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SPECIFICATION: **IP-27-14**

TITLE: **INSTALLATION OF ELECTROFUSION FITTINGS ON POLYETHYLENE (PE) PLASTIC PIPE/TUBING AND MOLDED FITTINGS USING A UNIVERSAL ELECTROFUSION PROCESSOR**

VOLUME: **2 (Section 4.0), 10 and Yellow Book**

COURSE ID: **GAS0173**

REQUIRED TRAINING GROUPS: **Gas Construction, Emergency Response Force (ERF), Gas Development Lab, Gas Quality Control, Construction Management-Gas, Construction Services, Per Diem, Gas Contractors, TLC**

Each group listed is responsible for its own training which may be specific to a title/individual and not to the group in its entirety. Please check with your local training coordinator/department.

Applicable Bulletins

B-24-14 – NGA 2025 Butt Fusion and Electrofusion Update

SUBSTANTIVE REVISIONS: (See★)

1) Section 5.9 - Added clarifying language on the inspection requirements for surface defect to PE plastic pipe, tubing and fittings prior to installation. Added reference to DOJT GAS0173.

2) Section 6.1 C) - Updated C&S numbers.

3) Section 6.1 E) - Added in the process of measuring the insertion depth.

SUBSTANTIVE REVISIONS: (Continued)

4) Section 6.1 F) - Was edited to include information about a washing zone. define all the clean areas or zones. Figure 1 was updated from the image of just the pipe to one that highlights the different clean zones discussed. Due to the edits within this section subsequent sections were renumbered. Replaced “99.9% liquid isopropyl alcohol (Class/Stock # 630-1246)” with "liquid isopropyl alcohol (90% or greater)". Figure 1 was removed and replaced by Figures 1 and 2 to depict marks and all clean areas or zones.

5) Sections 6.1 F) 1. - These sections used to be 6.1 G) and has not been incorporated into section 6.1 F). This section was updated to include more detail on marking the water-wash zone.

6) Section 6.1 F) 2. - This section is new with this revision and gives details on how to clean the water wash zone.

7) Section 6.1 F) 3. - This section is new with this revision and gives details on marking the solvent-wash zone.

8) Section 6.1 F) 4. - This section is new with this revision and gives details on how to clean the water wash zone.

9) Section 6.1 F) 5. This section is new with this revision and gives details on how to mark the peel zone.

10) Section 6.1 G) - Added in materials to be used to properly clean the pipes. Add in statements at the end of the first paragraph discussing to avoid gouging and removing excess material. Added in reference to Figure 2.

11) Section 6.1 H) - Added additional step to clean peel area to further cleanliness. Replaced “99.9% liquid isopropyl alcohol (Class/Stock # 630-1246)” with "liquid isopropyl alcohol (90% or greater)"

12) Section 6.1 I) - Added additional step to clean peel area to further cleanliness. Added additional cleaning step should incidental contamination occur

13) Section 6.1 J) - The beginning part of this section concerning placing the fitting on the pipe is new with this revision.

14) Section 6.1 K) - Removed reference to section 7.2 (F).

15) Section 6.1 M) - This section is new with this revision. It was removed from section 6.1 A) and placed here.

SUBSTANTIVE REVISIONS: (Continued)

16) Section 6.1 N) - Revised guidance on optional pre-heating of large diameter coupling.

17) Section 6.1 P) - MTD-ISCO coupling total cool time updated. GF Central Plastics electrofusion manual link updated to new version.

18) Section 6.1 Q) - Reworded for Clarity.

19) Section 6.1 R) - Titled the section and added the requirement to “mark with the appropriate identification next to the coupling”.

20) Section 8.1 B) - This section was moved up in the process It was originally section 8.1 C). All subsequent sections were renumbered.

21) Section 8.1 C) - Edited to define all the clean areas or zones. Figure 3 was updated from the image of just the pipe to one that highlights the different clean areas or zones discussed. Due to the edits within this section subsequent sections were renumbered. This is a new addition with this revision. Provides information on how to properly handle the marking, washing and peeling zones. Defines all the clean areas or zones. The original figure was replaced by Figures 3 and 4 to depict the marks and all clean areas or zones.

22) Section 8.1 C) 1. This section was updated to include more detail on how to mark the water-wash zone.

23) Section 8.1 C) 2. - This section is new with this revision and gives details on how to clean the water wash zone.

24) Section 8.1 C) 3. This section is new with this revision and gives details on marking the solvent-wash zone.

25) Section 8.1 C) 4. - This section is new with this revision and gives details on how to clean the water wash zone. Replaced “99.9% liquid isopropyl alcohol (Class/Stock # 630-1246)” with "liquid isopropyl alcohol (90% or greater)"

26) Section 8.1 C) 5. - This section is new with this revision and gives details on how to mark the peel zone.

27) Section 8.1 D) - Add in statements at the end of the first paragraph discussing to avoid gouging and removing excess material. Added in reference to Figure 2.

28) Section 8.1 E) - Reworded to clarify how to properly clean the pipe surface.

SUBSTANTIVE REVISIONS: (Continued)

29) Section 8.1 F) - Updated the first paragraph to include promptly installing the saddle fitting and cleaning the fusion surface. The second paragraph was edited to include that is it acceptable to hand scrape all or part of the fusion zone. The second paragraph was edited to include the statement “except when hand scraping the fusion zone of a repair patch”.

30) Section 8.1 G) - Reworded for clarity.

31) Section 8.1 I) - MTD-ISCO coupling total cool time updated. GF Central Plastics electrofusion manual link updated to new version.

32) Section 8.1 J) - Titled the section and added the requirement to “mark with the appropriate identification next to the coupling”.

33) Section 8.1 K) - This is a new section added with this revision concerning the second inspector visual inspection.

34) Section 12.0 - Added in reference to ASTM F3565-23.

Gas Operations Standards

TITLE: INSTALLATION OF ELECTROFUSION FITTINGS ON PE PLASTIC PIPE/TUBING AND MOLDED FITTINGS USING A UNIVERSAL ELECTROFUSION PROCESSOR

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1.0. SCOPE

This specification describes the requirements for the installation of approved electrofusion fittings on polyethylene (PE) plastic pipe, tubing, and molded fittings using a universal electrofusion processor. All electrofusion joints must be installed in accordance with the electrofusion procedures outlined in this specification, the Northeast Gas Association (NGA) Plastic Pipe Joining Manual, and manufacturer's assembly instructions included with the electrofusion fitting. If there is a discrepancy between the requirements of this specification and the manufacturer's instructions, the more stringent requirements are to be followed unless explicitly noted.

- See Gas Specification G-8123, "Heat Fusion Joining of Polyethylene (PE) Plastic Pipe/Tubing and Fittings for Gas Mains and Services" for the requirements to join PE plastic pipe, tubing, and molded fittings by butt fusion and branch saddle fusion.
- See Gas Specification IP-20, "Installation of Mechanical Fittings for Polyethylene (PE) Plastic Pipe and Tubing" for the requirements to join PE plastic pipe and tubing with mechanical fittings as well as the Approved Joining Methods for PE Plastic Pipe/Tubing Table.
- See DOJT GAS6006, "Documenting PE Plastic Gas Joints" for the requirements for visual inspection, second inspection, and documentation of PE plastic joints.
- See Specification G-8104, "Polyethylene Pipe, Tubing, and Fittings for Gas Mains and Services" for all approved PE plastic pipe, tubing, and fittings.
- See the PE Plastic Pipe Fusion Library on the Gas Hub for electrofusion fitting manufacturers' installation instructions and approved electrofusion processors' operating manuals.

2.0. LEGAL REQUIREMENTS

Federal: 49 CFR Part 192, Sections 273, 281, 283, 285, and 287.

State: 16 NYCRR Part 255, Sections 273, 281, 283, 285, and 287.

3.0. OPERATOR QUALIFICATION

3.1 Span of Control means the ratio of nonqualified to qualified individuals allowed for a covered task to be performed. Nonqualified individual(s) may be directed and observed by a qualified individual when performing a single covered task. The qualified individual must be able to effectively respond to errors or abnormal operating conditions that may occur during the performance of the task by the non-qualified individuals.

Tapping a pipeline, welding steel, and joining plastic pipe have a span of control of zero, meaning that the Operator Qualified individual must perform the entire task. Certain other covered tasks also have a span of control of zero, and those are detailed in their applicable specifications and the OQ Written Plan. All other covered tasks shall be completed by either Operator Qualified individuals or individuals under the direct observation of someone who is Operator Qualified. Direct observation means that the Operator Qualified individual remains in direct visual and verbal contact at all times with the individual performing the single covered task.

Both the nonqualified and qualified individuals should be identified on the applicable records being generated, for the work performed under span of control.

3.2 Installers who join PE plastic pipe/ tubing and fittings must be Operator Qualified **and** in compliance with the annual requalification requirements of Gas Specification G-8121, "Qualification of Joiners and Inspectors of Polyethylene (PE) Plastic Pipe/Tubing and Fittings for Gas Mains and Services."

If necessary to produce a quality joint, the joiner can request assistance from another qualified mechanic. If two qualified mechanics work on the same fuse, the lead fuser will be responsible for the overall fusion process and its quality. Once the fusion process is completed, the lead fuser will sign off and be the only mechanic of record for the completed fuse.

3.3 Second Inspectors of PE Plastic Joints

A) Second inspectors who inspect PE plastic pipe joints (heat fusion, electrofusion, or with mechanical fittings) shall be Operator Qualified as a fusion joiner or as a second inspector (e.g. Covered Task 52 or equivalent). The second inspector must be in compliance with the

annual requalification for either joiner or second inspector stipulated in Gas Specification G-8121.

B) Second inspectors may be a third-party Company contractor or non-crew based Company management employee.

C) See DOJT GAS6006, "Documenting PE Plastic Gas Joints" for the requirements for visual inspection, second inspection, and documentation of PE plastic joints.

4.0. QUALIFICATION OF ELECTROFUSION JOINING PROCEDURES

- NGA Plastic Pipe Joining Manual
- GTI Report: GTI Project No. 23372.1.18, Qualification of Pipe Joining Procedures per CFR 49 §192.283
- GT-14-048-4 Procedure for Qualifying Electrofusion Plastic Pipe Joints

5.0. GENERAL GUIDELINES

5.1 Prior to starting any task pursuant to this Specification, Con Edison employees should be familiar with Con Edison's Job Safety Analysis (JSA) library. Any Con Edison employee preparing a job briefing for any task to be accomplished pursuant to this Specification should review the JSA library to determine if there is a JSA applicable to the task. Any relevant JSA found in the library should be discussed during the job briefing for the task. This provision is applicable to Con Edison employees.

5.2 The preferred method to join PE plastic pipe and tubing is heat fusion (butt and branch saddle). (See Gas Specification G-8123). When heat fusion is not practical or available, electrofusion or MetFit fittings (where applicable) should be used. When heat fusion, electrofusion, or MetFit fittings are not practical or available, approved restraining-type mechanical fittings other than MetFit shall be installed on PE plastic pipe and tubing per Gas Specification IP-20. All steel mechanical fittings shall be cathodically protected per Gas Specification G-8209, "Preparation and Field Coating of Gas and Other Steel Pipes Installed Aboveground and Underground."

5.3 Heat fusion, electrofusion, and MetFit couplings are approved methods for joining to PE plastic molded fittings such as tees or elbows. Mechanical fittings other than MetFit fittings may not be installed directly onto a plastic molded fitting. Where needed, butt fuse pup lengths of pipe or tubing to molded fittings to enable the use of these fittings, or to allow use of restraining clamps for electrofusion joining and to ensure visibility of surface preparation.

5.4 All electrofusion fittings are approved for use with all currently approved high-density PE 3408/4710 plastic pipe and tubing. See Attachment A for details on legacy (vintage) PE plastic piping.

5.5 Joining of PE plastic pipe/fitting with SDR wall thickness **greater than one change in SDR** shall only be done using electrofusion.

5.6 Approved restraining-type mechanical couplings may only be used for joining PE plastic pipe when an electrofusion coupling or MetFit coupling is unavailable. (See Gas Specifications IP-20 and G-8209)

5.7 Electrofusion fittings **must** be installed at least three (3) pipe diameters or 12", whichever is **greater**, from a squeeze-off point.

5.8 Quality fusion requires use of all required tools and equipment and adherence to the fusion procedure in the correct sequence. Use of improper or defective equipment and/or not following the procedure (omitting steps or performing steps out of sequence) will cause faulty fusion. If there is a discrepancy between the instructions in this specification and the manufacturer's instructions, follow the more stringent standard. If it is uncertain which standard is more stringent, contact the Gas Development Laboratory for guidance.

★ 5.9 Inspect PE plastic pipe, tubing, and fittings prior to installation to verify:

- No cuts, gouges (10% pipe wall thickness or greater), deep scratches, or other interfering defects. Minor surface defects or scratches on previously-installed pipe are acceptable, so long as the pipe surface can be properly cleaned and prepared. See DOJT GAS0173 "IP-27" for specific guidance on managing these defects.
- No toe-in (reduction of diameter at pipe end).
- PE plastic material is high density polyethylene (HDPE), PE3408/4710, and manufactured per ASTM D2513.

- PE plastic material is not older than 10 years old.
- PE plastic material is dry and free from contaminants.

(See Gas Specification G-8122, "Inspection, Handling, Storage and Transportation of Polyethylene Plastic Pipe/Tubing, and Fittings for Gas Mains and Services")

5.10 Whenever possible, excavations should be of sufficient size to prepare the pipe, check alignment, and inspect the joint without interference from side walls or floor. If there are space constraints that may lead to contamination from surrounding excavation surfaces or 3rd party interference, the excavation should be expanded to allow for proper clearance. If proper clearance cannot be obtained, a barrier should be installed between the interference and the fusion area. Examples of barriers which may be used include water impingement rubber mats (Class & Stock #059-5306) and 0.006 mil polyethylene film (Class & Stock 686-0027).

5.11 All scrap PE plastic pipe, tubing, and/or fittings that cannot be reused shall be brought back to the workout location for proper disposal/ recycling.

6.0. ELECTROFUSION COUPLINGS INSTALLATION GUIDELINES

6.1 The following installation guidelines provide general steps necessary to install an electrofusion coupling using a universal electrofusion processor and to inspect the completed joint. For more detailed information, refer to the manufacturer's assembly instructions and the latest revision of the NGA Plastic Pipe Joining Manual.

A) **Inspect** PE plastic pipe, tubing, and coupling as per Section 5.9. Keep electrofusion coupling in the plastic bag provided until needed to avoid accidental contamination. Visually inspect the inside of the coupling for defects and then check the coupling for electrical continuity (e.g. calibrated fluke meter or flashlight continuity tester). If any defects are noted, or if there is no electrical continuity, the electrofusion coupling shall not be installed.

B) **Measure pipe diameter.** Measure the pipe diameter using a Pi tape or circumferential wrap to ensure that diameter falls within recommended tolerance shown in the table below. Pipe that is outside of the diameter tolerance should not be used.

Pipe Diameter Tolerances (all measurements in inches)			
Size	Nominal Diameter	Tolerance	Range
1" CTS	1.125	0.005	1.12-1.13
1" IPS	1.315	0.005	1.31-1.32
1¼" CTS	1.375	0.005	1.37-1.38
1¼" IPS	1.660	0.005	1.655-1.665
2" IPS	2.375	0.006	2.369-2.381
3" IPS	3.500	0.016	3.484-3.516
4" IPS	4.500	0.020	4.48-4.52
6" IPS	6.625	0.030	6.595-6.655
8" IPS	8.625	0.039	8.586-8.664
10" IPS	10.750	0.048	10.702-10.798
12" IPS	12.750	0.057	12.693-12.807
16" IPS	16.000	0.072	15.928-16.072

★ C) **Cut the pipe** ends to ensure a square, even surface. Where needed, use Wrap-A-Round tape (MSC punchout 16998841 & 61713970A) or similar tool to mark a cutting line perpendicular to the pipe axis. Remove any burrs or shavings with a clean knife.

D) **Check pipe for out-of-round.** Measure the vertical and horizontal diameters of the pipe across the cut end using a tape measure. The two diameters should be nearly identical. The table below lists the maximum difference allowed for different pipe sizes:

Pipe Size	Max Diameter Difference
3"	1/16"
4"	1/16"
6"	1/8"
8"	1/8"
10"	1/8"
12"	1/8"
16"	1/4"

If pipe ends are outside of tolerance limits, use a re-rounding clamp to bring the pipe back to round within tolerance limits.

Re-rounding clamps are required during electrofusion joining of 16" PE plastic pipe, regardless of measurement.

★ E) **Measure the coupling stab depth and insertion depth.**

- **Stab depth**: For straight couplings, the stab depth will be half the length of the coupling. For elbows and other non-linear couplings, measure the stab depth on the fitting by inserting a ruler or tape measure inside the fitting mouth up to the internal stop. This should be done prior to unwrapping the fitting to prevent contamination. If the fitting is unpackaged, and ruler is inserted into the fitting to measure the insertion depth, the inside of the fitting shall be wiped clean.

- **Insertion depth**: Depending on space constraints, determine how far the coupling will need to be inserted onto the pipe during installation. For installations with space constraints, the insertion depth may be equal to the full length of the coupling. For installation without space constraints, the insertion depth will equal the stab depth.

★ F) **Establish clean zones on the pipe.** Establish and mark each of the clean zones as shown in Figure 1 below, and as described in the subsequent steps. The solvent wash zone shall encompass the entire insertion depth (length of pipe that will be exposed to the inside of the fitting during installation). All markings on the pipe shall be done using a non-oil-based silver Sharpie (e.g. MSC # 42258343) or Friatec marking pen (Contact Development Lab). Do not use keel, lumber crayons, or paint markers for marking pipe.

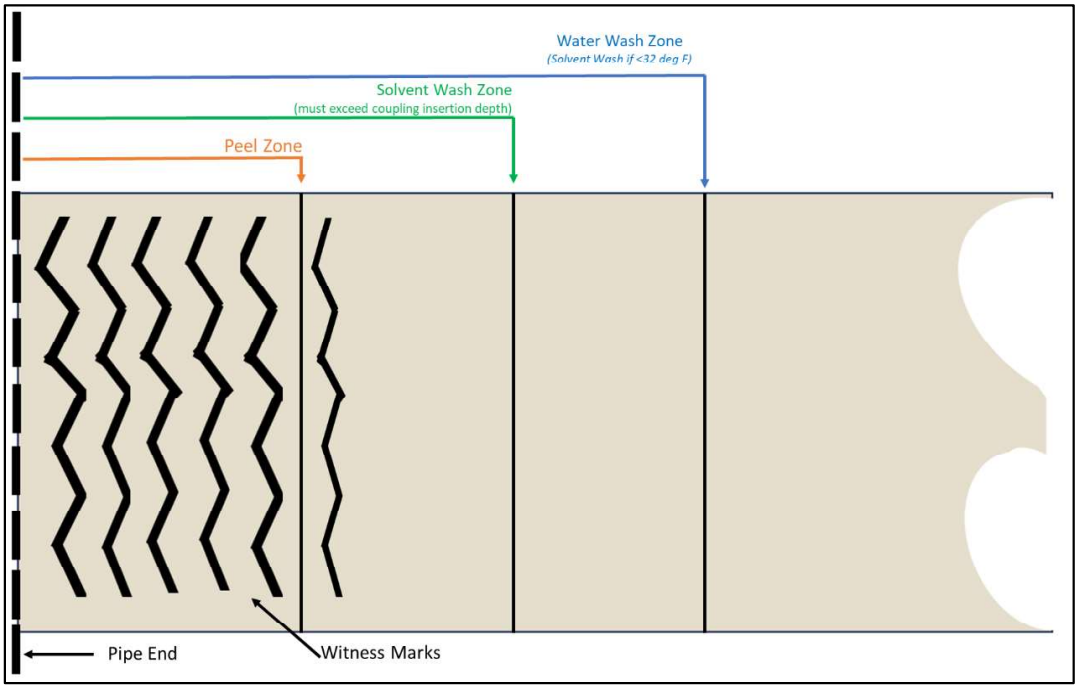


Figure 1: Pipe Markings – Electrofusion Coupling

★ 1. **Mark Water Wash Zone:** Establish a water-wash area on the pipe end long enough to accommodate the peel and solvent wash zones as shown in Figure 1. Mark the boundary of the water wash zone on the pipe and ensure that subsequent cleaning does not exceed this established zone.

★ 2. **Clean Water Wash Zone**: Use detergent-free water to remove dirt and mud from the pipe. Do **not** use soap water (leak detection solution) to clean the pipe. Clean the pipe exterior all the way to the marked wash zone boundary. Use a clean, dry, lint-free non-synthetic (e.g. cotton) cloth or paper towel (WypAll L40 or similar) to dry the pipe outside, inside, and ends. The cloth or paper towel should be replaced every time after wiping the pipe. Do not reuse it to clean other surfaces. For temperatures below 32 degrees, alcohol wipes (Class/Stock # 689-3135) or liquid isopropyl alcohol (90% or greater) with a clean, lint-free, non-synthetic cloth/paper towel (e.g. NS0209687) should be used in place of water. It is recommended to wipe the pipe surface in a circumferential manner around the pipe versus longitudinally along the pipe.

NOTE 1: When performing fusion in a lab setting, alcohol wipes may be used in place of water.

NOTE 2: When using liquid isopropyl alcohol, place plastic sheeting and absorbent pads underneath the fitting. The used wipes/cloth/absorbent pads shall be disposed as non-hazardous industrial waste. Liquid isopropyl alcohol shall be disposed as flammable hazardous waste. Contact EH&S Operations for guidance when disposing liquid isopropyl alcohol.

★ 3. **Mark Solvent-Wash Zone**: Within the water wash zone, mark another area longer than the coupling insertion depth. This area is the solvent wash zone.

★ 4. **Clean Solvent-Wash Zone:** Clean this area with a solvent. Alcohol wipes (Class/Stock # 689-3135) or liquid isopropyl alcohol (90% or greater) with a clean, lint-free, non-synthetic cloth/paper towel (e.g. NS0209687) are to be used to clean the surface. Clean all the way to, but do not exceed the marked boundary of the solvent wash zone when cleaning during this or later steps. Allow to dry completely before proceeding.

NOTE: When using liquid isopropyl alcohol, place plastic sheeting and absorbent pads underneath the fitting. The used wipes/cloth/absorbent pads shall be disposed as non-hazardous industrial waste. Liquid isopropyl alcohol shall be disposed as flammable hazardous waste. Contact EH&S Operations for guidance when disposing liquid isopropyl alcohol.

★ 5. **Mark Peel Zone:** Mark the length of the area to be peeled on the pipe, so that it is slightly longer than the fitting stab depth. Make witness marks on the pipe surface with a non oil-based Sharpie (e.g. MSC # 42258343) in the area to be peeled. Avoid using paint markers to make witness marks, as the paint can leave residue and interfere with the surface preparation. The witness

marks are used as a visual aid after peeling. Any visible marks remaining on the pipe indicate that an adequate amount of pipe surface was not removed and further peeling is required.

★ G) **Peel** the marked peel zone on the outside of the pipe to remove surface oxidation using an approved rotary peeler tool (See Operation of Fusion Equipment for approved peelers and scrapers).

- Hand scrapers are **only to be used** when field conditions preclude the use of a rotary peeler. *Use of hand scrapers must be approved and documented through the Gas Engineering Service Request application (see Attachment C).*
- Do not use a file or sandpaper.
- Do not use a hand scraper after any pipe has been peeled.
- Avoid gouging or removing excessive material from the pipe surface and do not touch the prepared pipe or fitting surfaces after peeling.

See Figure 2 for an illustration of pipe after peeling is complete.

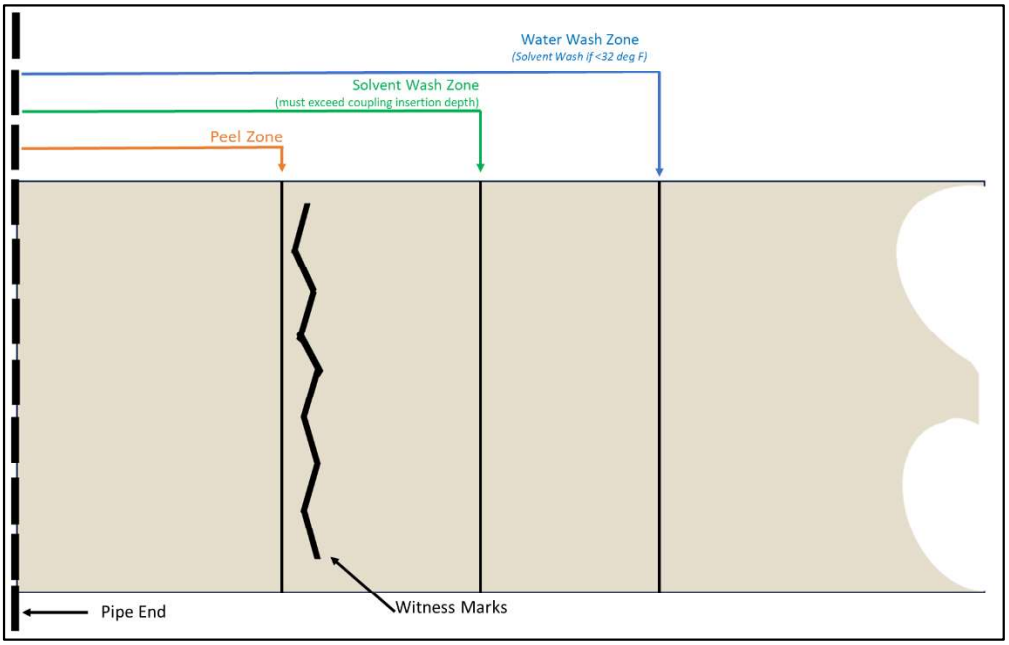


Figure 2: Pipe Markings After Peeling – Electrofusion Coupling

Make sure that peeler is maintained and stored according to manufacturer's instructions and cleaned before each use to ensure that

it can produce a continuous ribbon of PE. Any witness marking that remains afterwards indicates that areas were missed and that more scraping or peeling is required. Make sure that the outer surface is completely prepared such that the pipe surface has no oxidation, no surface contamination and is uniform and gouge free.

★ H) **Clean Peeled Area:** Remove any debris from the inside of the pipe with a clean, dry, lint-free non-synthetic (e.g. cotton) cloth (WypAll L40 or similar). Clean the peeled area of the pipe with 96% alcohol wipes (Class/Stock # 689-3135) or liquid isopropyl alcohol (90% or greater) with a clean, lint-free, non-synthetic cloth/paper towel (e.g. NS0209687) all the way to, but do not exceed the edge of the peeled surface. Make sure the pipe surface is completely dry. If the surface of the peeled/scraped pipe becomes contaminated with dirt, debris, water, finger marks or other foreign substances, clean again.

> **NOTE**: When using liquid isopropyl alcohol, place plastic sheeting and absorbent pads underneath the fitting. The used wipes/cloth/absorbent pads shall be disposed as non-hazardous industrial waste. Liquid isopropyl alcohol shall be disposed as flammable hazardous waste. Contact EH&S Operations for guidance when disposing liquid isopropyl alcohol.

★ I) **Re-measure and Mark the stab depth**: While keeping the electrofusion coupling in its plastic bag, measure the depth of the fitting and transfer a mark onto the pipe end equal to that distance. This mark is the stab depth mark and is used to indicate that the pipe is fully inserted into the fitting once assembled.

★ J) **Install the coupling.** Promptly after preparing the pipe surface, remove the fitting from the plastic bag and clean the fitting's fusion surfaces with alcohol wipes. Allow to dry before assembling. Center the fitting on the pipe ends so that the stab depth marks are visible against the fitting entrance and the fitting is inserted to the marked insertion depth on pipe. PE plastic pipe and coupling should be kept clean, supported, and free of any external stresses. If there is excessive resistance while sliding the fitting onto the pipe, use a re-rounding clamp to bring the pipe back to round. Clean pipe as needed after removing the re-rounding clamp.

★ K) **Insert the plastic pipe** into the opposite end of the coupling. Check both measurement marks for the proper stab depth when this is completed.

> **NOTE:** If it is difficult to install the two pipe ends into the electrofusion coupling because of lack of movement that occurs with short pieces or larger pipe sizes, it may be necessary to slide one coupling completely onto one of the pipe ends, bring the two pipes together, then slide the coupling from the fully stabbed pipe back to the other until the proper insertion depth is reached on both pipes.

L) **Install Restraining Clamps**. While maintaining the marked stab depth, keep the pipe secured from movement and the fitting supported during both the fusion and cooling cycles. Restraining clamps shall be required during electrofusion joining of pipes of all diameters, whenever possible, with the exception of adjustable elbows or back-to-back elbows.

- *When other field conditions preclude the use of clamps (e.g. insufficient space), the exception shall be approved and recorded in the Gas Engineering Service Request app (see Attachment C).*

★ M) **Connect Processor.** Connect the universal electrofusion processor to an adequate AC power source. If using a generator, turn the generator on and allow it to run for 30 seconds before connecting the universal electrofusion processor. Turn on the universal electrofusion processor.

★ N) **Connect fusion plugs** to the contact pins on the fitting.

> **NOTE:** Some couplings 12" and larger are bi-filament and each side of the coupling must be fused independently. Some couplings may require pre-heating. Follow manufacturer's instructions.

If performing optional pre-heating on 8"-16" couplings, seal the annular gap between the coupling and the pipe according to manufacturer's instructions. If installing the coupling one side at a time, the annular gap can be sealed with tape or by securing the plastic bag around the coupling and the pipe. Connect the fusion plugs to the contact pins on the coupling and scan the pre-heating **(yellow)** barcode. On completion of the pre-heating cycle, allow 10 minutes to warm through. If annular

gap is still not sealed, scan the pre-heating (yellow) barcode again. On completion of additional pre-heating cycle, allow 10 minutes to warm through. This can be done up to three times.

O) **Process Fuse.** Following the applicable universal electrofusion processor's operating manual, scan the fitting barcode and verify the coupling information on the processor. Manual input to the electrofusion processor should not be performed unless approved by a Company Authorized Representative. Begin the fusion process. If necessary, repeat the pre-heating and fusion process on the other side of the coupling. Record the fusion start time on the fitting or pipe.

★ P) **Wait appropriate cool time**. Keep the pipe secured from movement and the coupling assembly continuously supported during both the clamp and total cool times.

- **Clamping Cool Time**: The cool time listed on electrofusion fitting labels (CT) is the clamping cool time. This time indicates the amount of time that the joint must remain in the electrofusion restraining clamp. This also indicates the time at which the joint can be visually inspected.

- **Total Cool Time**: In addition to the time listed on the fitting label, an additional period must elapse prior to performing activities that exert force on the fitting, such as pressure testing, tapping, or pressurization. The clamping cool time and additional time makes up the total cooling time required for the fitting. Total cool time varies by fitting type and manufacturer.

Action to Perform	Applicable Time to Wait
Remove Clamp Visually Inspect	CT (Cool time listed on fitting label)
Pressure Test Tap Pressurize Rough Handle	Total Cool Time (See table below)

	TOTAL COOLING TIME GUIDANCE			
	IPEX	**CP**	**MTD – ISCO**	**PLASSON**
COUPLING (Including non-linear)	<3" – 3 x CT, 3-12" – 4 x CT, 16" – 120 min	3x CT	2x CT	3 x CT
TAPPING TEE	CT + 15 min	N/A	3x CT	3 x CT
BRANCH SADDLE	CT + 15 min		3x CT	3 x CT
SPA SADDLE	CT + 15 min		N/A	N/A
Manufacturer Instructions	IPEX Friatec Catalog for Gas Electrofusion	GF Central Plastics Electrofusion Installation Manual	MT Deason EF Fittings Instructions	Plasson EF Handling Time - One Sheet

Note: This table contains conservative generalizations for manufacturer cool times. See manufacturer instructions for total cool time required for specific fitting.

★ Q) **Joiner Visually Inspect**. Following completion of the fusion cycle, the entire area of the electrofusion joint shall be visually inspected by the Operator Qualified installer and marked with the appropriate identification next to the coupling. (See GAS6006 – Documenting PE Joints).

★ R) **Second Inspector Visually Inspect.** The entire area of the electrofusion joint shall be visually inspected by the Second Inspector and marked with the appropriate identification next to the coupling. (See GAS6006 – Documenting PE Joints).

6.2 The following table contains the criteria on the acceptability of electrofusion couplings in which a minor amount of molten material and/or wires extrude or come out of the boundaries of an electrofusion fitting. Melt-out and/or wire out on spa saddle or tapping tee fittings is not acceptable.

Manufacturer	Pipe Size	Allowable Melt or Wire or both Distance Past Edge of Coupling	Allowable Circumference of Visible Melt-Out
GF Central Plastics, Plasson	6 inch IPS	½ inch	90 degrees
IPEX-Friatec, GF Central Plastics, Plasson	8 inch IPS	½ inch	90 degrees
IPEX-Friatec, Plasson	10 inch IPS 12 inch IPS 16 inch IPS	½ inch	180 degrees

Note: Melt out or wire out is NOT acceptable on newer MT Deason/ISCO fittings

7.0. PE PLASTIC PIPE REPAIR GUIDELINES

7.1 Damaged live low-pressure PE pipe sizes 3" to 16" IPS may be repaired by an electrofusion repair patch. For damaged elevated pressure with escaping gas (intermediate, medium, and high pressure), PE plastic pipe must have the flow of gas stopped prior to installation of the repair patch. (See Gas Specification G-8178, "Shut-Off of Polyethylene Plastic Pipe/Tubing Used for Gas Mains and Services").

7.2 Damaged PE plastic pipe, sizes ½" CTS to 16" IPS, may also be repaired by cutting out the damaged section of PE plastic pipe and installing a replacement piece of pipe with two electrofusion couplings, following the joining procedure in Section 6.0.

A) For damaged PE plastic gas mains, safely stop-off and control the flow of gas by operating an isolation valve or stop off using the approved methods in Gas Specification G-8178.

B) For damaged PE plastic gas services, safely stop-off and control the flow of gas by operating an isolation valve or stop-off using the approved methods in Gas Specification G-8178. If feasible, replace the entire section of damaged service pipe (e.g., main to valve, valve to building).

C) Cut-out and remove the damaged section of pipe per Gas Specifications IP-7, "Cut-Outs and Tie-Ins of Existing Gas Mains", IP-9, "Requirements for Long Form Written Procedures and Contingency Plans", and IP-8, "Requirements for Short Form Written Procedures." Be sure the pipe ends on the pipe are square and evenly cut. Remove any burrs or shavings from the pipe ends that may have developed during the cutting process.

D) Measure the repair section of pipe to fit within 1/16" of the open section length.

E) For PE plastic gas main replacement, use pretested pipe or pressure test the replacement piece prior to installation. (See Gas Specification G-8204, "Pressure Testing Requirements for Gas Distribution Mains and Services".)

F) For most gas main repairs, remove the center stops, if applicable, in both couplings. Slide each coupling onto the repair segment for the full length of the coupling. Place the repair segment between the two pipe ends and slide both electrofusion EF couplings onto the existing pipe to the correct insertion depth.

G) For most service repairs where sufficient material is exposed, there is enough flexibility in the pipe/tubing to install electrofusion couplings without removing center stops. If there is excessive resistance while sliding either coupling onto the pipe, use a re-rounding clamp to bring the pipe back to round. Clean pipe as needed after removing the re-rounding clamp.

8.0. ELECTROFUSION TAPPING TEE AND SPA SADDLE INSTALLATION GUIDELINES

8.1 The following installation guideline details the steps necessary to install an electrofusion tapping tee or a SPA saddle (up to 16") on a PE plastic gas main using a universal electrofusion processor. For detailed instructions on installing electrofusion tapping tees and SPA saddles, refer to the manufacturer's assembly instructions included with the fitting. For detailed instructions on using the universal electrofusion processor, refer to the manufacturer's operating manual.

A) **Inspect** the PE plastic pipe, tubing, and fittings as per Section 5.9. Inspect the bottom of the tapping tee/SPA saddle for defects and then check the tapping tee/SPE saddle for electrical continuity (e.g. calibrated fluke meter or flashlight continuity detector). If any defects are noted, or if there is no electrical continuity, the electrofusion fitting shall not be installed. Keep electrofusion tapping tee/SPA saddle in the plastic bag provided until needed to avoid accidental contamination.

★ B) **Check pipe for out-of-round.** Use a re-rounding clamp to bring the pipe back to round if needed. Leave clamps on throughout fusion.

★ C) **Establish clean areas or zones on the pipe.** Establish and mark each of the clean zones as shown in Figure 3 below, long enough to accommodate the fitting area, and and as described in the subsequent steps. All markings on the pipe shall be done using a non-oil based silver Sharpie (e.g. MSC # 42258343) or Friatec marking pen (Contact Development Lab). Do not use keel, lumber crayons, or paint markers for marking pipe. Establish and mark each of the clean areas or zones as follows.

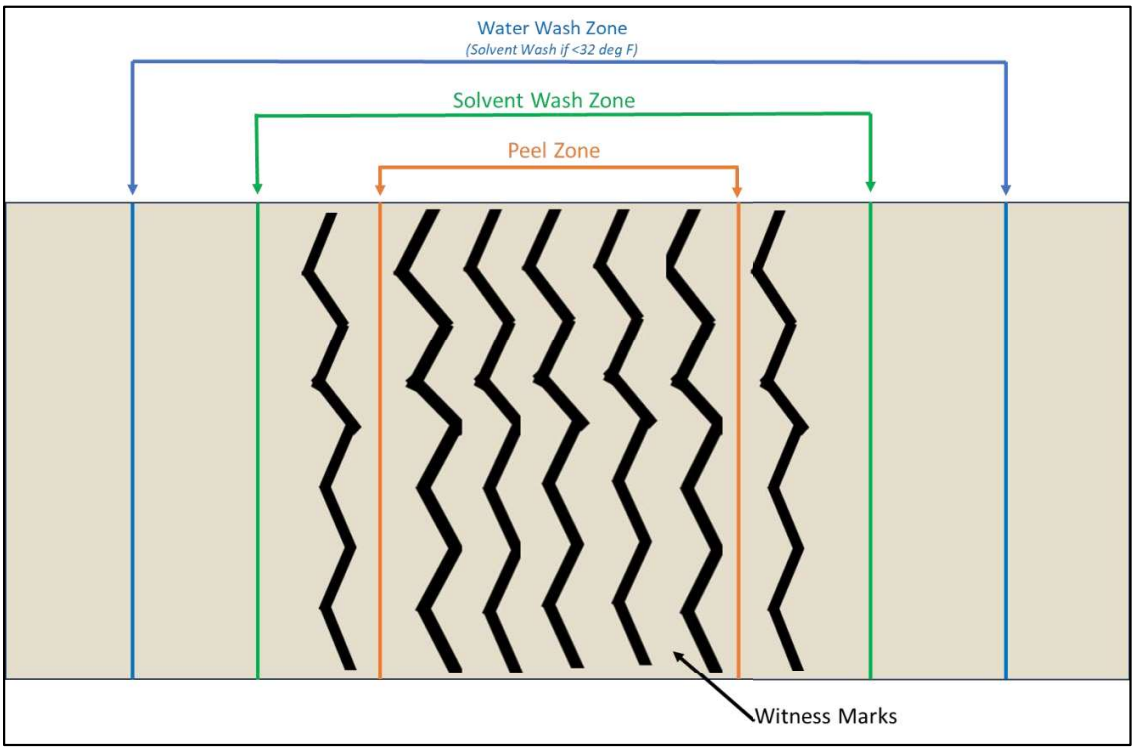


Figure 3: Pipe Markings – Electrofusion Saddle

★ 1. **Mark Water Wash Zone:** Establish a water wash clean area on the pipe long enough to accommodate the fitting and solvent wash clean area as shown in Figure 3. Mark the boundary of the water wash zone on the pipe and ensure that subsequent cleaning does not exceed this established zone.

★ 2. **Clean Water Wash Zone:** Use detergent-free water to remove dirt and mud from the pipe. Do **not** use soap water (leak detection solution) to clean the pipe. Clean the pipe exterior all the way to the marked wash zone boundary. Use a clean, dry, lint-free non-synthetic (e.g. cotton) cloth or paper towel (WypAll L40 or similar) to dry the pipe outside, inside, and ends. The cloth or paper towel should be replaced every time after wiping the pipe. Do not reuse it to clean other surfaces. For temperatures below 32 degrees, alcohol wipes (Class/Stock # 689-3135) or liquid isopropyl alcohol (90% or greater) with a clean, lint-free, non-synthetic cloth/paper towel (e.g. NS0209687) should be used in place of water. It is recommended to wipe the pipe surface in a circumferential manner around the pipe versus longitudinally along the pipe.

NOTE 1:	When performing fusion in a lab setting, alcohol wipes may be used in place of water.
NOTE 2:	When using liquid isopropyl alcohol, place plastic sheeting and absorbent pads underneath the fitting. The used wipes/cloth/absorbent pads shall be disposed as non-hazardous industrial waste. Liquid isopropyl alcohol shall be disposed as flammable hazardous waste. Contact EH&S Operations for guidance when disposing liquid isopropyl alcohol.

★

3. **Mark Solvent Wash Zone:** Within the water wash zone, mark another area longer than the area to be peeled. This area is the solvent wash zone.

★ 4. **Clean Solvent Wash Zone:** Clean this area with a solvent. Alcohol wipes (Class/Stock # 689-3135) or liquid isopropyl alcohol (90% or greater) with a clean, lint-free, non-synthetic

cloth/paper towel (e.g. NS0209687) are to be used to clean the surface. Clean all the way to, but do not exceed the marked boundary of the solvent wash zone when cleaning during this or later steps. Allow to dry completely before proceeding.

> **NOTE**: When using liquid isopropyl alcohol, place plastic sheeting and absorbent pads underneath the fitting. The used wipes/cloth/absorbent pads shall be disposed as non-hazardous industrial waste. Liquid isopropyl alcohol shall be disposed as flammable hazardous waste. Contact EH&S Operations for guidance when disposing liquid isopropyl alcohol.

★ 5. **Mark Peel Zone:** Mark the length of the area to be peeled on the pipe so that it is slightly longer than the width of the saddle fitting. Make witness marks on the pipe surface with a non oil-based Sharpie (e.g. MSC # 42258343) in the area to be peeled. Avoid using paint markers to make witness marks, as the paint can leave residue and interfere with the surface preparation. The witness marks are used as a visual aid after peeling. Any visible marks remaining on the pipe indicate that an adequate amount of pipe surface was not removed and further peeling is required.

★ D) **Peel** the marked area on the outside of the pipe to remove surface oxidation using an approved rotary peeler tool (See Operation of Fusion Equipment for approved peelers and scrapers). Hand scrapers are **only to be routinely used** for the following cases:

- When performing electrofusion on pipe that has been rolled down to a reduced diameter, it is acceptable to hand scrape the fusion zone, as no peeler matches the size of the reduced pipe.
- When installing an electrofusion repair patch, it is acceptable to hand scrape all or part of the fusion zone, as peelers cannot operate next to the patch plug.
- When installing a SPAK saddle cap, it is acceptable to hand scrape the outlet surface.

Outside of these cases, hand scrapers may only be used when field conditions preclude the use of peelers. *Use of hand scrapers in these*

cases must be approved and documented through the Gas Engineering Service Request application (see Attachment C).

- Do not use a file or sandpaper.
- Do not use a hand scraper after any pipe has been peeled, except when hand scraping the fusion zone of a repair patch.
- Avoid gouging or removing excessive material from the pipe surface and do not touch the prepared pipe or fitting surfaces after peeling.

See Figure 4 for an illustration of pipe after peeling is complete.

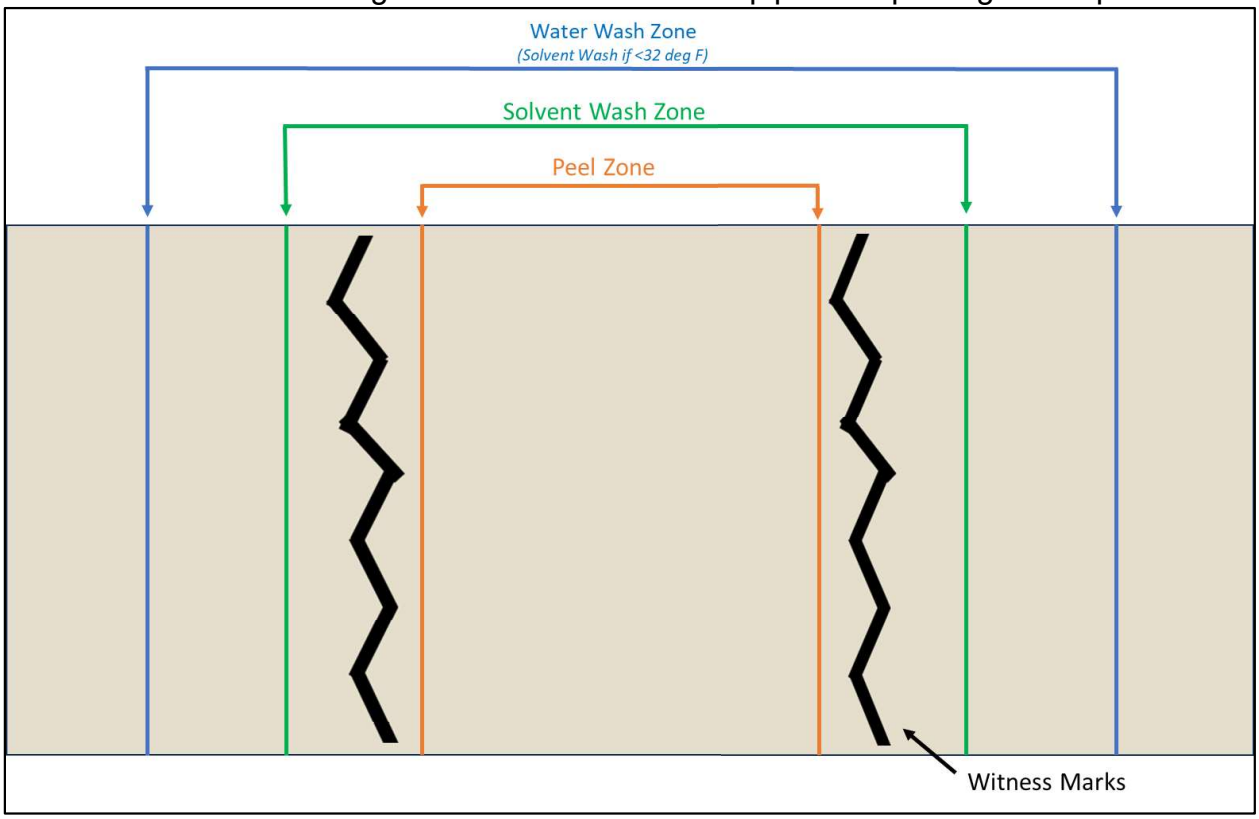


Figure 4: Pipe Markings After Peeling – Electrofusion Saddle

Make sure that peeler is cleaned before each use and maintained to ensure that it can produce a continuous ribbon of PE. Any marking that remains afterwards indicates that areas were missed and that more scraping or peeling is required. Make sure that the outer surface is completely prepared such that the pipe surface has no oxidation, no surface contamination and is uniform and gouge free.

★ E) **Clean Peeled Area:** Remove any debris from the inside of the pipe with a clean, dry, lint-free non-synthetic (e.g. cotton) cloth (WypAll L40 or similar). Clean the peeled area of the pipe with 96% alcohol wipes (Class/Stock # 689-3135) or liquid isopropyl alcohol (90% or greater) with a clean, lint-free, non-synthetic cloth/paper towel (e.g. NS0209687) all the way to but do not exceed the edge of the peeled surface. Make sure the pipe surface is completely dry. If the surface of the peeled/scraped pipe becomes contaminated with dirt, debris, water, finger marks or other foreign substances, clean again.

NOTE:	When using liquid isopropyl alcohol, place plastic sheeting and absorbent pads underneath the fitting. The used wipes/cloth/absorbent pads shall be disposed as non-hazardous industrial waste. Liquid isopropyl alcohol shall be disposed as flammable hazardous waste. Contact EH&S Operations for guidance when disposing liquid isopropyl alcohol.

★ F) **Install the saddle fitting.** Promptly after preparing the pipe surface, remove the tee/SPA saddle from the bag, visually inspect for dirt or contaminants, and clean the fitting's fusion surfaces with alcohol wipes. Allow to dry before assembling. Center the tapping tee on the freshly peeled pipe surface.

If the electrofusion fitting or the surface of the peeled pipe becomes contaminated with dirt, debris, water, finger marks or other foreign substances, clean again.

1. For non-top loading tapping tees and SPA saddles, release the pre-assembled screws on one side of the tee. Using the side of the tapping tee that is still bolted together as a hinge, open the upper and lower sections of the tapping tee. Place the tapping tee onto the peeled and cleaned area of the PE plastic pipe. Evenly tighten all four screws to the stops. Tighten as per manufacturer's instructions to assure proper tightness has been achieved. Incorrect tightening can cause tee failure. The bottom section of the tapping tee will remain on as a permanent component of the tee.

2. For tapping tees and SPA saddle that require the Top Loading tool from Friatec, follow the mounting instructions of the Top Loading tool to properly secure the fitting onto the scraped and cleaned area of the PE plastic pipe.

G) **Connect Processor.** Connect the universal electrofusion processor to an adequate AC power source. If using a generator, turn the generator on and allow it to run for 30 seconds before connecting the universal electrofusion processor. Turn on the universal electrofusion processor. Connect fusion plugs to the contact pins on the tapping tee.

H) **Process Fuse.** Following the applicable universal electrofusion processor's operating manual, scan the fitting barcode and verify the fitting information on the processor. Manual input to the electrofusion processor should not be performed unless approved by a Company Authorized Representative.

Begin the fusion process. (Reference the "Approved Joining Methods for PE Plastic Pipe/Tubing" Table 1 in Gas Specification IP-20, for electrofusion to different SDR PE plastic pipe). Record the fusion start time on the fitting or pipe.

★ I) **Wait appropriate cool time**. Keep the pipe and fitting secured from movement during both the clamp and total cool times.

- **Clamping Cool Time**: The cool time listed on electrofusion fitting labels (CT) is the clamping cool time. This time indicates the amount of time that the joint must remain in the electrofusion restraining clamp. This also indicates the time at which the joint can be visually inspected.
- **Total Cool Time**: In addition to the time listed on the fitting label, an additional period must elapse prior to performing activities that exert force on the fitting, such as pressure testing, tapping, or pressurization. The clamping cool time and additional time makes up the total cooling time required for the fitting. Total cool time varies by fitting type and manufacturer.

Applicable Time to Wait	Action to Perform
CT (Cool time listed on fitting label)	Visually Inspect
Total Cool Time (See table below)	Pressure Test Tap Pressurize Rough Handle

	TOTAL COOLING TIME GUIDANCE			
	IPEX	**CP**	**MTD – ISCO**	**PLASSON**
COUPLING (INCLUDING NON-LINEAR)	<3" – 3 x CT, 3-12" – 4 x CT, 16" – 120 min	3 x CT	2 x CT	3 x CT
TAPPING TEE	CT + 15 min	N/A	3 x CT	3 x CT
BRANCH SADDLE	CT + 15 min		3 x CT	3 x CT
SPA SADDLE	CT + 15 min		N/A	N/A
MANUFACTURER INSTRUCTION	IPEX Friatec Catalog for Gas Electrofusion	GF Central Plastics Electrofusion Installation Manual	MT Deason EF Fittings Instructions	Plasson EF Handling Time - One Sheet

Note: The table above contains conservative generalizations for manufacturer cool times. See manufacturer instructions for total cool time required for specific fitting.

★ J) **Joiner Visually Inspect**. Following completion of the fusion cycle, the entire area of the electrofusion joint shall be visually inspected by the Operator Qualified installer and marked with the appropriate identification next to the coupling. (See GAS6006 – Documenting PE Joints).

★ K) **Second Inspector Visually Inspect.** The entire area of the electrofusion joint shall be visually inspected by the Second Inspector and marked with the appropriate identification next to the coupling. (See GAS6006 – Documenting PE Joints).

9.0. ELECTROFUSION EQUIPMENT

9.1 The following universal electrofusion processors are approved for use:

- EF Technologies/Mulcare/PERC – Phoenix Electrofusion Processor
- Georg Fischer Central Plastics – MSA 340 Polyvalent Electrofusion Processor
- IPEX - Friamat 1 and 2 Electrofusion Processor
- IPEX - Genesis F3 Electrofusion Processor
- Plasson – Polymatic Plus Electrofusion Processor

The operating manuals for these electrofusion processors are located in the Fusion Equipment Manuals site on the GasHub.

9.2 All Electrofusion Processors shall be inspected by the Gas Development Lab prior to initial use and prior to the next inspection due date which is the manufacturer's calibration due date that is affixed to every processor. Otherwise, the Electrofusion Processor shall not be used.

9.3 Electrofusion processor units are not intrinsically safe and shall not be used in a hazardous environment.

9.4 Due to the high amperage draw of electrofusion fittings, the electrical source should not be loaded down by other equipment when an electrofusion is being performed and the use of an extension cord is not encouraged. In the event an extension cord is needed, the following is recommended:

Cord Length	Wire Gauge
25 ft.	# 10/3
50 ft.	# 8/3
100 ft.	**DO NOT USE**

NOTE: Extension cords should not be used for electrofusion 16" couplings.

9.5 The following are requirements and precautions regarding the electrical equipment required to perform electrofusion:

Manufacturer	Fitting Size	AC Power	Amps	Min. Generator Wattage	Minimum Allowable Generator Output Voltage
Central Plastics	½" CTS - 8" IPS	110V	20	3,500	90 VAC
Friatec	2" - 6" IPS	110V	20	3,500	90 VAC
Friatec	8" IPS - 20" IPS	110V	30	4,500	95-135 VAC

10.0. ELECTROFUSION DURING COLD AND/OR INCLEMENT WEATHER

10.1 Extreme weather conditions may affect the quality of the electrofusion joint. The recommended ambient temperature range for electrofusion is as follows:

Manufacturer & Equipment Type	Temperature Range
Friatec fittings	-4°F to 120°F
Genesis processors	0°F to 140°F
GFCP fittings	-10°F to 120°F
MT Deason fittings	-10°F to 120°F
Phoenix processors	0°F to 120°F
Plasson fittings	14°F to 113°F
Plasson processors	14°F to 122°F

10.2 Temperatures below 40°F

A) Pipe and fittings should be about the same temperature when they are electrofused.

10.3 During inclement weather (rain or snow)

A) Protect the universal electrofusion processor and leads from the rain or snow.

B) The pipe must be clean and dry before, during, and after electrofusion.

C) Approved fire-resistant tents (Class/ Stock # 689-3929, 10' x 8' or Class/ Stock # 689-3945, 6' x 6') shall only be used to protect the PE pipe at the point of joining during inclement weather and shall **not** be used when there is escaping gas.

NOTE:	If gas is escaping, it must be allowed to rise and vent unobstructed. If a connection is needed and the cause of the escaping gas can't be repaired in a timely manner, then making the joint with a mechanical fitting should be considered.

11.0. RECORDS RETENTION

Any records generated in the course of performing work in accordance with this specification shall be maintained as required by Corporate Instruction CI-870-1 "Records Management". Guidance on the retention of Company Gas Operations records can also be found on the Records Management intranet site.

★ 12.0. REFERENCES

G-8104	Polyethylene Pipe, Tubing, and Fittings for Gas Main and Services
G-8121	Qualification of Joiners and Inspectors of Polyethylene (PE) Plastic Pipe/Tubing and Fittings for Gas Mains and Services
G-8122	Inspection, Handling, Storage, and Transportation of Polyethylene (PE) Plastic Pipe, Tubing, and Fittings for Gas Mains and Services
G-8123	Heat Fusion Joining Of Polyethylene (PE) Plastic Pipe and Fittings for Gas Mains and Services

G-8178 Shut-Off of Polyethylene (PE) Plastic Pipe/Tubing Used for Gas Mains and Services

G-8204 Pressure Testing Requirements Gas Distribution Mains and Services

G-8209 Preparation and Field Coating of Gas and Other Steel Pipes Installed Aboveground and Underground.

IP-7 Cut-outs and Tie-ins of Existing Gas Mains

IP-8 Requirements for Short Form Written Procedure

IP-9 Requirements for Long Form Written Procedures and Contingency Plans

IP-20 Installation of Mechanical Fittings for Polyethylene (PE) Plastic Pipe and Tubing

GAS6006 Documentation and Inspection of Polyethylene (PE) Plastic Joints on Gas Mains and Services

ASTM F3565-23 - Standard Practice for Electrofusion Joining for Polyethylene (PE) Pipe and Fittings for Pressure Pipe Service

Plastics Pipe Institute – MAB Generic Electrofusion Procedure for Field Joining of 12 Inch and Smaller Polyethylene (PE) Pipe

Plastics Pipe Institute – MAB Generic Electrofusion Procedure for Field Joining of 14 Inch to 30 Inch Polyethylene (PE) Pipe

Northeast Gas Association (NGA) Plastic Pipe Joining Manual

GTI Project No. 23372.1.18, Qualification of Pipe Joining Procedures per CFR 49 §192.283

GT-14-048-4 Procedure for Qualifying Electrofusion Plastic Pipe Joints

Operation of Fusion Equipment

13.0 ATTACHMENTS

Attachment A: Vintage Plastic Pipe

Attachment B: Details for Plastic Pipe

Attachment C: Approval and Documentation of Process Exceptions

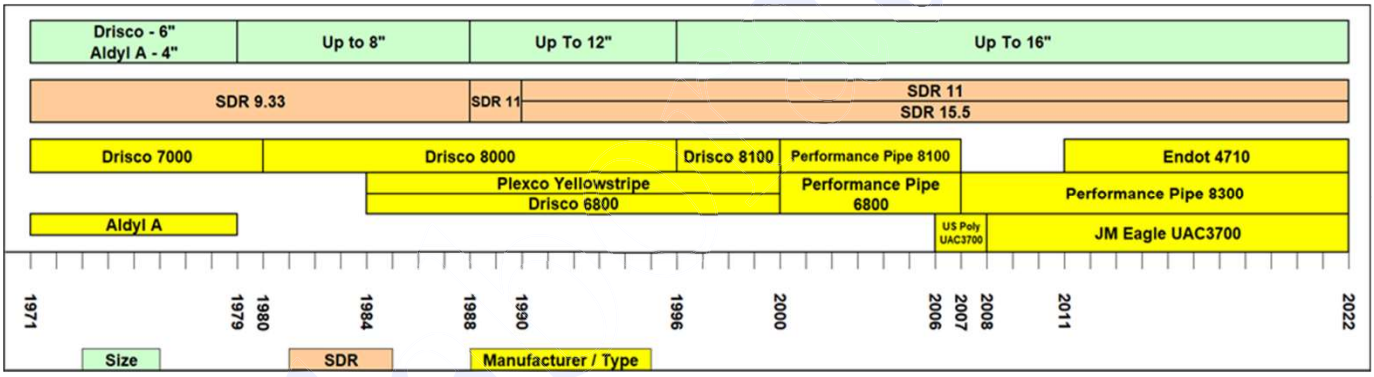
ATTACHMENT A

VINTAGE PLASTIC PIPE

HISTORY OF PLASTIC PIPE USAGE AT CON EDISON:

Con Edison has been using Polyethylene (PE) plastic pipe for mains and services since 1971. The earlier vintage gas pipe (1970s – mid 1980s) may be the following solid colors (no striping): black; yellow; tan; orange, green, and gray. Plastic gas pipe from the mid-1980s to present are predominantly black with yellow stripes (some exceptions apply). PE plastic gas pipes are distinguished from other PE pipes by the ASTM D2513 imprint on the line.

The following chart shows the sizes, Standard Dimension Ratio (SDR) and manufacturers/type of pipe used in Con Edison. The SDR is the ratio of pipe diameter to the wall thickness. The higher the SDR, the thinner the wall for the same pipe diameter. While not shown on the chart, Con Edison used some thin-wall Drisco SDR 23.5, 26 and 32.5 pipe from 1974-76. This chart also does not include plastic tubing or pipe used as a liner.



*See text above for thin walled pipe

ATTACHMENT B

DETAILS FOR PLASTIC PIPE:

The following chart shows the common name and who made it with the martial designation and information about the color and striping of pipes used at Con Edison.

Common Name	Company	Material Designation	Physical Description
Aldyl A	Dupont Pipe	PE 2306*	Tan, but can turn grey
Aldyl 4A	Dupont Pipe	PE 2406	Green
CAB	Unknown	Unknown	Clear tubing
Drisco 7000	Driscopipe / Phillips	PE 3406	Solid Black
Drisco 8000	Driscopipe / Phillips	PE 3308	Solid Black
Plexco Yellowstripe	Plexco Pipe	PE 3406/3408	Black pipe with four yellow stripes
Drisco/Performance Pipe 6800	Driscopipe / Phillips	PE 3408/4710	Black with two thick yellow stripes at three different points on the pipe surface
Drisco/Performance Pipe 8100	Driscopipe / Phillips	PE 3408/4710	"Yellow shell" around black pipe.
Performance Pipe 8300	Performance Pipe	PE 3408/4710	Black with one thick yellow stripe at four different points on the pipe's surface. Print line indicates PE 100.
US Poly UAC 3700	US Poly	PE 3408	Black with one yellow stripe at three different points on the pipe surface. Print line states PE100.
JM Eagle UAC 3700	JM Eagle	PE 3408	Black with one yellow stripe at three different points on the pipe surface. Print line states PE100.
Endot PE4710	Endot	PE4710	Black with one thin yellow stripe at three different points on the pipe surface.
Dura-Line GDB50	Dura-Line/Polypipe	PE4710	Black with either one thin yellow stripe at three different points on the pipe surface (similar to JM Eagle and ENDOT) or one yellow stripe at six different points on the pipe's surface.

* Resin change in 1971

ATTACHMENT C

APPROVAL & DOCUMENTATION OF PROCESS EXCEPTIONS

When field conditions preclude full adherence to procedure requirements (e.g. use of peelers or clamps), a variance must be approved and recorded in the Gas Engineering Service Request (GESR) system. The following workflow outlines the process needed for obtaining a GESR variance: