the fusion time as stated on the card insert provide with each fitting. The bar-code entry of data automatically sets the fusion parameters



**NOTE:**

*If using a Model C or a Model U Processor fusion times should be manually set using the fusion time card packaged with the fitting.*

(8) After the fusion cycle is complete, the restraint and clamping device being used must remain in place and be allowed to cool for 15 minutes. The Flex Restraint should be completely cool before it is subjected to any forces.

**CAUTION:** *The fusion zone of the Flex Restraint gets very hot and it is also a potential shock hazard! DO NOT TOUCH THE WIRES DURING THE FUSION OR THE COOLING TIME!*

# 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 SCRAPING

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 scraping or other pipe preparation was done.



## PIPE OVER-SCRAPED

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 scraper. 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.



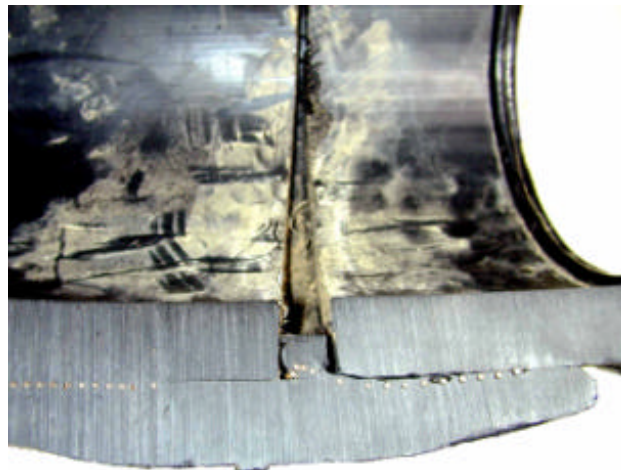
# Examples of Incorrect Electrofusion Joints

## PIPE UNDER-SCRAPED



The visible tool marks show that some effort was made to scrape 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.

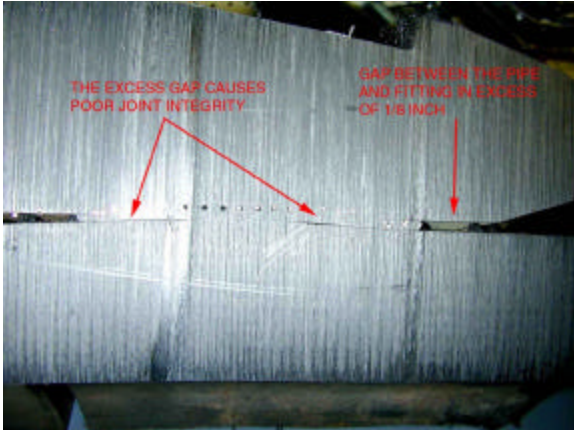
## PIPE MIS-STAB



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 an 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.

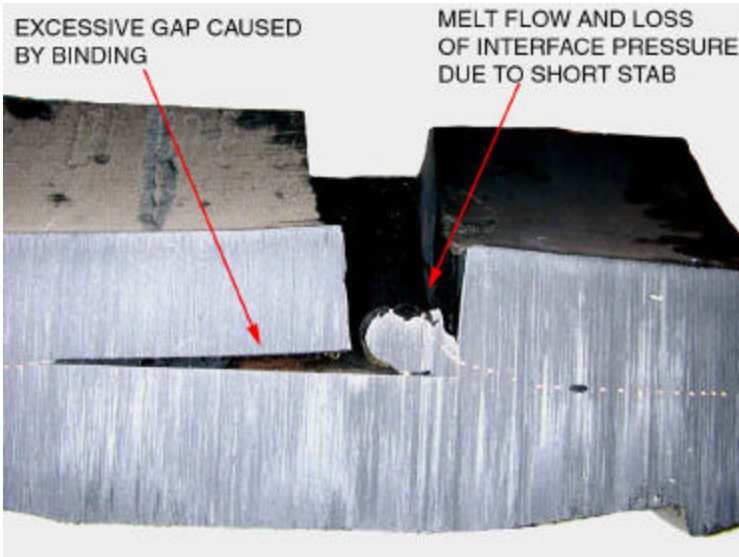
# Examples of Incorrect Electrofusion Joints

## 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 scraping, 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.

## **DESTRUCTIVE TESTING PROCEDURES FOR ELECTROFUSION FITTING QUALIFICATION**

The following test methods are useful as an evaluation of bonding strength and quality between the pipe and fitting. Similar tests can be used as user qualification criteria. As these methods are destructive, they are only useful in determining joint quality of a fusion to verify that proper procedures were followed.

The following steps should be used only as a guide for cursory analysis of suspect fittings or fusions, this guide should not be considered as proof of long-term performance of pipe and fitting fusions.

General information regarding a suspect fusion or fitting failure that should be obtained whenever possible:

1. Heating coil ohmic value
2. ID resistor ohmic value
3. Label fuse time information
4. Barcode label information
5. Fusion download (if possible)
6. Visible indications of malfunction or preparation errors
7. Field conditions/Site conditions (weather factors, generator size, etc.)
8. Fitting Lot number
9. Fitting production date

### **1. COUPLINGS:**

After all relevant information is gathered, the fitting should be cut and subjected to joint evaluation tests. Bend tests, peel tests, and crush tests are helpful in locating fusion weaknesses. It is desirable to obtain x-ray photographs of the fitting before dissection to locate any possible contact points of the fusion coil.

To prepare a specimen for crush testing, it is necessary to cut the pipe and coupling longitudinally in half as near to the centerline of the pipe and coupling as possible. It is desirable to leave at least 3"(75mm) to 5"(125mm) of pipe length at each end of the coupler.

Place a specimen half in a vise so that the outermost wire of the fusion zone is approximately 1 1/4" (32mm) from the vise jaws, ( **Figure 1** )

Close the vise jaws until the pipe walls meet, ( **Figure 2** ) Repeat this process for each end of both halves of the coupling.

Inspect the crushed specimens for separation of the pipe and fitting in the fusion zone. Some minor separation (up to 15%) may be seen at the outermost region of the fusion zone, this does not constitute failure. Ductile failure of the pipe, fitting, or PE insulation around the wires is acceptable. There should be no separation at the fusion interface of the pipe and fitting.

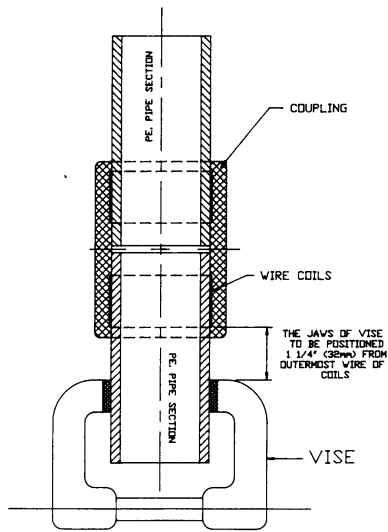


Figure 1

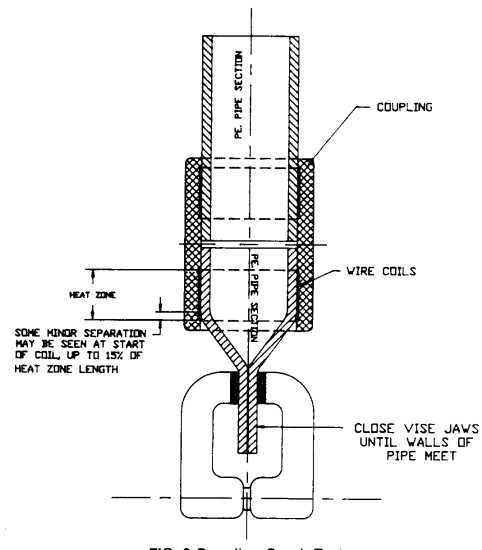


Figure 2

## 1. TAPPING TEES

Tapping tees should be left intact for crush testing. Pipe lengths can be cut to the edges of the fitting base.

Place the pipe and fitting into a vise so that the jaws are within 1/2" (13mm) of the bottom of the saddle, ( **Figure 3**). Close the vise until the pipe walls meet, ( **Figure 4**).

Inspect the crushed specimens for separation of the pipe and fitting in the fusion zone. Some minor separation (up to 15%) may be seen at the outermost region of the fusion zone, this does not constitute failure. Ductile failure of the pipe, fitting, or PE insulation around the wires is acceptable. There should be no separation at the fusion interface of the pipe and fitting.

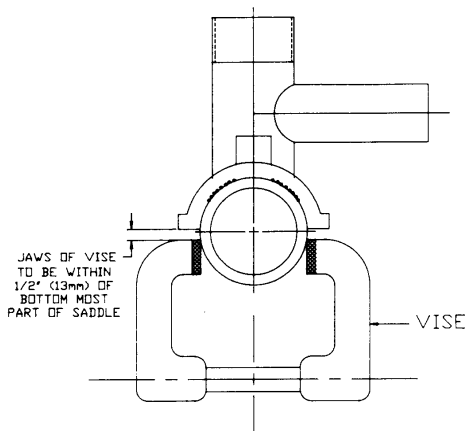


Figure 3

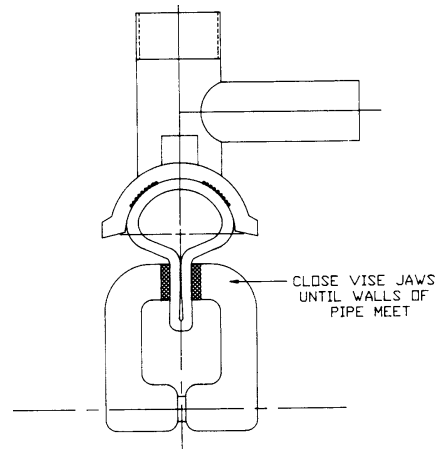
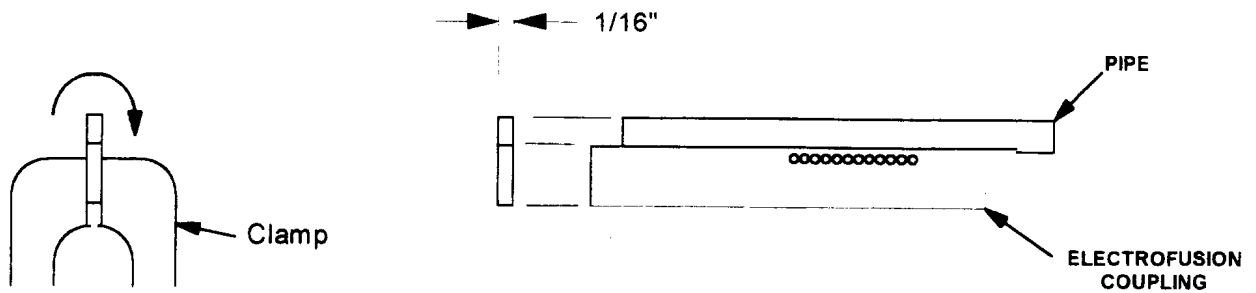
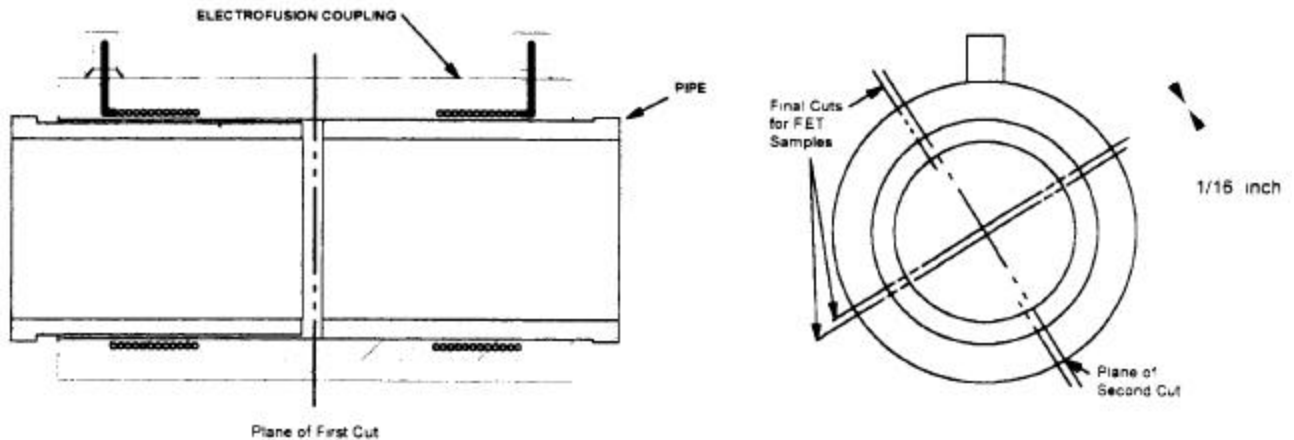


Figure 4

Further evaluations are possible by cutting the fusion area and surrounding pipe and fitting materials in thin strips for bend tests. The strips are then placed into a vise and bent directly on the fusion interface and evaluated for separation. The same visual criteria are used for fusion evaluation tests as is used for crush tests.



**Couplings** should have four strips cut from the fusion interface at 90° intervals as shown in figure 5. The strips should be approximately 1/16"(1.5mm) to 1/8"(3mm) in thickness.



**Figure 5**

**Tapping Tees** should have four strips cut along the center line of the pipe through the fitting fusion surface and a strip cut from the radial side of each half of the fitting.

