Electrofusion Issues

Discussion about the most causes for electrofusion installation errors.

While this does not cover every possible reason for electrofusion joint failures, it does cover the causes for roughly 98% of the failure analysis findings found through investigation.

Insufficient initial cleaning:

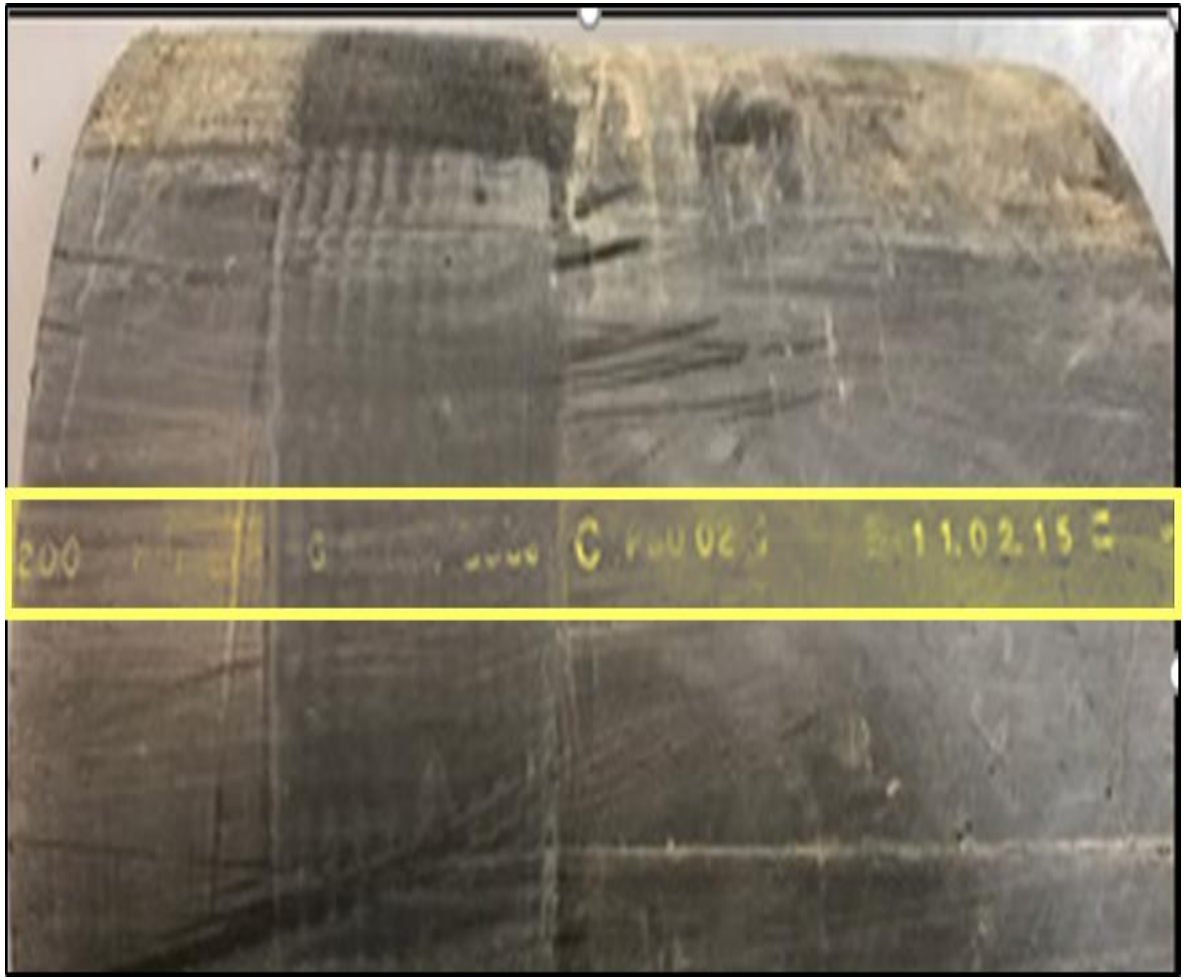
Failure to clean the pipe, first with clean water and then with appropriate strength and purity isopropyl alcohol or acetone as a best-practice, can leave embedded gravel and dirt, oil, soap, drilling fluid residue, etc., on the PE pipe or tubing. When these contaminates are present, they act as a barrier to a successful fusion. Even when the pipe is subsequently properly scraped or peeled, failure to begin by properly cleaning the pipe and removing any embedded gravel or dirt will prematurely dull the blades of the scraping and peeling tools. In addition, if the scraping or peeling tools have trailing wheels/bearings, these can draw contaminate residues back into the fusion zone.

Poor scraping, peeling:

As an industry, analyzation of thousands of failed joints show that the absence of scraping and/or poor scraping practices represent the root cause for the vast majority of electrofusion joint failures.   The science of pipe peeling, or scraping, has evolved and improved nearly as much as the resins used to manufacture PE pipe and fittings, but one thing has never changed. It was, and is, absolutely essential to remove the oxidized, or otherwise contaminated, outer layer of the PE Pipe or Tubing in the fusion zone.

Some Electrofusion customers continue to use paint scrapers and other low tech devices to prepare the pipe surface prior to fusion.   While it is possible to use a paint scraper to properly prepare the surface of the pipe, it takes considerable time and diligence on the part of the operator to do it right and can be very inconsistent .   It's like choosing to use a phone book and rotary dial phone while a smart phone remains in your pocket.   Both might work, but one gets the number right more often and faster than the other.   The new peeling tools are far superior to the old scrapers. For one, they circle the pipe and remove a consistent ribbon around the complete diameter of the pipe.   An individual using a paint scraper to prepare the pipe for an electrofusion coupling rarely has visibility to the underside of the pipe and there is often areas of oxidized pipe remaining.

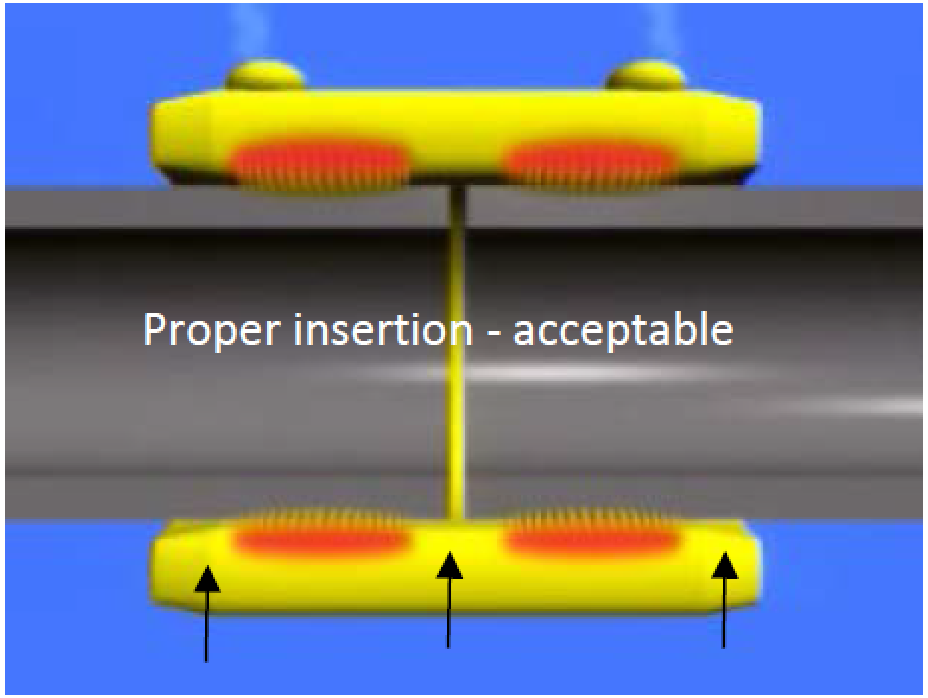
Poor scraping, peeling:



Improper pipe insertion depth:

Proper insertion depth of a pipe end into an electrofusion coupling is required for a successful fusion. Failure to insert the pipe end correctly can result in a loss of melt containment during the fusion process. The use of stab-depth marks help to insure proper insertion depth.

Melt containment and the resulting melt pressure that is generated through thermal expansion is a critical component to the fusion process. As seen on the image to the right, heating coils in fusion zones on either side of the coupling are separated by three areas known as "cold zones" where no heat is generated. The expanding melt in fusion zones reaches these cold zones and cools until the movement stops, thereby blocking the escape of any further melt. As the fusion process continues, a considerable amount of melt pressure is generated within the fusion zones. This pressure is necessary to provide adequate contact between the melted pipe and coupling surfaces for co-mingling and fusion.

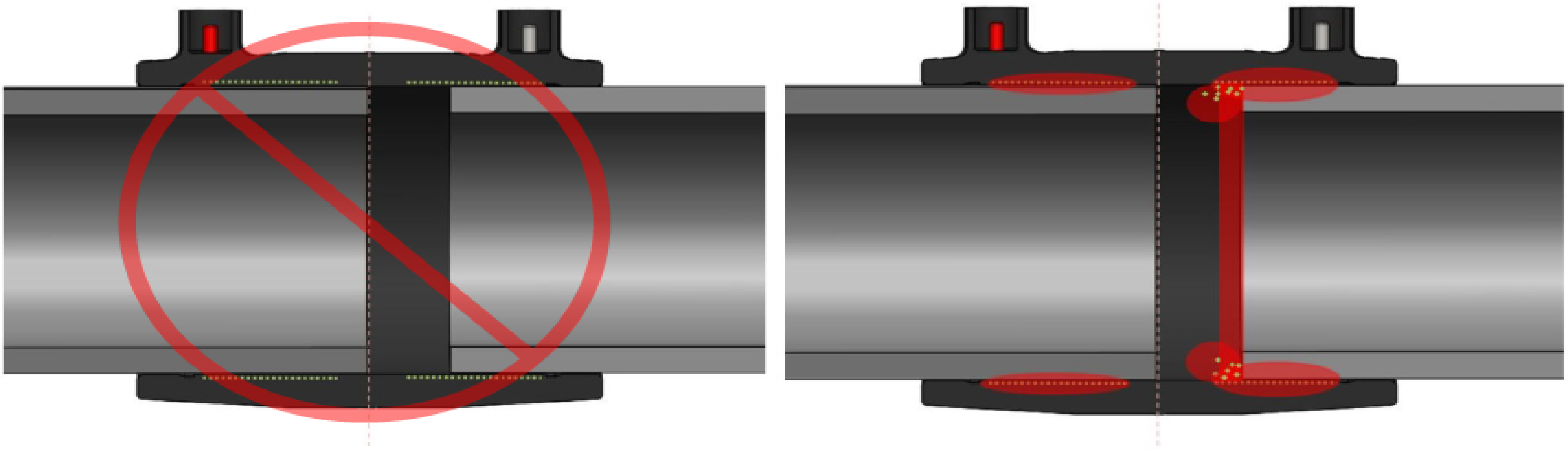


Cold zones

A pipe end that is not inserted beyond the innermost heating wire is commonly referred to as being "short-stabbed" and is the result of an assembly error.

Improper pipe insertion depth:

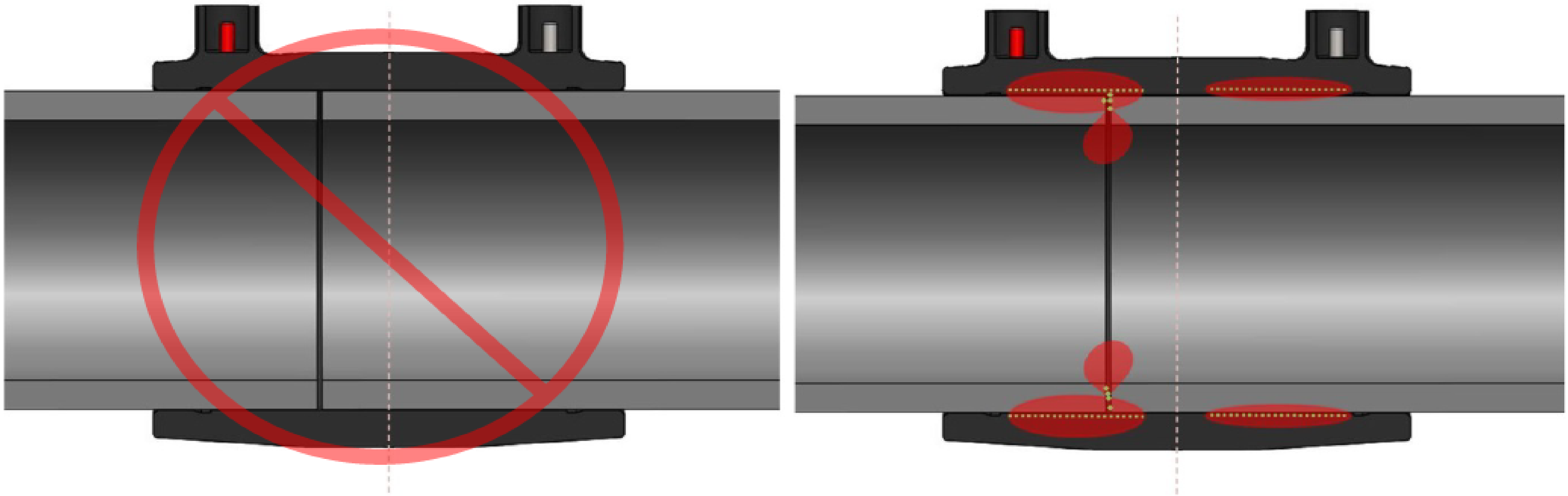
Short Stab – Incorrect Assembly: Assembly errors that can occur include "short-stab" conditions where the one or both of the pipe ends are not centered in the coupling. This condition is avoidable by measuring and marking the stab depth on the pipe ends before inserting them into the coupling. If the pipe ends are not properly inserted, the melt generated during the fusion cycle will expand and flow over the end of the exposed pipe inside the fusion zone. Heating coil wires are carried by the uncontained melt flow, causing shorting and rapid overheating of the fusion zones.



Short Stab - Incorrect Assembly

Improper pipe insertion depth:

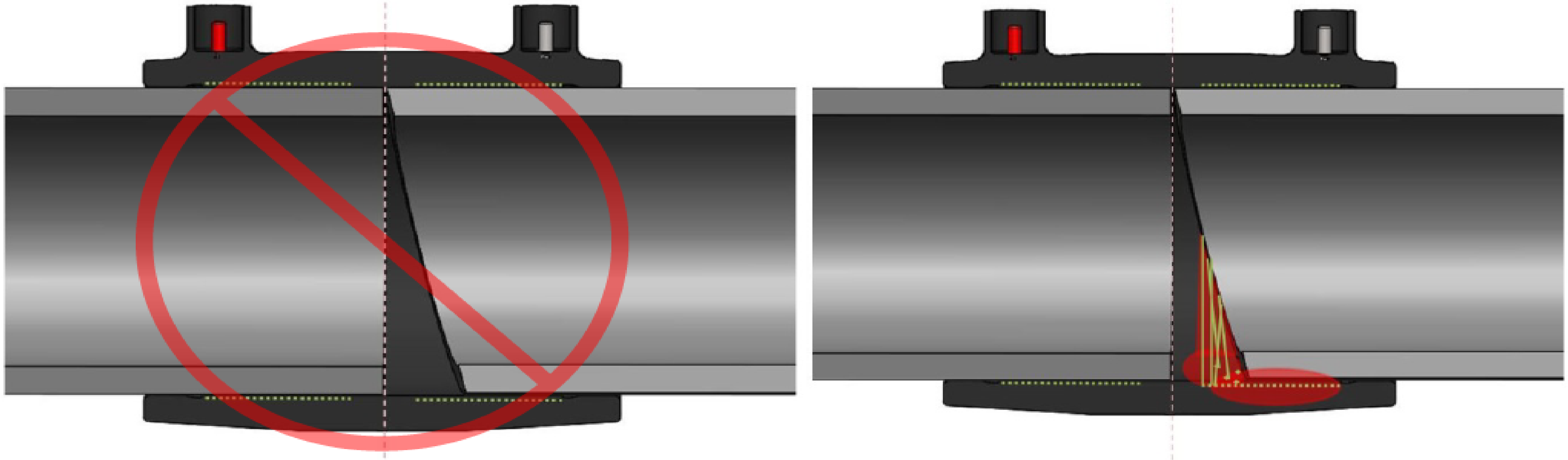
Mis-Stab – Incorrect Assembly: A mis-stab is another avoidable assembly error where the pipes are not located in the center cold zone of the coupling. In this case, one pipe end is over-inserted into the coupling, while the other is under-inserted. Melt again is allowed to escape between the pipe ends and the potential for heating coil shorting is likely.



Mis-Stab - Incorrect Assembly

Improperly cut pipe ends:

Another potential error that can cause loss of melt containment is the lack of a square cut on the pipe ends. While it is not necessary, nor practical, that the pipe ends must be cut to exactly 90 degrees, care should be taken to keep the cut as square as possible. Cold zone lengths are designed to accommodate some degree of mis-cut on the pipe ends and still ensure full coverage of the heating wires and sufficient cold zone contact to contain melt flow. A condition where the pipe end is cut at too great an angle to allow the pipe end to cover the heating coil and cold zone is referred to as a “mis-cut” assembly.



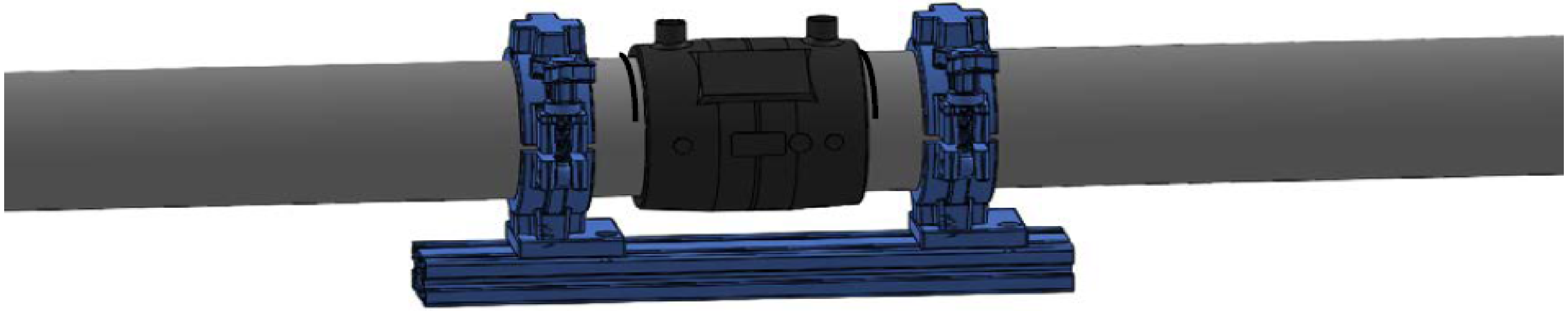
Mis-Cut - Incorrect Assembly

Assembly Clamping:

Assembly Clamping

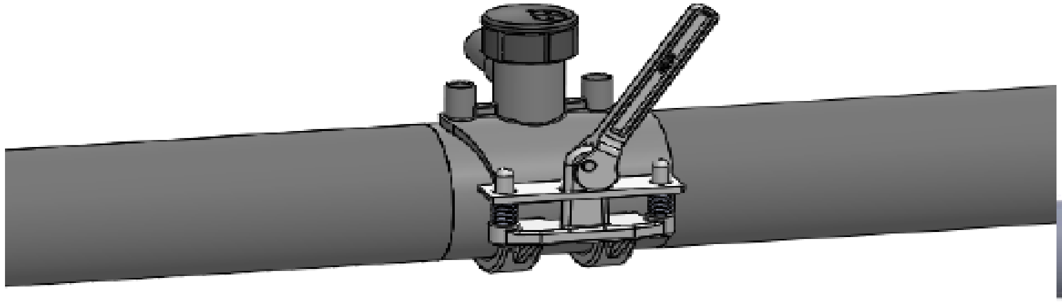
Assembly clamps are always required for saddle fusions to hold the fitting to the pipe using the correct amount of pressure in right places. Assembly clamps for couplings are also necessary to ensure that the area of the fusion is not subject to bending, binding, or movement. Under ideal conditions a coupling may even feel loose between the clamps on the pipe before fusion. Assembly clamps also offer protection from accidental movement during the cooling cycle that will disturb the joint. Assembly clamps can also provide the added benefit of re-rounding pipe ends. The primary goal is to ensure that the pipe and fitting assembly are stable, free of external stresses, and immobile until the cooling time has been achieved.

Clamping of Couplings: Clamps for couplings and reducers are designed to align and restrain the pipe ends on either side of the coupling. The coupling itself is not clamped and is free between the clamps:

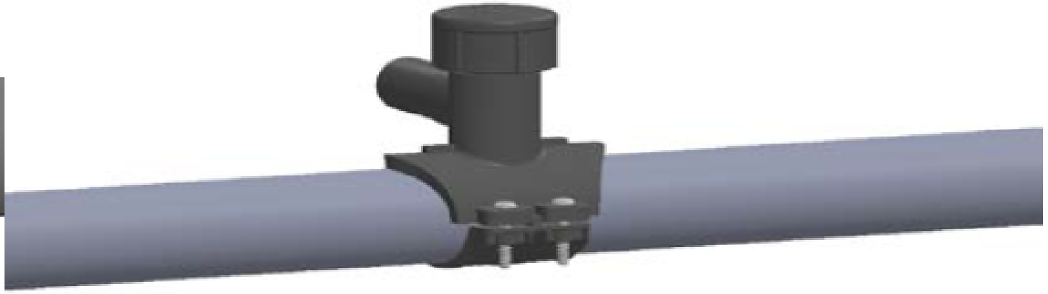


Assembly Clamping:

Clamping of Saddles: Clamps are always required when fusing saddles. The clamps provide the necessary attachment to the pipe and resist melt expansion forces to achieve the intended melt pressure on the pipe. Saddle clamps may be an external mechanical clamp that is re-usable or an integrated and permanent bolt-on clamp or strap. An underclamp (or strap) is a clamp that “pulls” the fitting base onto the pipe. A top loading clamp “pushes” the fitting downward onto the pipe. Each saddle fitting has a specific clamp(s) that has been designed and qualified for use. Substitutions are not acceptable and may result in failed fusion attempts.



Mechanical re-usable clamp

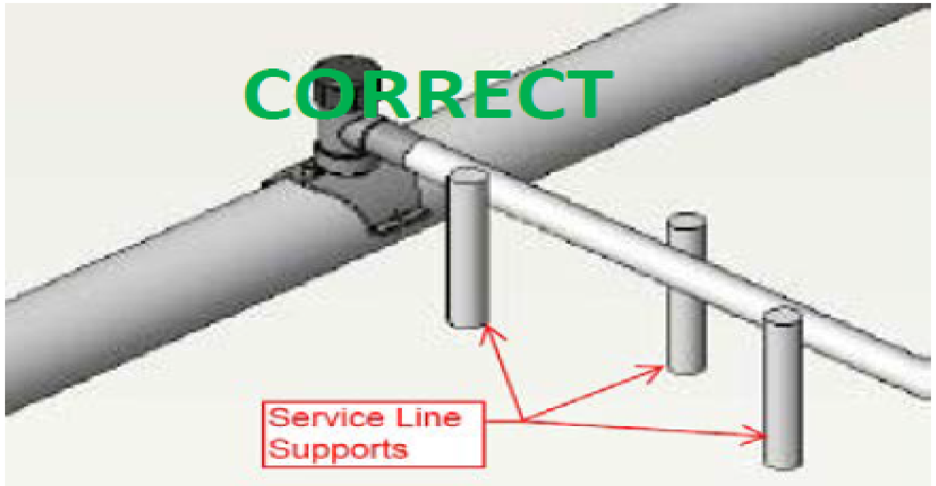


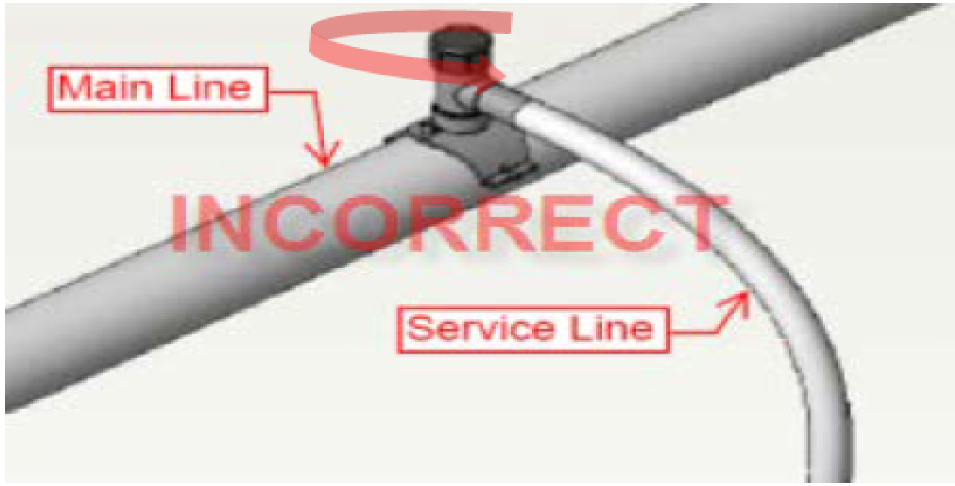
Permanent bolt-on underpart or understrap

Ensure that mechanical clamp placement is centered on the fitting and that underparts are bolted correctly to avoid uneven clamping.

Assembly Clamping:

⚠ Avoid connecting the service line to the outlet before fusing the saddle to the main when possible. If the outlet/service connection is made to the saddle fitting before the saddle is fused to the main always ensure that the pipe connected to the tubing does not exert any pulling, twisting, or sideways forces on the main. Use shoring/supports as shown below to prevent external forces if necessary:





- ⊘ Never attempt to fuse a saddle to the main by holding the fitting by hand.
- ⊘ Never use a clamp made for another brand or type of saddle on a GFCP saddle.
- ⊘ Never use hose clamps, ratchet straps, or other fasteners that are not qualified or intended for use with the saddle design.

Cooling Times:

Cooling

Proper observation of cooling time is important. During the heating phase of the fusion process the PE material of the pipe and fitting is heated to melting in order to allow co-mingling of the molecular structures. As the materials cool and co-crystallize into a solid state again the structures cannot be disturbed. PE is a thermoplastic that softens when heated and does not regain its full strength until cooled.

Cooling time is typically expressed by three different terms in the following tables for fusion and cooling times:

1. **Clamped cooling time**: The minimum time the fitting must remain clamped after the fusion cycle is complete. This is the time displayed by the control box.
2. **Time before pressure test & tapping**: The minimum time before the joint can be pressurized to 150% of MOAP and the main can be tapped.
3. **Time before rough handling:** The minimum time before the joint can be subjected to forces such as pulling, lifting, or back filling.

Thank You !

Questions ?