COSMOIND USA

COSMOIND PE PIPE
Total Solution Provider

We will provide One-Stop Service

COSMOIND CO., LTD.

The unique PE piping system company in Korea that promises an one-stop service to improve quality and trust by providing all services and products from product design to production and installation.

MAIN PRODUCTS

- ☐ PE Pipe supply
- ☐ PE Butt fusion fitting(Spigot)
- ☐ PE Butt fusion fitting(Segmented(Short) Spigot)
- ☐ PE Heat fusion fitting(Socket)
- ☐ PE Electrofusion fitting
- ☐ PE Ball valve
- ☐ Mold design and manufacture
- ☐ Installation tool

CONTENTS

COMPANY HISTORY

1987~1999	1987. 5	Establishment of COSMOIND. CO., LTD.
	1994. 8	Screw and fusion type mold design and manufacturing
	1996. 6	ISO9002 certification
	1999. 8	KS M 3411 certification of polyethylene coupling pipe for waterworks
2003~2006	2003. 1	Production of polyethylene coupling pipe for gas
	2003. 10	KS M 3515 certification of polyethylene coupling pipe for gas
	2003. 10	Development and production of E/F coupling pipe mold for gas
	2006. 3	Development of e-sewage collection unit, rainwater collection unit, small-sized manhole, and fusion socket
	2006. 9	Certification for environment new technology in environment part (No.182)
	2006. 9	KSM 3408-3 certification of polyethylene coupling pipe for waterworks
2007~2014	2007. 4	KSM ISO 8085-2 (KSA) certified for polyethylene coupling pipe for gas - part 2. spigot coupling pipe
	2007. 4	KSM ISO 8085-3 (KSA) certified for polyethylene coupling pipe for gas - part 3. electro fusion coupling pipe
	2008. 8	Acquisition of venture company certification
	2010. 8	Acquisition of INNO-BIZ certification
	2011. 6	Shifted of factory (Jeonui-Myen)
	2013. 1	Changed a company name(COSMOIND CO., Ltd)
	2013. 2	Established Annex research institute of COSMOIND Co., Ltd
	2014. 4	Acquired ISO 14001
2015~2019	2015. 1	Acquired PE valve KS for gas and water supply
	2015. 4	Acquired CE (ball valve)
	2017. 8	Export of E/F technology
	2017. 9	Acquired NSF (PE ball valve, butt, E/F for water supply)
	12	Acquisition of G-PASS certification
	2018. 04	Acquisition of MAIN-BIZ certification
	2019. 10	Acquisition the designated certificate of quality assurance procurement spare parts of polyethylene pipe for water

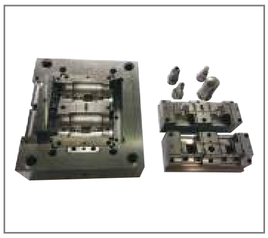
PE PIPE Total Solution Provider

Polyethylene pipe line Total solution provider

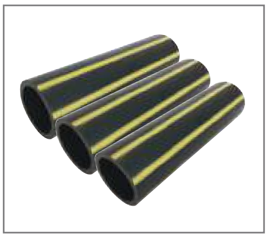
We supply total solution service from mold design to pipe, fitting, welding machine.
We are prepared to give our best products and service solution.

Mold Design



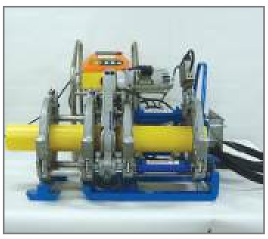


Production

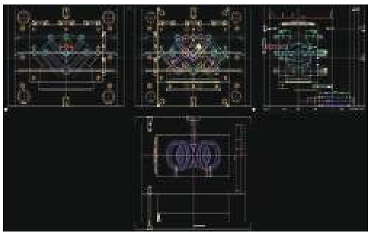


Installation

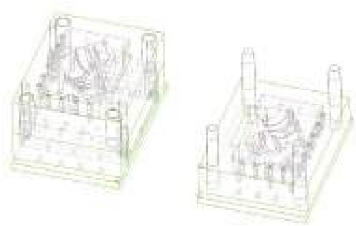




Mold design and manufacturing

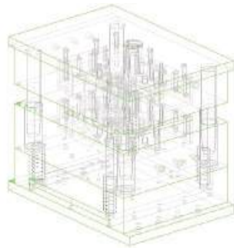
Mold Design



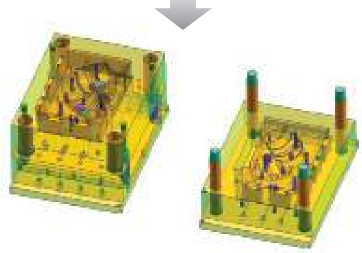
Mold Design(3D)



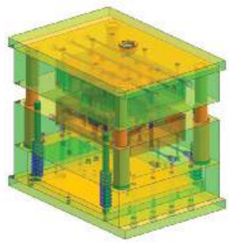
Medeling(3D)



Mold assembly

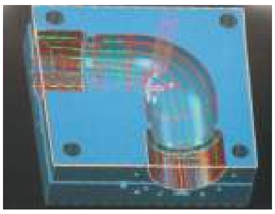


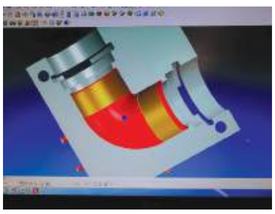
Sumulation



Sumulation(assembly)

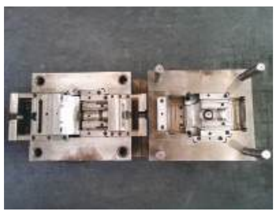
Mold manufacturing





Tooling
(CNC transfomation)

Outer-mold manufacturing



Mold assembly

Completion

COSMOIND USA

Joining Manual

The content and technical data contained in this manual have been developed based on conservative test methods and are considered accurate data. This information is available only in general instructions, and operators and/or all individual users should verify the intended use and specific parameters of each application for a particular system. No warranty or guarantee is provided, express or implied, in connection with the use of these procedures, due to significant differences in service conditions, installation techniques, site conditions, weather conditions and other factors.

In addition, this procedure does not mean addressing all safety issues associated with use. The user of this procedure is responsible for establishing all appropriate safety and health practices and to determine the applicability of regulatory requirements prior to use.

- Federal Regulations

Federal regulations require all operators to be qualified for both joining procedures and the personnel installing pipe. The Pipeline Safety Regulations, published by the Department of Transportation(DOT) Pipeline and Hazardous Materials Safety Administration can be found in 49 CFR Part 192. In accordance with 49 CFR 192.283(a), the operator shall verify the heat fusion joining procedure before using the procedure in the field. In addition, 49 CFR Part 192.285 requires operators to be qualified to create heat-fusion joints in the field. Additional federal regulations may apply, and state regulations correlated with pipeline safety regulations may also be subject to state regulations.

The operator is responsible for ensuring that all aspects of fusion joining processes and procedures comply with the requirements of 49 CFR, Part 192, and ASTM standards.

1.HEAT FUSION

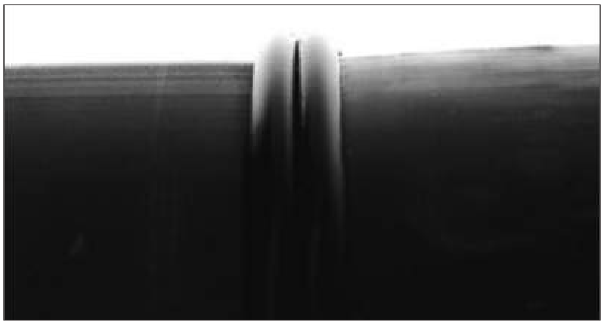
1) Introduction

An integral part of pipe system is the method used to combine system components. The proper engineering design of the system takes into account the type and effect of the techniques used to connect pipes and accessories, and the durability of the resulting joints. The integrity and versatility of the joining technology used in polyethylene(PE) pipes allow designers to take advantage of the performance benefits of PE for a variety of applications.

There are three types of heat fusion joints currently used in the industry; butt, saddle and socket fusion. Also, there are two additional methods of manufacturing sockets and saddle fusion joints. Recommended procedures for butt and saddle fusion are consistent with ASTM F2620 standard practices for Heat Fusion Joining of Polyethylene Pipe and Fittings, Plastics Pipe Institute(PPI) Technical Reports(TR) TR-33, Generic Butt Fusion procedures and TR-41, Generic Saddle Fusion procedures.

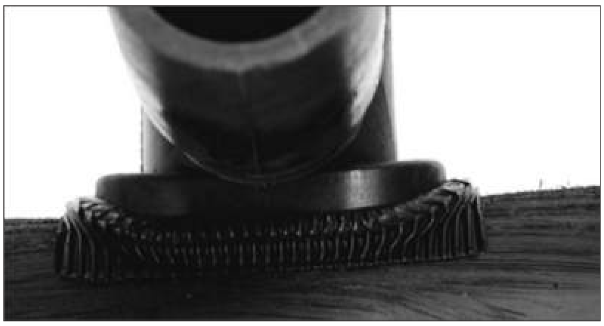
The principle of heat fusion is to heat two surfaces to a specified temperature and then apply the required force to connect them. When this force is applied, the molten surface is joined together to create a permanent single fusion joint. COSMO I&D fusion procedure requires specific tools and equipment for the type of fusion and the size of pipes and fittings to be joined.

Butt Fusion - This method consists of heating the squared ends of two pipes, pipes and fittings, or both fittings by fixing them to a heated plate, removing the plate, promptly joining the ends, and cooling the joints while maintaining the appropriate force.



Butt Fusion

Saddle Fusion - This method involves melting the concave surface of the saddle fitting base while melting the matching pattern on the pipe surface, bringing the two molten surfaces together and cooling the joints while maintaining the appropriate force.



Saddle Fusion

Socket Fusion - This method involves simultaneously heating the inner surface of a socket fitting smaller than the smallest outer diameter of the pipe and the outer surface of the end of the pipe. Proper melting occurs on each side to be joined, then the pipe is inserted into the joint to be joined.

Socket Fusion

Correctly fused PE joints will not leak. If a leak is detected during a pneumatic or hydrostatic test, a system faults will occur. Caution should be taken when approaching pressurized pipelines and no attempt should be made to correct leaks until system depressurization is complete. PE cannot be joined by solvent bonding or threading. Extrusion welding or hot air welding is not recommended for pressure applications.

2) Key factors for quality fusions

A. The fusion operator must have sufficient training and understanding of equipment, tools and fusion procedures.

Misunderstanding of the operation of equipment and tools can result in fusion quality degradation. The operator must thoroughly understand the use, function and operation of the equipment and tools. The operator must comply with the equipment manufacturer's instructions.

Fusion pressure and heating/cooling cycles can vary significantly depending on the pipe size and wall thickness. Operators should not rely entirely on automated fusion equipment for joint qualification. In addition, visual inspection and qualification should always be performed. If necessary, the correct pressure and heat/cooling cycle time should be determined through test fusion. Destructive test methods, such as bend back tests, may be required to formulate the correct pressure and heat/cooling cycle time.

B. Pipe and fitting surfaces must be clean and properly prepared.

Quality fusion is not possible when surfaces are dirty, contaminated or poorly prepared surfaces that do not mate. Clean and prepare the surfaces before proceeding the joining. If contaminants are reintroduced, clean the surfaces again.

C. Heating tool surfaces must be clean, undamaged and at the correct surface temperature.

Heating tool surfaces are usually coated with a non-sticky material. Correct cleaning techniques should be used accordingly. Do not use gasoline or other petroleum products if solvent is deemed necessary. Refer to the equipment manufacturer's instructions for correct cleaning products. It is important to regularly clean the heating tool surface to prevent accumulation of PE material that is damaged by prolonged contact with the heating tool.

Recommended heating tool temperature for each procedure is specified. This temperature indicates the surface temperature, not the heating tool thermometer. Surface temperature shall be checked daily using a surface thermometer. If you are using crayon indicators, it should not be used in an area that will be in contact with the pipe or fitting. It is recommended to store the heating plate in an insulated storage rack when not in use. This not only protects the heating surface from contaminants, but also prevents inadvertent contact, which can lead to serious injury.

D. Ensure that the fusion tools and equipment are in the correct condition and suitable for operation.
Each type of fusion requires special tools and equipment. Fusion performed using incorrect fusion equipment, materials or tools and/or improperly maintained fusion equipment may result in poor fusion. All non-operating equipment components must be replaced or repaired before connecting pipe.

3) Fusion in cold weather

Polyethylene has reduced impact resistance under sub-zero conditions. Additional care must be taken during handling under sub-zero conditions. PE pipes also become more difficult to bend or straighten. For recommended guidelines when fusing in inclement weather, refer to the Plastics Pipe Institute, PPI, Technical Note TN-42: Recommended Minimum Training Guidelines for PE Pipe Butt Fusion Joining Operators for Municipal and Industrial Projects. These guidelines apply to all applications. Additional information on cold temperature procedures can be found in ASTM F2620, Standard Practice for Heat Fusion Joining of Polyolefin Pipe and Fittings, Annex A1. The operator should consider qualified fusion procedures and be suitable for all potential inclement weather conditions in which the operator can fuse polyethylene pipe.

4) Pre-Checklist

A. Inspect pipe length and fittings for unacceptable cuts, gouges, deep scratches or other defects. Damaged products are not available.

B. Should be no defects or surface disruption in the fusion area.

C. Ensure that all necessary tools and equipment are on site and in correct operation.

D. The surfaces of the pipe and fitting where the tools and equipment are installed must be clean and dry. Use a clean, dry, non-synthetic cloths, or paper towel to remove dirt, snow, water and other contaminants. Isopropyl alcohol is recommended for alcohol use.

E. Protect or cover fusion equipment and surfaces from inclement weather and wind conditions. A temporary shelter may need to be installed on top of the fusion equipment and fusion operation may be required.

F. Relieve the line before connecting. When fusing coiled pipe, you can relieve the tension by creating an S-curve between the pipe coils. In some cases, it may be necessary to allow pipe to equalize to the ambient temperature. Allow pulled-in pipes to relax for several hours to recover from tensile stresses.

G. Make sure the pipes are correctly aligned before connecting.

H. At the start of the day, preferably, test fusion can be used to determine the fusion procedures and equipment setup for actual workplace conditions.

5) Butt fusion

- Heater Surface Temperature - 400˚F(minimum) ~ 450˚F(maximum)

Heating tool surface must be up to temperature before starting. All points on both heating tool surfaces where the heating tool surfaces contacts the pipe or fitting end shall be within the prescribed minimum and maximum temperatures and the maximum temperature difference between the two points on the heating tool fusion surfaces must not exceed 20˚F for equipment for smaller pipe(~18"), or 35˚F for larger equipment. Heating tool surface must be cleaned.

- Interface Pressure – 60 psi(minimum) ~ 90 psi(maximum)
// 414 ~ 621kPa // 4.14 ~ 6.21bar

Interfacial pressure is used to calculate the fusion coupling gauge pressure value for hydraulic butt fusion machines or manual machines equipped with pressure gauge. Interface pressure is constant for all pipe sizes and for all butt fusion machines. However, the fused pressure gauge setting is calculated for each butt fusion machine and depends on the outer diameter, dimensional ratio and piston area of the fusion machine.

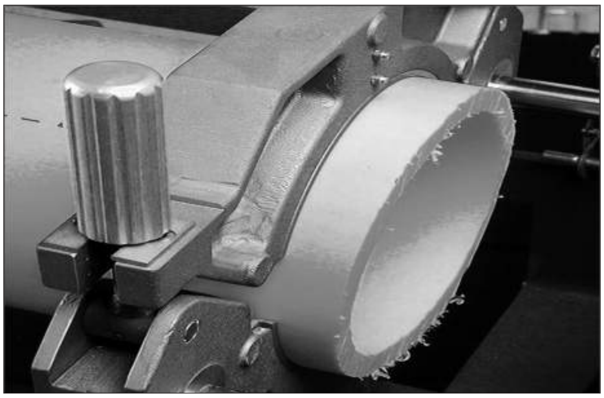
For hydraulic machines, calculate the hydraulic fusion pressure gauge setting using interface pressure, fusion surface area, machine's carriage cylinder size and internal drag pressure, and if necessary, the pressure needed to overcome external drag resistance. Calculate this value using the instruction from the equipment manufacturer.

Interfacial pressure and hydraulic fusion pressure gauge setting of fusion machine are not same.

- Procedure

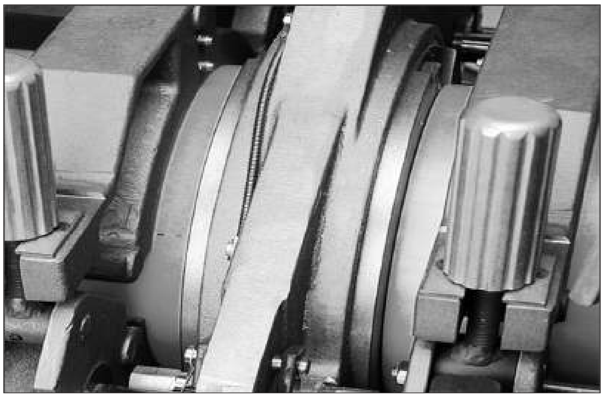
A. Secure

Clean the inside and outside of the pipe or fitting ends by wiping with a clean, dry, lint-free cloth or paper towel. Remove all foreign substances. Align the components with the machine, place them in the clamps and then close the clamps. Ensure that ends of components are sufficiently protruded past the clamp to contact. Bring the ends together and check high-low alignment. If necessary, adjust the alignment by tightening the high side down.



B. Face

Place the facing tool between the component ends, and face them to establish smooth, clean, parallel mating surfaces. Face until the distance between the fixed and moveable clamps is minimized. If the machine is equipped with facing stop, proceed the facing until the facing stop is activated. Stop the facing tool before moving the pipe ends away from the facing tool. Remove the facing tool, and clear all shavings and pipe chips from the component ends. Do not touch the component ends with your hands after facing.



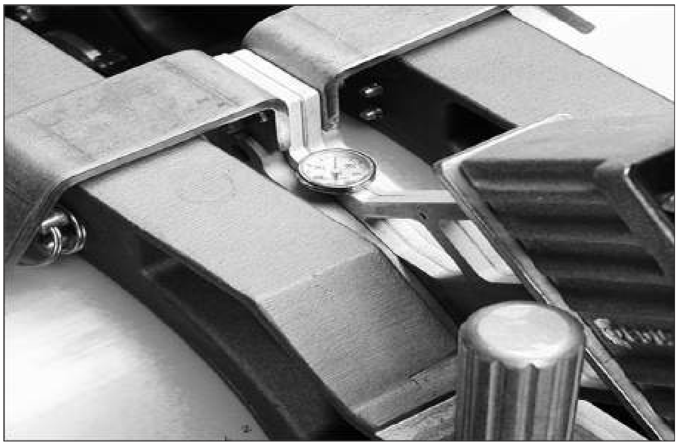
C. Align

Bring the component ends together, check alignment and check for slippage against fusion pressure. Look for complete contact all around both ends with no detectable gaps, and check the high-low alignment. If necessary, adjust the alignment by tightening the high side clamp. Do not loosen the low side clamp because components may slip during fusion. Face again if high-low alignment is adjusted.

D. Melt

Make sure the heating tool surface is at the correct temperature. Place the heating tool between the component ends, and move the ends against the heating tool. Bring the component ends together under pressure to ensure full contact. The initial contact pressure should be held very briefly and released without breaking contact. Pressure should be reduced when evidence of melt appears on the circumference of the pipe. Secure both ends to the heating tool without force. Beads will form against the heating tool at the component ends. When the proper melt bead size is formed, quickly separate the ends and remove the heating tool.

During heating, the molten bead will expand out flush to the heating tool surface, or may curl slightly away from the surface. Unacceptable pressure during heating can cause the molten bead to curl considerably away from the surface of the heating tool surface.



Approximate Melt Bead Size

Pipe Size, in	Approximate Melt Bead Size, in
1-1/4" and smaller	1/32" ~ 1/16"
Above 1-14" through 3"	About 1/16"
Above 3" through 8"	1/8" ~ 3/16"
Above 8" through 12"	3/16" ~ 1/4"
Above 12" through 24"	1/4" ~ 5/16"
Above 24” through 36”	About 7/16”
Above 36” through 54”	About 9/16”

E. Join

Quickly inspect both ends of molten surfaces immediately after removing the heating tool. The end should be flat, smooth, and completely melted. If the molten surfaces are acceptable, bring them together immediately and apply the correct joining force. The correct fusion pressure will form a double bead that is rolled over and contacts the pipe surface on both ends.

A concave molten surface is unacceptable. It is caused by heating pressure. Do not continue. Allow the component ends to cool and start over with Step A.

The maximum recommended time allowed for heater plate removal is indicated in below table.

Maximum heater plate removal times

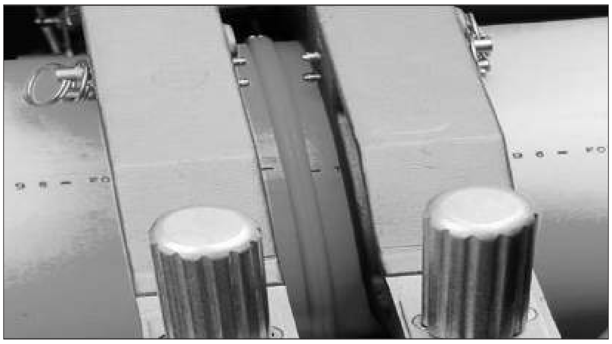
Pipe Wall Thickness, in	Max. Heater Removal Time, sec
0.20 to 0.36	8
Above 0.36 to 0.55	10
Above 0.55 to 1.18	15
Above 1.18 to 2.5	20
Above 2.5 to 4.5	25

F. Hold

Maintain the fusion gauge pressure until the joint is cooled. Allow the double bead to cool enough to be handled smoothly. Cool for a minimum of 11 minutes per inch of pipe wall. Do not try to decrease the cooling time by applying water, ice, wet cloth or the like.

Avoid pulling, installation, pressure testing and rough handling for at least an additional 30 minutes.

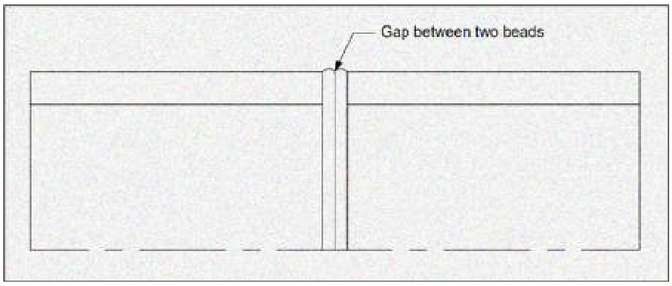
If the ambient temperatures exceeds 100°F, the cooling times may be longer.



G. Inspection

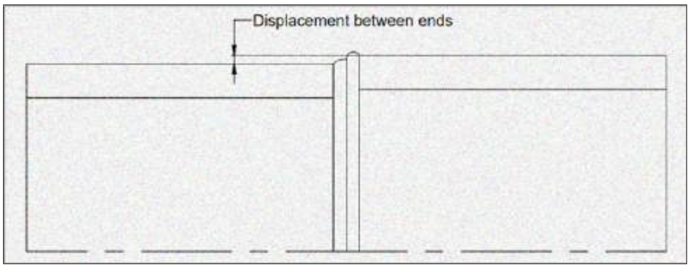
On both sides, the double bead should be rolled over to the surface, and be uniformly rounded and consistent in size all around the joint.

a) The gap between the two single beads must not be below the fusion surface.



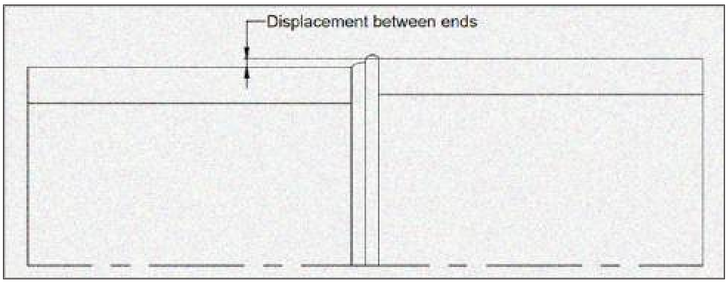
Gap between two beads

b) The displacement between fusion surfaces of two fused products must not exceed 10% of the products minimum wall thickness.



Gap between two beads

c) Refer to below table for general guidelines for bead width for each respective wall thickness.



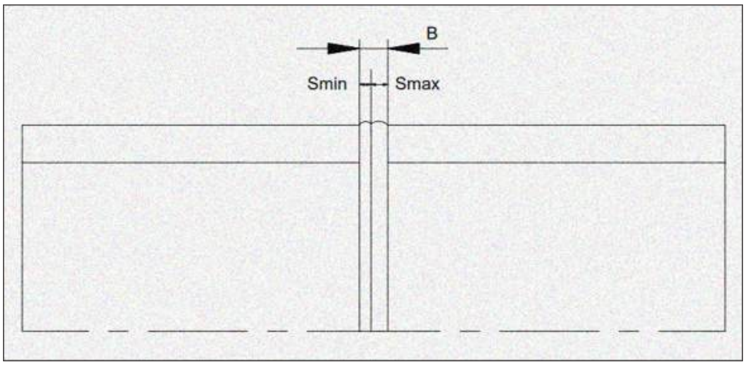
Bead width

Bead widths per wall thickness

Minimum Wall Thickness, in.	Approximate Bead Width (B), in.	Minimum Wall Thickness, in.	Approximate Bead Width (B), in.
0.118	5/32 ~1/4	1.06	19/32 ~ 25/32
0.157	5/32 ~ 9/32	1.18	5/8 ~ 13/16
0.197	3/16 ~ 5/16	1.34	21/32 ~ 7/8
0.246	1/4 ~ 11/32	1.57	11/16 ~ 29/32
0.315	9/32 ~ 3/8	1.77	25/32 ~ 1
0.354	5/16 ~ 7/16	1.97	7/8 ~ 1-1/16
0.433	11/32 ~ 1/2	2.16	15/16 ~ 1-3/16
0.512	3/8 ~ 9/16	2.36	1 ~ 1-1/4
0.630	7/16 ~ 19/32	2.56	1-1/8 ~ 1-7/16
0.710	1/2 ~ 5/8	2.76	1-3/16 ~ 1-1/2
0.750	1/2 ~ 11/16	2.95	1-1/4 ~ 1-9/16
0.870	1/2 ~ 11/16	3.15	1-5/16 ~ 1-11/16
0.940	9/16 ~ 3/4	3.35	1-3/8 ~ 1-3/4
		3.35	1-1/2 ~ 1-13/16

d) The difference in size between two single beads shall not exceed X% of the width of combined bead.

Where: $X = \Delta S/B \times 100$ = Percent difference of bead width, %
~ pipe to pipe, maximum X = 10%
~ pipe to fitting, maximum X = 20%
~ fitting to fitting, maximum X = 20%



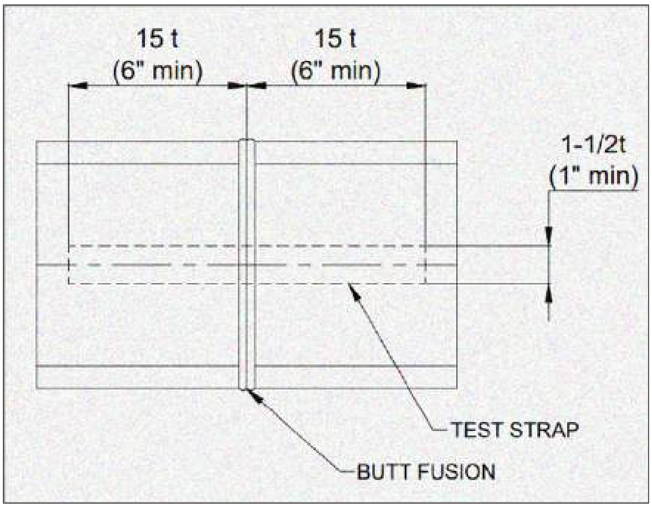
Bead size differential

Butt fusion bead troubleshooting

Observed Condition	Possible Cause
Excessive double bead width	Overheating; Excessive joining force
Double bead v-groove too deep	Excessive joining force: Insufficient heating; Pressure during heating
Flat top on bead	Excessive joining force; Overheating
Non-uniform bead size around pipe	Misalignment; Defective heating tool; Worn equipment; Incomplete facing
One bead larger than the other	Misalignment; Component slipped in clamp; Worn equipment; Defective heating tool; Incomplete facing; Dissimilar material
Beads too small	Insufficient heating; Insufficient joining force
Bead not rolled over to surface	Shallow v-groove – Insufficient heating & insufficient joining force; Deep v-groove – Insufficient heating & Excessive joining force
Beads too large	Excessive heating time
Squared outer bead edge	Pressure during heating
Rough, sandpaper-like, bubbly, or pockmarked melt bead surface	Hydrocarbon contamination

- Qualification

A. Prepare a sample joint. Sample length should be at least 6” or 15 times the minimum wall thickness.



Bead width

B. Observe the fusion process and ensure that recommended procedure for butt fusion is being followed.

C. Visually inspect the sample joint and compare it to the picture of an acceptable joint.

D. Allow the sample joint to cool completely for at least one hour.

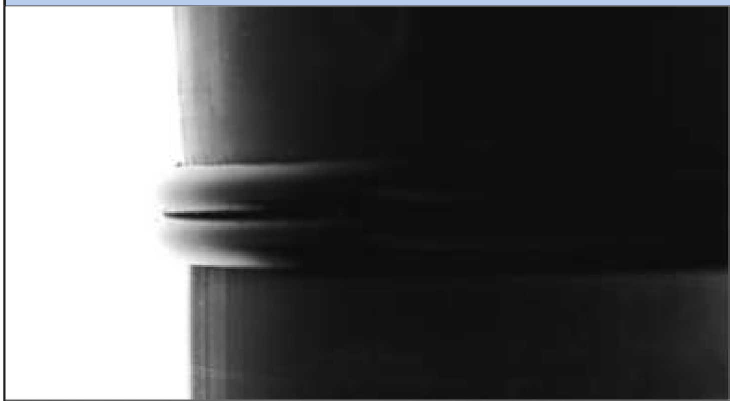
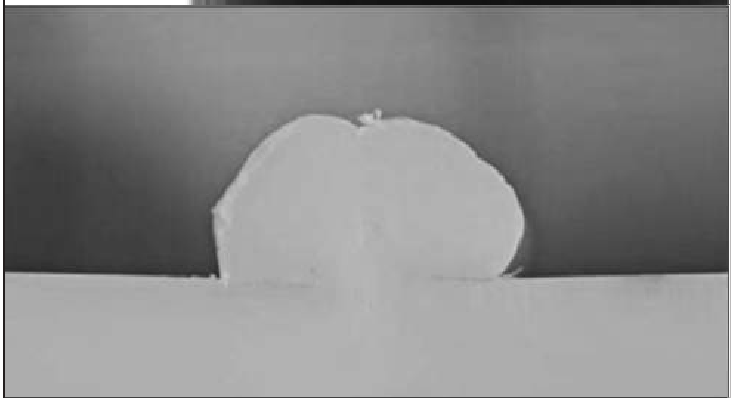
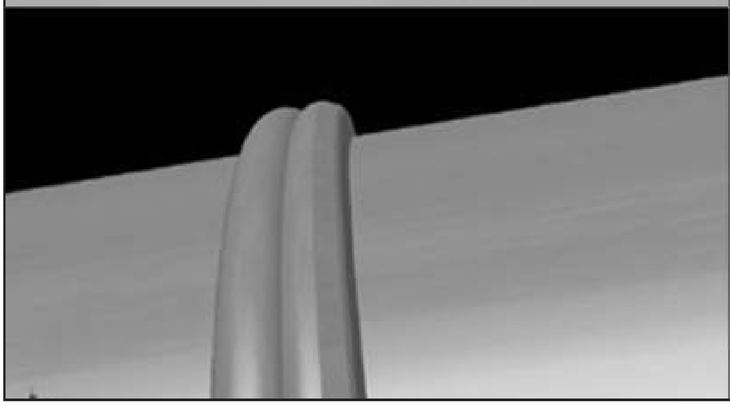
E. Cut the sample joint lengthwise along the pipe into at least three straps that are at least 1" or 1.5 wall thickness in width. It is recommended that four equally spaced strips be cut, one from each quadrant of the pipe.

F. Visually inspect the cut surface at the joint and compare it to the picture of an acceptable joint. There should be no gaps, voids, misalignment, or unbonded areas.

G. Bend the strap until the ends of the strap touch.

H. If flaws are observed in the joint, compare appearance with pictures of unacceptable joints. Prepare a new sample joint using correct joining procedure, and repeat the qualification procedure.

- Acceptable Appearance (refer to ASTM F2620)

Appearance	Description
  	•Proper double roll-back bead. •Proper alignment.

– Unacceptable Appearance (refer to ASTM F2620)

Appearance	Description
	•□Incomplete face-off.
	•Unacceptable concave melt appearance after heating. •Possible over-pressurization during the heat cycle.
	•Improper "High-Low" pipe alignment. •Visually mitered joint.
	•Improper alignment in fusion machine-mitered joint.
	•Contamination in joint.

6) Saddle Fusion

- Heater surface Temperature: 500˚F ± 10˚F

  Heater tool surfaces must be preheated prior to the starting. All points on both heating tool surfaces in contact with the pipe and fitting shall be within the prescribed minimum and maximum temperatures. Heater tool surfaces must be clean.

- Interface Pressure: Minimum 54 psi – Maximum 66 psi

- Definitions

  Initial Heat(Bead-up) : The heating step used to form molten beads on the pipe.

  Initial Heat Force(Bead-up Force) : The force applied to establish the melt pattern on the pipe. The initial heat force is determined by multiplying the fitting base area by the initial heat interfacial pressure.

  Heat Soak Force : The force applied after an initial melt pattern is established on the pipe. The heat soak force is the minimum force that ensures the fitting, heater and pipe stay in contact with each other.

  Fusion Force : The force applied to establish the fusion bond between the fitting and pipe. The fusion force is determined by multiplying the fitting base area by the fusion interfacial pressure.

  Total Heat Time : A time that begins when the heater is placed on the pipe and initial heat force is applied and stops when the heater is removed. Maximum heating times are shown in below table for both pressure and non-pressure applications.

  Cool Time : The time required to cool the joint to approximately 120˚F ± 10˚F. The fusion force must be maintained for 5 minutes on 1-1/4" IPS or 10 minutes for all other pipe sizes, after which the saddle fusion equipment can be removed. The joint must be cooled for an additional 30 minutes before tapping the pipe or joining to the branch outlet. Recommended minimum cooling times are shown in below table.

Maximum heating/Minimum cooling times

Pipe Size	Maximum heating time	Pipe Size
1-1/4" IPS	1/16" melt pattern visible around the base of the fitting. Do not exceed 15 seconds when hot tapping.	5 min + 30 min
2" IPS	1/16" melt pattern visible around the base of the fitting. Do not exceed 35 seconds when hot tapping.	10 min + 30 min
3" IPS & larger	1/16" melt pattern visible around the base of the fitting.	10 min + 30 min

- Interfacial Area

  Rectangular base - The major width times the major length of the saddle base, without taking into account the curvature of the base or sides, minus the area of hole in the center of the base.

  Round base fittings – The radius of the saddle base squared times π(3.1416), without taking into account the curvature of the base or sides, minus the area of the hole in the center of the base.

- Procedure

A. Preparation

The area of the main pipe where the saddle fusion machine and fittings are to be located must be clean, dry and free from harmful wounds, grooves or cuts. Remove dirt and debris from the main pipe surface.

a) Install the saddle fusion tool on the pipe according to the manufacturer's instructions. The tool should be centered in a clean, dry location where the fitting will be fused. Secure the tool to the pipe. For the pipe of 6" IPS and smaller pipe sizes, the support is recommended.

b) Grind the pipe surface, where the fitting will be joined, with a 50-60 grit utility cloth until a thin layer of material is removed from the pipe surface. The grinded area must be larger than the area covered by the saddle base. After grinding, clean the residue with a clean, dry cloth.

c) Grind the fusion surface of the fittings with a 50-60 grit utility cloth. Remove all dirt and residue with a clean, dry cloth. Loosely insert the saddle fitting into the fusion tool. Using the saddle fusion tool, place the fitting base on the pipe and apply a force of approximately 100 pounds to seat the fitting. Secure the fitting to the saddle fusion tool.

B. Heating

Heating and fusion process must be carried out accurately and efficiently, especially when fusing into pressurized main pipes. Overheating or excessive time between operations can cause a blowout. Do not interrupt heating to inspect the melt pattern on the main pipe.

Determine saddle fusion forces from the fitting label. Ensure that the heating tool is maintaining 490-510°F surface temperature. Check that heating tool surfaces are clean.

a) Place the heating tool on the pipe in the center below the fitting base. Immediately move the fitting against the heater faces, apply the initial heat force and start the heating time. Apply the initial heat force until melting is first observed at the crown of the pipe main. "Initial heat" is a term used to describe the initial heating step to develop a melt bead on the pipe and is usually 3-5 seconds, and then reduce the force to the heat soak force. Maintain heat soak force until the total heating time is complete.

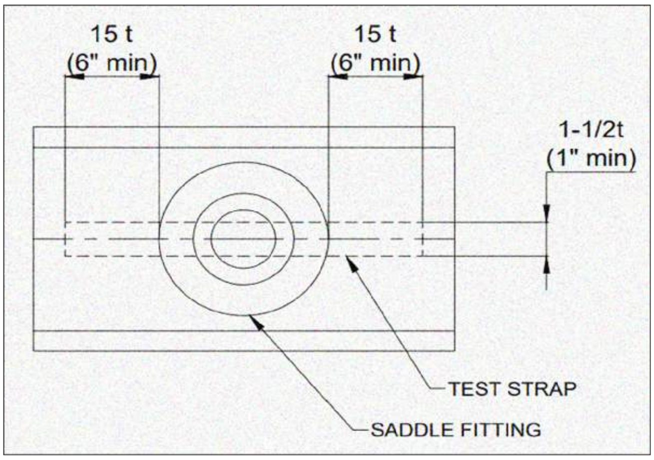
b) At the end of the total heating time, quickly separate the fitting from the heater and heat from the pipe and remove the heating tool. Quickly check for an even melt pattern on the pipe and heated fitting surfaces. A melt bead of about 1/16" or more should be visible around the fitting.

C. Fusion and Cooling

After removing the heater, press the fitting onto the pipe within 3 seconds and apply a fusion force. Maintain the fusion force on the assembly for 5 minutes on 1-1/4" IPS and for 10 minutes for larger sizes. When this initial cooling time expires, the saddle fusion equipment may be removed. Allow the assembly to cool for an additional 30 minutes before handling or tapping.
If the melt pattern is not satisfactory or fusion beads are not allowed, the saddle fusion should not be placed in service. To prevent re-use, the fitting should be cut off near the fitting base. Relocate to a new section of main and make a new saddle fusion by following the complete saddle fusion procedure.

D. Inspection

Visually inspect the fusion bead around the entire base of the fitting at the pipe. The fusion bead must be uniformly sized all around the fitting base, and should have a characteristic “three-bead” shape. The first bead is a fitting base melt bead. The second or outermost bead is the result of the heater face on the main. The third or center bead is the main pipe melt bead. The first and third beads should be about the same size all around the fitting base. The second bead is usually smaller, but should also be uniformly sized around the fitting base.



Bead size differential

Maximum heating/Minimum cooling times

Observed Condition	Possible Cause
Non-uniform bead size around fitting base	Misalignment; Defective heating tool; Loose or contaminated heating tool saddle faces; Worn equipment; Fitting not secured in application tool; Heating too faces not within specified temperature
One bead larger than the other	Misalignment; Component slipped in clamp; Worn equipment; Defective heating tool; Loose or contaminated heating tool saddle faces; Heating tool faces not within specified temperature
Beads too small	Insufficient heating; Insufficient joining force
Beads too large	Excessive heating time; excessive force
No second bead (or outermost bead)	Incorrect pipe main heating tool face
Serrated bead appearance	Normal for serrated heating tool faces
Smooth bead appearance	Normal for smooth heating tool faces
Pressurized main pipe blowout (beside base or through fitting center)	Overheating; Incorrect heating tool faces; Heating tool faces not within specified temperature; Taking too much time to start heating, or to remove the heating tool and join the fitting to the main pipe.
Rough, sandpaper-like, bubbly, or pockmarked meltbead surface	Hydrocarbon contamination
No third (or center) bead	Insufficient joining force

- Procedure

a) Prepare at least two sample joints. The pipe length shall be at least 2” or seven times greater than the maximum saddle fitting base dimension, whichever is greater.

b) Observe the fusion process and ensure that the recommended saddle fusion procedure is followed.

c) Visually inspect the quality of the sample joints.

d) Wait at least an hour for the joint to cool. Pipe sample should not be tapped for this qualification process.

e) Prepare the test straps. Cut the joint lengthwise through the saddle fitting along the main pipe.

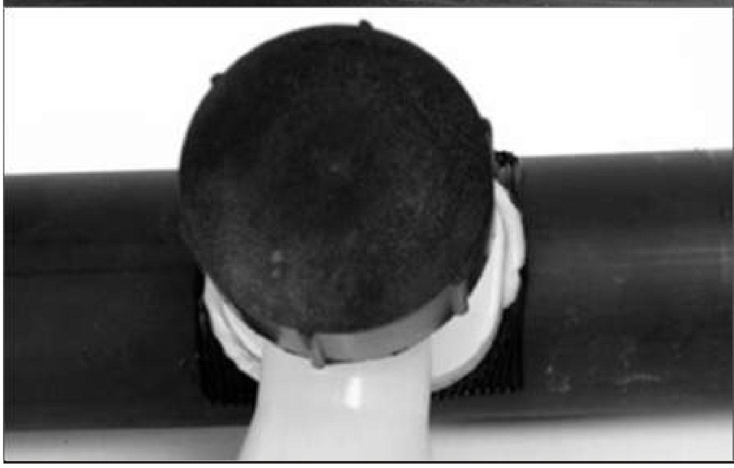
f) Visually inspect the joint for any voids, gaps, misalignment or incorrectly bonded surface.

g) Bend each test strap 180° with the inside facing out.

h) The fusion joint must be free of cracks, voids, gaps and disconnections.
Test the other sample joint with impact on saddle fitting. The failure must be caused by tearing the fitting, bending the fitting at least 45° or by removing a part of pipe. Failure at the fusion line is not acceptable. This test is a federal requirement for qualification of fusion procedures.

i) If failure does occur at the joint in any of the samples, then the fusion procedure should be reviewed and corrected. After modification, prepare new sample joints using correct joining procedure, and repeat the qualifying procedure.

- Acceptable Appearance (refer to ASTM F2620)

Appearance	Description
	•Proper alignment, force and melt. •Proper surface preparation.
	•Improper alignment. •Fitting offset from melt pattern.

- Unacceptable Appearance (refer to ASTM F2620)

Appearance	Description
	•Over-melt of fitting and main. •Possible over-pressurization of fitting on main.
	•Under-melt of fitting and main. •Fitting offset from melt pattern. •Possible under-pressurization of fitting on main.

7) SOCKET FUSION

- Equipment Requirements

The following equipment is required to produce high quality socket fusion in this procedure:

Tools – Socket fusion tools manufactured in accordance with ASTM F1056.

Heating tool faces – It consists of two parts, a male end for the interior socket surface and a female end for the exterior pipe surface.

Rounding clamps (cold ring) – Device to maintain the roundness of the pipe and control the depth of pipe insertion into the socket during the joining operation.

Depth gauge – Proper positioning of the rounding clamp.

Chamfering tool – Device to bevel the end of the pipe. The depth gauge and chamfering tool may be combined into a single tool.

Holding tools – Recommended for socket fusion of 2” IPS and larger pipe and fittings.

-Heater Temperature

Heater surface temperature – 490°F ~ 510°F

In order to obtain an appropriate melt, a uniform temperature must be maintained over the heating surface. All points on both heating surfaces in contact with pipes and fittings must be within the specified minimum and maximum temperatures. The heating tool surface must be cleaned.

- Procedure

A. Preparation

a) Make sure that heating temperature is within the specified temperature range. (490˚F ~ 510˚F)

b) Cut the pipe end squarely, and clean the pipe end and fitting, both inside and out with a clean, dry, lint-free cloth. Do not touch cleaned surfaces with your hands.

c) Chamfer the outside edge of the pipe end slightly. The pipe should be free of debris and burrs.

d) Place the cold ring on the pipe as determined by the depth gauge. Place the depth gauge over the chamfered end of the pipe. Clamp the cold ring immediately behind the depth gauge.

B. Heating

a) Review the recommended heating times in below table. The heating time begins after step (c) Has been completed.

b) Insert the fitting onto the male heating face. The fitting should be secured against the back surface of the male heater face.

c) Insert the pipe into the female heating face. The female heating face should meet the cold ring clamp.

d) Secure the pipe and fitting to the heater faces for the recommended heating time as shown in below table.

Socket Fusion Time Cycles

Pipe Size (PE4710)	Heating Time seconds	Cooling Time seconds
1/2" CTS	8 ~ 10	30
3/4" CTS	3/4" CTS	30
1" CTS	12 ~ 14	30
1/2" IPS	8 ~ 10	30
3/4" IPS	12 ~ 14	30
1" IPS	14 ~ 16	30
1-1/4" IPS	18 ~ 20	60
1-1/2" IPS	18 ~ 20	60
2" IPS	22 ~ 26	60
3" IPS	25 ~ 30	75
4" IPS	30 ~ 35	75

C. Fusion and Cooling

a) At the end of the heating time, quickly remove the pipe and fitting from the tool. Snap them straight off with a sharp rap on the heating tool handle. Do not torque or twist the pipe or fitting during removal.

b) Quickly check the melt pattern on pipe end and the fitting socket. The surfaces should be 100% melted with no cold spots. If there is evidence of an incomplete melt pattern, do not continue with the fusion procedure. Cut off the melted pipe end, start over from step A by using a new fitting. Do not reuse a melted fitting.

c) Within 3 seconds of removing from the heating tool, push the end of the pipe and fitting socket straight together until the cold ring clamp firmly touches the end of the fitting socket. During cooling, pressure must be maintained on the fusion according to the recommended cooling time shown in the above table.

d) Allow additional cooling time before removing the cold ring. An additional 10 minutes of cooling time is recommended.

D. Inspection

Visually inspect the joint. A clear impression of the clamp should be visible in the melt pattern at the end of the socket. There should be no gaps, voids or unbonded areas.

Socket Fusion Troubleshooting

Observed Condition	Possible Cause
No cold ring impression on socket fitting melt bead	Depth gauge not used, Cold ring no used or set to incorrect depth, Insufficient heating time
Gaps or voids around the pipe at the socket fitting edge	Pipe or fitting not removed straight from the heater face, Pipe or fitting not joined together straight when fusing, Cold ring not used Cold ring set at incorrect depth
Wrinkled or collapsed pipe end	Cold ring not utilized, Cold ring set at incorrect depth, Incorrect heating sequence
Voids in fusion bond area	Pipe or fitting not removed straight from the heater face, Pipe or fitting not joined together straight when fusing, Cold ring not used, Cold ring set at incorrect depth
Unbonded area on pipe at end of pipe	Cold ring not used, Cold ring set too deep
Socket melt extends past end of pipe	Cold ring set too shallow
Rough, sandpaper-like, bubbly or pockmarked melt bead surface	Hydrocarbon contamination

- Qualificationn

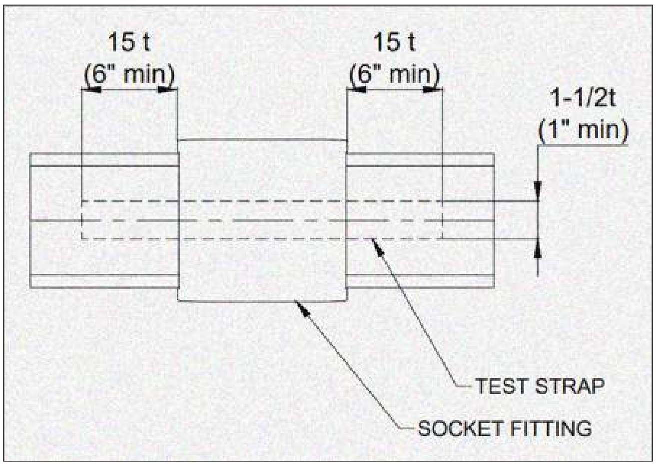
a) Prepare a sample joint such as coupling with pipe socket fused to both ends. The pipe length should be at least 6” or 15 times the wall thickness in length.

b) Observe the fusion process and ensure that the recommended procedure for socket fusion is being followed.

c) Visually inspect the quality of sample joints.

d) Allow the sample to cool completely.

e) Prepare test straps as shown in below figure. Cut the joints lengthwise into at least three longitudinal straps with at least 1” or 1.5 times the wall thickness in width.



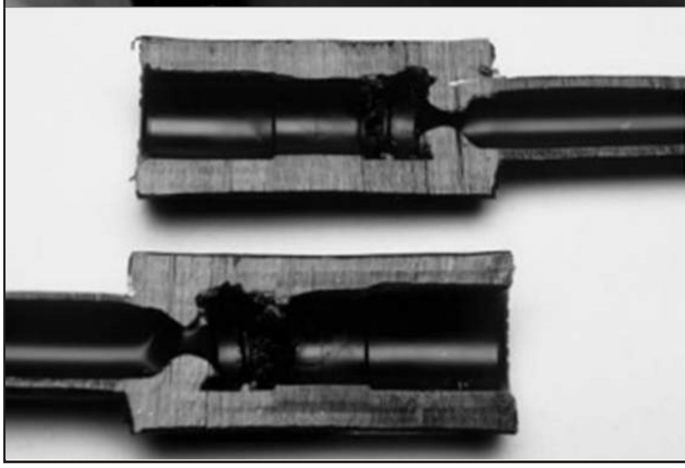
Bead width

f) Visually inspect the cut joint for any indications of voids, gaps, misalignment or surfaces that have not been fused.

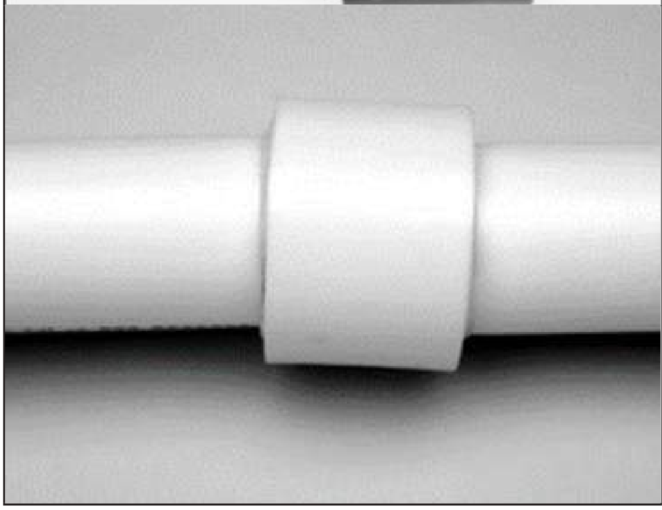
g) Bend each test strap 180° with the inside of the pipe facing out.

h) If flaws are observed in the joint, compare appearance with pictures of unacceptable joints. Prepare a new sample joint using correct joining procedure, and repeat the qualifying procedure.

– Acceptable appearance (refer to ASTM F2620)

Appearance	Description
	•Proper alignment, force and melt. •Proper surface preparation.
	•Excessive heating.

– Unacceptable appearance (refer to ASTM F2620)

Appearance	Description
	•Melt bead not flattened against the fitting/cold ring. •Improper insertion depth; no cold ring. •Excessive heating.
	•Misalignment.

2. Electro Fusion

1) Introduction

Electrofusion joining of PE pressure pipe has been used worldwide since the 1970's. There are many international standards for electrofusion fittings, testing, and fusion equipment. In north America, ASTM standard specification for materials (ASTM D3350), performance (ASTM F1055), and installation practice (ASTM F1290) have been in publication for many years. COSMO I&D electrofusion fittings are marked to indicate that they meet the material, design, and performance requirements of ASTM F1055 for use in a pressure pipe application. Additional markings indicate that other performance and health effect requirements are satisfied, such as AWWA C906 and NSF 61.

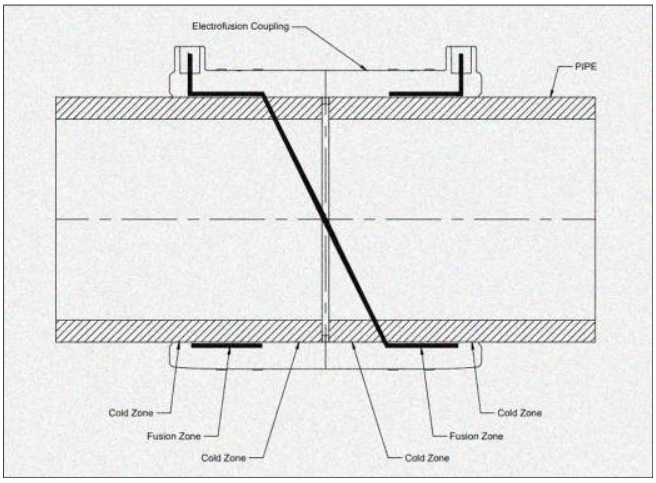
Proper installation techniques, installer's understanding and training of these techniques, and effective inspection before installation are all essential keys to a successful electrofusion joint. This document provides detailed instructions for each key step to making a successful installation, explains why each step is important, and describes how to ensure that the requirements for each step have been accomplished. Failure to follow these instructions or failure to satisfy the basic requirements for each step will result in a poor-quality fusion.

2) Principles of Electrofusion

Polyethylene(PE) electrofusion fittings are manufactured with a precisely designed resistance wire heating coil mechanism. The wire heating coil is encapsulated by PE and is located just below the fusion surface of the fitting.

The electrofusion process supplies a controlled electrical voltage to the heating coil to generate heat, melting the fitting and pipe surfaces. As the PE surface melts, it becomes bulky to fill the gap between the pipe and the fitting. If melt expansion continues after the gap is closed, pressure is generated within the heating area.

The expanding melt reaches the "cold zone" within the fitting, where the leading edge of the melt cools and solidifies to prevent further movement or escape of the melt. The heating process continues for a predetermined time so that substantial pressure is reached through continued melt expansion in the contained melt pool of the pipe and fitting surfaces. The molten surfaces under pressure will join at the molecular level. Upon completion of the heating phase, the assembly is held stationary by external clamps as the melted materials begin to immediately cool and co-crystallize into a single homogenous monolithic structure between the pipe and fitting. When completely cooled, the surfaces are permanently joined and cannot be separated.



Principle of Electrofusion

The cooling phase is as important as the heating phase in the electrofusion process. Since polyethylene is a thermoplastic, the material becomes soft when heated, thus vulnerable to external forces such as the weight of the pipeline and bending forces due to pipe curvature or misalignment while it is still hot. Fittings must be secured and aligned by clamps during the fusion and cooling phase to protect against inadvertent disturbance of the molten PE until the assembly has cooled and regained its material strength.

3) Fitting handling

A. Storage

Electrofusion fittings are packaged in a plastic bag to prevent accumulation of dust, dirt and contamination. The bag should be kept in place during normal handling and removed only during installation. Bags are not sealed and are often perforated to allow trapped air to escape. Small dust particles or moisture from humidity may enter the bag, which can be removed with isopropyl alcohol during installation. In addition, electrofusion fittings are packaged in boxes to protect them from other causes of degradation, such as oxidation due to UV exposure, during prolonged storage.

Fittings should always be stored indoors in a packed state until the time of installation. The resin of black electrofusion fitting contains 2% to 3% carbon black additive to protect against UV degradation effects. Fittings stored indoors in their original packaging have a virtually unlimited shelf life.

Fittings with an unclear or suspicious storage history should be evaluated by sample fusion destructive test prior to use. If fusion quality appears to be affected, the fitting should be discarded and not installed.

Before installation, inspect the fitting to ensure that connections such as terminal pins are not damaged during handling, that there is no visible damage to the fusion surfaces or heating wires, and that there is no foreign matter on or near the fusion surfaces.

In the event of accidental contact with the fusion surface, it should be cleaned with a suitable cleaning agent that does not contain any additives that may interfere with the fusion process. More than 90% isopropyl alcohol without additional additives other than water is widely accepted as a good cleaning agent. Be careful not to reuse wipe or cloth used to clean the fitting in advance, as contaminants that may interfere with the process may accidentally enter. Acetone is an acceptable alternative cleaning agent in situations where isopropyl alcohol is not available. However, when using acetone, be sure to conduct a test fusion to check in advance for any other additives that may interfere with or prevent the fusion process. Do not use denatured alcohol. Denatured alcohols may contain additives that can prevent fusion so that it should not be used.

The clean fitting has no visible debris or particles on the fusion surface. Although the fitting may not necessarily be sterilized to operate as intended, some invisible compounds may prevent fusion. Since the fusion surface area of electrofusion fitting is larger than pipe end cross-sectional area, so that small dust particles or droplets do not cause failure points, but clean fittings and properly prepared pipe surfaces are essential to ensure successful fusion.

B. Labels and stamps

All fittings are labeled and stamped with important information. Labels may look slightly different, but the information contained does not.

a) Fusion barcode label

This black and white label includes fitting description, fusion time, cooling time, lot number and ISO 13950 fusion barcode.

b) Traceability barcode label

This black and yellow label includes the ASTM F2897 tracking & traceability barcode. It contains no human-readable information and must be read and decoded by a device.

c) Data stamp

This information is molded into the body of the fitting. It includes fitting branding, description, fusion voltage and time, fitting material, cooling time, standards information, DR rating, country of origin and 'G' indicating for fuel gas service.

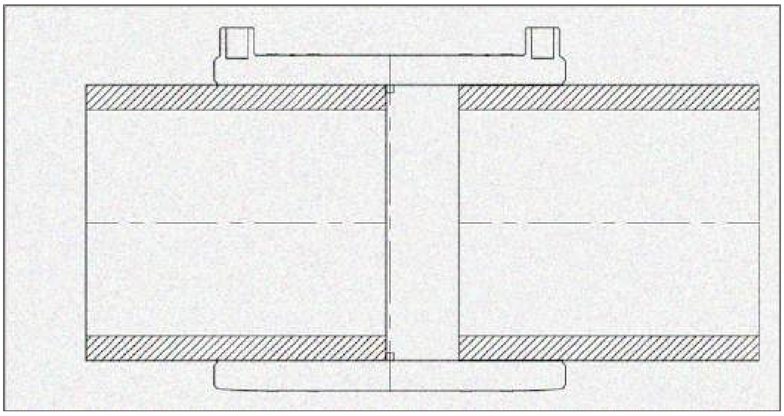
4) Pipe handling

A. End cutting

For successful fusion, the pipe must be correctly inserted into the electrofusion coupling. Failure to insert the pipe end correctly can result in the loss of melt containment during the fusion process.

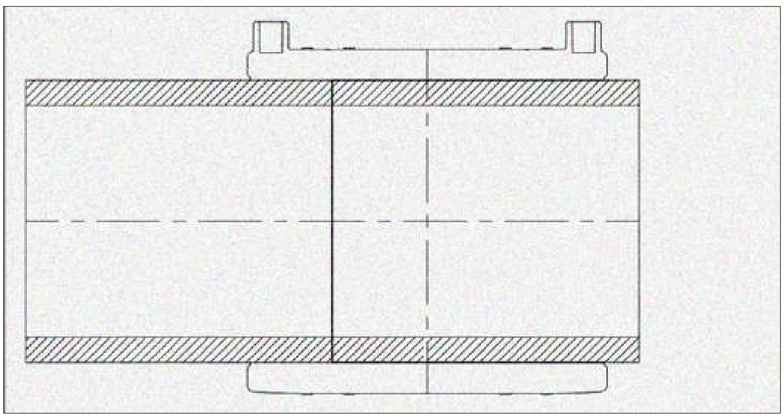
As shown in the image below, the heating coils in the fusion area on both sides of the coupling are separated by three areas known as "cold zone" where no heat is generated. The expanding melt in the fusion region reaches these cold zones and is cooled until movement stops, thereby preventing the escape of any further melt. As the fusion process continues, a significant amount of melt pressure is generated within the fusion region. This pressure is required to provide adequate contact between the molten surfaces of pipe and coupling.

Short stab : Short stab can be prevented by measuring and marking the stab depth at the end of the pipe before insertion into the coupling. If the pipe end is not properly inserted, the melt generated during the fusion cycle will expands and flows over the exposed pipe end inside the fusion area. If this melt is transferred to the heating coil wire, it may cause shorting and rapid overheating of the fusion area.



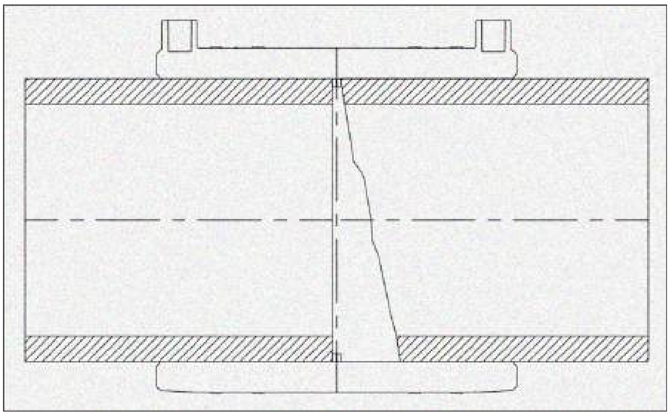
Short stab

Mis stab : Mis stab is another assembly error that occurs when the pipe is not located in the center cold zone of the coupling. In this case, one pipe end is over-inserted into the coupling and the other pipe end is under-inserted. Melt again is allowed to escape between the pipe ends and the potential for heating coil shoring is likely.



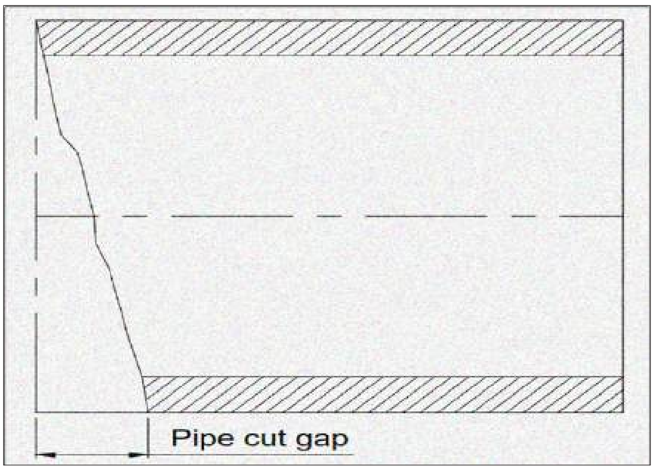
Mis stab

Mis cut : Mis cut is another potential error that can cause loss of melt containment, which is caused by the pipe end is not being cut at right angles. It is not necessary and not practical to cut the end of pipe at exactly 90 degrees, but care should be taken to make it as square as possible. The length of cold zone is designed to accommodate some mis cuts at the end of the pipe and still ensures full coverage of the heating wire and sufficient cold zone contact to accommodate 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

- End cutting procedure
  a) Cut the pipe ends as evenly and squarely as possible. If the size of pipe is small, it is recommended to use a cutter made for this purpose. For larger pipe sizes that are cut by hand, make a guide mark around the pipe that can be followed with the cutting tool. To accomplish this, a wrap-around strap can be used to ensure straight mark. Large diameter pipes may require chain saws or reciprocating saws. Do not use chain oil if chainsaw is used.
  b) If a square cut cannot be achieved, ensure that the resulting gap between the pipe and the square as measured in below figure should be equal to or less than that is shown in the table below.



Gap between pipe and square

Pipe cut maximum gap

Pipe Size	Maximum gap
1/2" CTS to 1-1/2" IPS	1/8"
2" IPS	3/16"
3" IPS	5/16"
4" IPS	5/16"
6" IPS	1/2"
8" IPS	3/4"
10" IPS	7/8"
12" IPS	1"

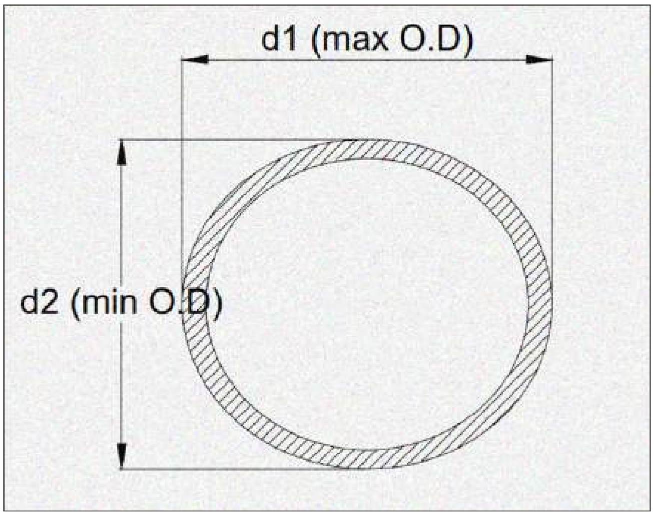
B. Pipe roundness

Storage, coiling, stacking, soil loading and even processing can affect to roundness of pipe because polyethylene is a flexible material. Pipe roundness is an important factor to consider in the electrofusion process. Electrofusion works through volumetric expansion when the polyethylene material as it is melted to close gap between the pipe and coupling. An excessive gap can reduce the fusion pressure of inside coupling and weaken the strength of the fusion. Melt escape may also occur at the end of coupling. 2" IPS and smaller diameter pipe is generally flexible enough to provide rounding force requiring coupling and alignment clamps and does not require any other rounding device. For sizes larger than 3" IPS, the following steps can be used to prevent roundness problem.

The pipe roundness condition can be expressed as out-of-roundness or ovality. Both refer to the same basic conditions, but can be confused.

Out-of-roundness is difference between the maximum measured diameter and the minimum measured diameter. Measure the pipe with a tape measure or caliper to find the maximum and minimum diameter points. Out-of-roundness is calculated as d1-d2 as measured in the field.

Ovality is a percentage of the difference between the maximum and minimum measured outside diameters. Ovality is calculated as (d1-d2) / Davg*100



Gap between pipe and square

For sizes equal to or larger than 3” IPS, re-rounding clamps may be required on both sides of the electrofusion fitting to ensure that the gap between the pipe and fitting is not too large. The table in below can be used as a guide when the measured pipe roundness conditions are approaching the condition where re-rounding clamps may be needed. The difference between d1 and d2 measured of re-rounding of the pipe should be equal or less than the value shown in the below table.

Out of roundness limits

Pipe Size	Maximum gap
3" IPS	1/8"
4" IPS	1/8"
6" IPS	3/16"
8" IPS	3/16"
10" IPS	1/4"
12" IPS	1/4"

C. Cleaning and marking

Clean the pipe with clean water during the initial pipe inspection and prior to scraping. Do not use detergents as wetting agents and other substances contained in detergents can be difficult to remove from the pipe and will interfere with the fusion process later. If oil is suspected to be on the pipe, an additional cleaning may be required using isopropyl alcohol.

Pipe that has been installed by directional boring where drilling lubricants such as bentonite have been used requires particular attention to pre-cleaning before scraping as well as any cleaning after scraping. Drilling lubricants can be difficult to see even when dried and easily spread by wiping. To prevent spreading onto prepared surfaces, wipe only the area cleaned with isopropyl alcohol before.

Inspect the pipe surface to be scraped or peeled for debris such as rock that could damage the scraping tool blade.

Do not use detergents to clean the pipe.

- Marking Procedure:

a) Mark the first area to be cleaned.

In case of a saddle, initially clean, dry and mark an area approximately three times wider than the area to be peeled off or scraped. Do not wipe outside of this area in later steps.

In case of a coupling, initially clean, dry and mark the end of each pipe at least twice the total length of the coupling. Do not wipe outside of this area in later steps.

This is the first area where removes loose particles and mud and establishes area that should not be exceeded when cleaning in later steps. Additional cleaning of this area with isopropyl alcohol is good way to remove other potential contaminates such as drilling fluids that cannot be removed with water. Do not exceed the marked limits of the cleaned area when wiping beyond the range marked with alcohol.

b) Mark a second area inside the first area that is slightly longer than the area to be scraped or peeled.

Clean the second marked area again with isopropyl alcohol prior to scraping, being careful not to remove the marking. Discard the cloth/wipe after cleaning and do not reuse it.

c) Mark the pipe surface at regular intervals or a cross pattern to check for missing scraping.

d) Make sure that the markings dry before scraping or peeling the pipes and that the scraping tool does not touch the surfaces that have not been cleaned previously. Avoid shavings produced by the peeler from winding around pipe. In this case, contaminates that have not been removed during the initial cleaning may be redispersed. Break the tailings away frequently as needed.
The best practice is to physically mark a scraping depth indicator mark, or witness mark, on the pipe surface at intervals to ensure that the entire circumference is properly scraped or peeled. This mark scribes the pipe surface to the depth of at least 0.006" while not removing more than 10% of the pipe wall thickness. When at least 0.007" has been scraped, it is visual evidence that the pipe surface has been properly removed as the witness mark has been removed.
When using the peeling type scraping tools, you can also measure the effectiveness of the scraper by measuring the ribbons that come off the pipes. Using approved and validated peeling tool, peel the pipe at least 0.007" of the outer surface. The oxidation layer of the pipe will be removed with surface contaminants that prevent melting.

D. Scraping and Peeling

Scraping and peeling are probably the most important and least understood aspect of making an appropriate electrofusion joint. Improper pipe preparation is major cause of unsuccessful electrofusion joint attempts, as the installer may not fully understand the goal of pipe scraping to remove a thin layer of outer pipe surface and expose clean virgin material beneath.
The extrusion process, transportation, handling and outdoor UV exposure can cause surface oxidation to the pipe surface. Surface oxidation is a chemical reaction that results in physical changes in the molecular structure of polymer chains on the pipe surface. Since oxidation acts as a physical barrier, these surfaces cannot be heat fused. Oxidation cannot be wiped away with any cleaner. Roughing or scratching the pipe surface is not enough. Oxidation layer must be removed for successful fusion. Even new pipe can have surface contamination, so it should be properly scraped or peeled before proceeding of fusion.
Certain contaminants such as hydrocarbon and very fine particulates such as those contained in drilling fluid may not be easily removed by cleaning and can only be removed by scraping or peeling because they are not readily visible from the piping surface.
The outer oxidation layer of pipe surface is very thin. It does not increase in depth more than a few thousandths of an inch even over long periods of outdoor exposure, so regardless of the amount of time the pipe has been stored before scraping, the scraping depth requirement is same. A minimum amount of material that must be removed is just seven one-thousandths of an inch (0.007"). That thickness is approximately the same as two sheets of paper.
Always identify areas of unprocessed pipe surface by using witness mark. Make sure that the marking is completely dry before scraping. Use a permanent marker to mark the fitting position on the pipe as described in the Marking section. This mark indicates the surface of the pipe to be scraped or peeled off to remove contamination and oxidation. As a visual indicator, it is recommended to mark the entire fitting location or the circumference of the pipe with lines in a horizontal and vertical criss-cross pattern. These witness marks serve as visual indicators during scraping, as all remaining marks on the pipe after scraping are evidence that pipe surface material has not been removed by scraping.
The approved tools for electrofusion are tools that cleanly remove the material. Tools of the peeler type that remove continuous and measurable ribbons from the pips surface are preferred scraping tools and should be used as far as possible. The ribbon thickness can be measured to verify that the tool works as designed and continuously peeled ribbon ensure that the entire circumference of pipe is peeled.
Most of fusion failures may have been caused by improper or inadequate pipe scraping. If peeler is available for the fitting being installed, the use of hand tools should be avoided. Regardless of the tools being used, ensure that the tools operate properly and that the pipe surface is free of greases or other potential contaminants. It is recommended that you make sure that the installation tool works properly before each use. Peeler blades must

not be damaged. Damaged or dull blades that cannot peel the pipe should be replaced. Check rollers and guides of tools that do not progress properly along the pipe. When using the peeler, make sure that there are no missed or skipped areas on the pipe.
Grinder, sandpaper, utility/emory cloth, wood rasps and metal files are never allowed and may lead fusion failure.

5) Clamping

Assembly clamps are always required for saddle fusion to secure the fitting to the pipe using the correct pressure in the correct position. Assembly clamps for couplings are also required to prevent bending, binding, or movement of fusion area. Ideally, you may feel a looseness between the clamps in the pipe before joining. Assembly clamps also protect the joint against accidental movement that interferes with the joint during the cooling cycle. Clamps also have the advantage of holding re-rounding of pipe end. The primary goal is to ensure that the pipe and fitting assembly are stable, free of external stress, and immobile until the cooling time has been achieved.
Clamps for couplings and reducers are designed to align and secure the pipe ends on both sides of the coupling. The coupling itself is not clamped and is free between the clamps.
Clamps are always required when fusion saddles. Clamps provide the necessary attachment to the pipe and resist melt expansion to achieve the intended melt pressure on the pipe. Saddle clamps may be reusable external mechanical clamp or an integrated and permanent bolt-on clamp or strap. The underclamp is a clamp that pulls the fitting base to the pipe. The top loading clamp is a clamp that pushes the fitting onto the pipe. Each saddle fitting has a specific clamp designed and certified for use. Replacement is not allowed and may result in failed fusion attempts.
Ensure that mechanical clamp position is centered on the fitting and that underpart is correctly bolted to ensure that the clamp is uniform.
During fusion and cooling of saddle fittings, external forces from service lines, valves and heavy accessories must be blocked or supported.
If possible, do not connect the service line to the outlet before fusing the saddle to the main pipe. If the 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. If necessary, use the shoring or support to prevent external forces.
Do not hold the fitting by hand to fuse a saddle to the main pipe.
Do not use hose clamps, rachet straps, or other fasteners that are not suitable or intended for use with the saddle design.
Do not support the weight of pipes, valves or accessories with only saddles.
If cribbing or pipe stand are used to support the pipeline while an electrofusion joint is being made, ensure that the supports are positioned on either side so that no weight is being supported by the electrofusion fitting and that no bending stress is exerted on the joint area.

6) Cooling

It is important to comply with the cooling time properly. In 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. Because the material is cooled and recrystallized 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 generally expressed in three different terms. Clamping time is the minimum time that the fitting should remain clamped after the fusion cycle is completed. This is displayed in the control box. Time before pressure test & tapping is the minimum time before the joint can be pressurized to 150% of MOAP and the main can be tapped. Total cooling time means the minimum time before the joint can be subjected to forces such as pulling, lifting or back filling.

Cooling Time Reference (Couplings)

Size	Fusion Time (seconds)	Cooling Time		
		Clamping Time (minutes)	Total Cooling Time(pressure) (minutes)	Total Cooling Time(rough) (minutes)
1/2" CTS	40	5	15	30
3/4" IPS	40	5	15	30
1" CTS	45	10	20	30
1" IPS	50	10	20	30
1-1/4" IPS	45	10	20	30
2" IPS	60	10	20	30
3" IPS	120	10	20	35
4" IPS	180	10	20	35
6" IPS	440	20	40	45
8" IPS	500	20	40	45
12" IPS	900	30	60	60
16" IPS	750/750	20/20	40/40	60/60

Cooling Time Reference (90 Elbows)

Size	Fusion Time (seconds)	Cooling Time		
		Clamping Time (minutes)	Total Cooling Time(pressure) (minutes)	Total Cooling Time(rough) (minutes)
1" CTS	45	10	20	30
2" IPS	60	10	20	30
3" IPS	120	10	20	30
4" IPS	180	10	20	30
6" IPS	440	20	40	45
8" IPS	500	20	40	45
12" IPS	900	30	60	60
16" IPS	750/750	20/20	40/40	60/60

Cooling Time Reference (45 Elbows)

Size	Fusion Time (seconds)	Cooling Time		
		Clamping Time (minutes)	Total Cooling Time(pressure) (minutes)	Total Cooling Time(rough) (minutes)
2" IPS	60	10	20	30
3" IPS	120	10	20	30
4" IPS	180	10	20	30
6" IPS	440	20	40	45
8" IPS	500	20	40	45
12" IPS	900	30	60	60
16" IPS	750/750	20/20	40/40	60/60

Cooling Time Reference (Endcaps)

Size	Fusion Time (seconds)	Cooling Time		
		Clamping Time (minutes)	Total Cooling Time(pressure) (minutes)	Total Cooling Time(rough) (minutes)
1" CTS	40	5	15	30
1" IPS	40	5	15	30
2" IPS	60	10	20	30
3" IPS	100	10	20	35
4" IPS	120	10	20	35
6" IPS	140	10	20	45
8" IPS	500	20	40	45
12" IPS	750	20	40	60
16" IPS	750	20	40	60

Cooling Time Reference (Tees)

Size	Fusion Time (seconds)	Cooling Time		
		Clamping Time (minutes)	Total Cooling Time(pressure) (minutes)	Total Cooling Time(rough) (minutes)
3/4" IPS	40	5	15	30
3/4" IPS x 1/2" IPS	40	5	15	30
1" IPS x 1/2" IPS	50	10	20	30
1" IPS x 3/4" IPS	50	10	20	30
2" IPS	50	10	20	30
2" IPS x 1/2" IPS	60	10	20	30
2" IPS x 3/4" IPS	60	10	20	30
2" IPS x 1" IPS	60	10	20	30
2" IPS x 1-1/4" IPS	60	10	20	30
3" IPS	120	10	20	35
3" IPS x 1/2" IPS	120	10	20	35
3" IPS x 3/4" IPS	120	10	20	35
3" IPS x 1" IPS	120	10	20	35
3" IPS x 1-1/4" IPS	120	10	20	35
3" IPS x 2" IPS	180	10	20	35
4" IPS	180	10	20	35
4" IPS x 1/2" IPS	180	10	20	35
4" IPS x 3/4" IPS	180	10	20	35
4" IPS x 1" IPS	180	10	20	35
4" IPS x 1-1/4" IPS	180	10	20	35
4" IPS x 2" IPS	180	10	20	35

4" IPS x 2-1/2" IPS	180	10	20	35
4" IPS x 3" IPS	180	10	20	35
6" IPS	440	20	40	45
6" IPS x 3/4" IPS	440	20	40	45
6" IPS x 1" IPS	440	20	40	45
6" IPS x 1-1/4" IPS	440	20	40	45
6" IPS x 2" IPS	440	20	40	45
6" IPS x 3" IPS	440	20	40	45
6" IPS x 4" IPS	440	20	40	45
8" IPS	500	20	40	45
8" IPS x 4" IPS	500	20	40	45
8" IPS x 6" IPS	500	20	40	45
12" IPS	500	30	60	60
12" IPS x 4" IPS	500	30	60	60
12" IPS x 6" IPS	500	30	60	60
12" IPS x 8" IPS	500	30	60	60

Cooling Time Reference (Reducers)

Size	Fusion Time (seconds)	Cooling Time		
		Clamping Time (minutes)	Total Cooling Time(pressure) (minutes)	Total Cooling Time(rough) (minutes)
3/4" IPS x 1/2" CTS	40	5	15	30
3/4" IPS x 1" CTS	40	5	15	30
1" CTS x 1/2" CTS	40	5	15	30
1" IPS x 1/2" CTS	40	5	20	30
1" IPS x 3/4" IPS	50	10	20	30
1" IPS x 1" CTS	50	10	20	30
2" IPS x 1" IPS	50	10	20	35
2" IPS x 1-1/4" IPS	60	10	20	35
4" IPS x 2" IPS	140	10	20	35
4" IPS x 3" IPS	140	10	20	35
6" IPS x 4" IPS	300	20	40	35
8" IPS x 6" IPS	440	20	40	45
12" IPS x 6" IPS	750	20	40	60
12" IPS x 8" IPS	750	20	40	60

Cooling Time Reference (Tapping Tee)

Size	Fusion Time (seconds)	Cooling Time		
		Clamping Time (minutes)	Total Cooling Time(pressure) (minutes)	Total Cooling Time(rough) (minutes)
1-1/4" CTS x 1" CTS	50	10	20	30
1-1/4" CTS x 1" IPS	50	10	20	30
1-1/4" CTS x 1-1/4" IPS	50	10	20	30
1-1/4" IPS x 3/4" IPS	50	10	20	30
1-1/4" IPS x 1" CTS	50	10	20	30
1-1/4" IPS x 1" IPS	50	10	20	30
2" IPS x 1/2" CTS	90	10	20	35
2" IPS x 3/4" IPS	90	10	20	35
2" IPS x 1" CTS	90	10	20	35
2" IPS x 1" IPS	90	10	20	35
3" IPS x 1/2" CTS	90	10	20	35
3" IPS x 3/4" IPS	90	10	20	35
3" IPS x 3/4" IPS	90	10	20	35
3" IPS x 1" IPS	90	10	20	35
4" IPS x 3/4" IPS	90	10	20	30
4" IPS x 1" CTS	90	10	20	30
4" IPS x 1" IPS	90	10	20	30
6" IPS x 1/2" CTS	90	10	20	30
6" IPS x 3/4" IPS	90	10	20	30
6" IPS x 1" CTS	90	10	20	30
6" IPS x 1" IPS	90	10	20	35
8" IPS x 3/4" IPS	200	10	20	35
8" IPS x 1" CTS	200	10	20	35
8" IPS x 1" IPS	200	10	20	35
12" IPS x 1" CTS	320	20	40	45
12" IPS x 1" IPS	320	20	40	45
HV 2" IPS x 1-1/4" IPS	90	10	20	35
HV 2" IPS x 2" IPS	90	10	20	35
HV 2" IPS x 2" IPS	120	10	20	35
HV 3” IPS x 2” IPS	120	10	20	35
HV 4” IPS x 1-1/4” IPS	120	10	20	35
HV 4” IPS x 2” IPS	120	10	20	35
HV 6” IPS x 1-1/4” IPS	120	10	20	35
HV 8” IPS x 1-1/4” IPS	120	10	20	35
HV 8” IPS x 2” IPS	120	10	20	35
HV 12” IPS x 1-1/4” IPS	400	20	40	45
HV 12” IPS x 2” IPS	400	20	40	45

Cooling Time Reference (Repair Saddle)

Size	Fusion Time (seconds)	Cooling Time		
		Clamping Time (minutes)	Total Cooling Time(pressure) (minutes)	Total Cooling Time(rough) (minutes)
4” IPS	500	20	40	45
6” IPS	500	20	40	45
8” IPS	750	20	40	45
10” IPS	750	20	40	60
12” IPS	750	20	40	60

Cooling Time Reference (Branch Saddle)

Size	Fusion Time (seconds)	Cooling Time		
		Clamping Time (minutes)	Total Cooling Time(pressure) (minutes)	Total Cooling Time(rough) (minutes)
2" IPS x 2" IPS	120	10	20	30
3" IPS x 2" IPS	120	10	20	30
4" IPS x 2" IPS	120	10	20	30
4" IPS x 4" IPS	500	20	40	45
6" IPS x 2" IPS	120	10	20	45
6" IPS x 4" IPS	500	20	40	45
6" IPS x 6" IPS	750	20	40	45
8" IPS x 4" IPS	500	20	40	60
8" IPS x 6" IPS	750	20	40	60
8" IPS x 8" IPS	750	20	40	60
10" IPS x 4" IPS	500	20	40	60
10" IPS x 6" IPS	750	20	40	60
12" IPS x 2" IPS	400	20	40	60
12" IPS x 4" IPS	500	20	40	60
12" IPS x 6" IPS	750	20	40	60
12" IPS x 8" IPS	750	20	40	60

7) Control Box and Power Requirement

- Control Box

The electrofusion control box performs an important function during the fusion process. The control box provides a carefully regulated voltage for the required fusion cycle time, providing the correct amount of energy for the fittings. During the fusion process, the control box can also monitor the power supply to the fittings and detect certain assembly or fitting errors, such as power supply fluctuations and heating coil disconnection or short stabbed pipe ends.

Each history of fusion attempts is stored in the control box memory and can be viewed on the display or downloaded over a USB connection. Records include information about the fitting that was fused, prescribed fusion parameters, the ambient temperature conditions at the time of fusion, GPS location, fusion operator details, fusion cycle termination reasons, and ASTM F2897 tracking and traceability codes for the pipe and fitting.

If any defined protocol is out of range, the control box will terminate a fusion process and will display an error message. The list of error message definitions is attached to the unit for reference if an error occurs.

When using the joint barcode, the control box checks the ambient air temperature and automatically adjusts the fusion time of the joint barcode if necessary.

Adjustment of the fusion time for higher or lower ambient temperature is called “temperature compensation”. Although not all fittings require temperature correction, all barcodes contain two characters that define whether the function is enabled or disabled. Fittings that require temperature compensation do not include a resistor pin and have no fusion voltage or time printed on the label. The fusion voltage and fusion time are replaced by “TC”. For fittings with TC on the label, always use the barcode supplied with the fitting.

Allow the control box acclimate to the work-site weather conditions for a minimum of 15 minutes to accurately measure ambient temperature before starting the fusion process.

The control box fusion cable tip can be changed or adapted to match the connecting pin size of electrofusion fitting.

The AC power control box must be calibrated regularly every two years to ensure that all monitored parameters are accurately measured and that control box is functioning normally. Devices that have expired calibration notify the operator that maintenance has expired at power-on, but will continue to operate when the operator press the green “Start/OK” button.

- Power Requirements

The control box is available in 115V or 230V versions and has a power cable connection sized to suit the maximum current usage of the generator or inverter. Table in below provides minimum power requirements by fitting type and size. The power cable connectors should not be replaced with any lower-rated components.

The control box monitors the energy input from the power source to ensure that fluctuations from the generator are within the operating range and alerts the installer when parameters are out of range. The control box is tolerant to small fluctuations in input voltage or frequency, however all generators or inverters are not same with it. In the event of an error during the fusion cycle, the cause is often found in the power supply if the electrofusion assembly is correctly installed. It is important to ensure that the power supply is operating normally, there is sufficient fuel to operate during the intended fusion time, and that it can supply the energy required to fused.

Power Requirements

Fitting Type	Fitting Size	Generator Minimum(W)	Breaker Minimum 115V/240V	Extension Cord 25ft.	Extension Cord 50ft.
Coupling	1/2” to 8”	3500	15/15 AMP	#10/3	#8/3
Coupling	10” to 12”	6000	30/20 AMP	#10/3	#8/3
Saddle	ALL	3500	15/15 AMP	#10/3	#8/3

Do not start or stop the generator with the control box connected.
Extension cords can be used, but the wire gauge must not be less than the maximum length shown in above table. Length of the extension cord affects the voltage drop. Voltage drop is the result of friction or resistance through a long wire. Use the shortest extension cord possible.
The rated capacity of the generator is generally less than the maximum generator capacity. Use the lower of the two specified capacities to determine suitability for use. Capacity may be further reduced depending on the life and condition of the generator. The generator governor control must be switched off and the generator must be operated at full speed before fusion begins to provide a constant generator electrical output. Users should verify and qualify the output of generator as required to ensure it functioning correctly. Generator performance can be verified by the test such as load bank generator test.

- Fusion Parameters

Control boxes can be operated by four different parameter input methods.

A. Auto ID – This method reads the resistance built into one of the terminal pins of most fittings. The cable lead with the red banding indicates resistance pin readers. The control box reads the resistance and automatically sets the fusion parameters for that fitting.

B. Barcode scanner – The fusion barcode supplied with each fitting contains a fusion parameter required to fuse the fittings. Scanning the barcode identifies fittings to the control box and sets fusion parameters for those fittings, including temperature compensation variables.

C. Manual Barcode entry – Each barcode consists of 24 digits. The 24 digits are printed under the barcode. If the barcode cannot be scanned, the 24 digits can be manually entered into the control box by the touch pad.

D. Manual time and voltage entry – you can manually enter the fuse voltage and fuse time in seconds for the fitting.

All fittings also contain a 16-character ASTM F2897 tracking and traceability barcode. This barcode is a different format from the fusion parameter barcode and cannot be used as a scan or manual character input method in the control box while the control box is in the fusion parameter entry sequence. If the tracking code input sequence is enabled in the control box, the installer is prompted to scan the ASTM F2897 barcode.
Barcodes should be kept as clean and flat as possible.
Barcode Wands – These devices are handheld pens with a light source at the tip. The wand must maintain an angle of 10 to 30 degrees relative to the barcode. Place the wand on the barcode starting in the white area and scan the barcode ending in the white area on the opposite side. The control box beeps when the barcode is recognized.
Barcode Scanners – Pull the trigger when the barcode is ready to be scanned. The scanner emits a circular red light on the barcode to aid in aiming. When the barcode is approved, the light turns green and a tone is emitted from the control box.

Gap between pipe and square

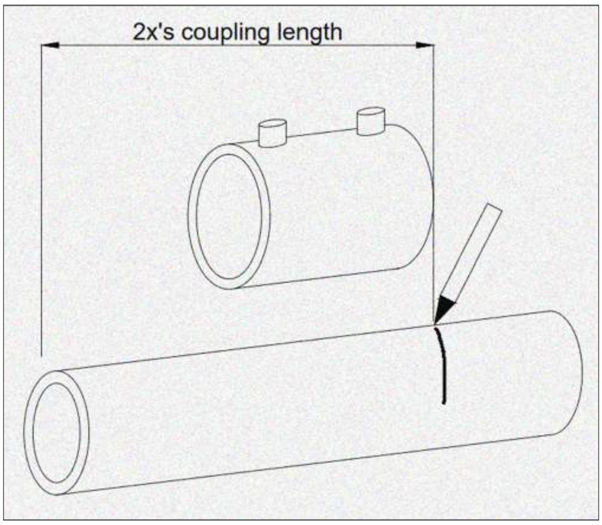
8) Electrofusion Procedures

- Coupling installation

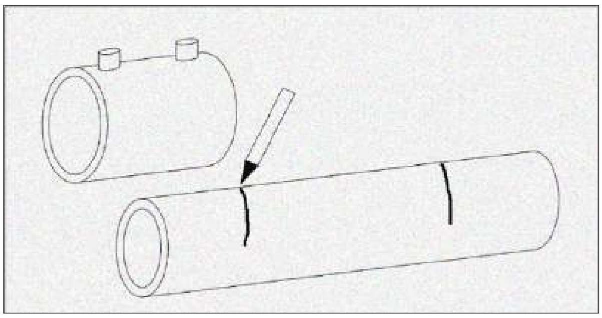
A. Wash the end of the pipe to remove mud, dust or other debris. For more information, refer to the “Cleaning” of Pipe handling section of this manual. For this initial cleaning, the end of each pipe should be marked and cleaned with an area two to three times the length of the electrofusion coupling. Water and clean cloth are available for this step. Dry the pipe and remove any embedded material on the pipe surface by inspection.

B. Cut the end of the pipe into squares. Pipe cutters are preferred.

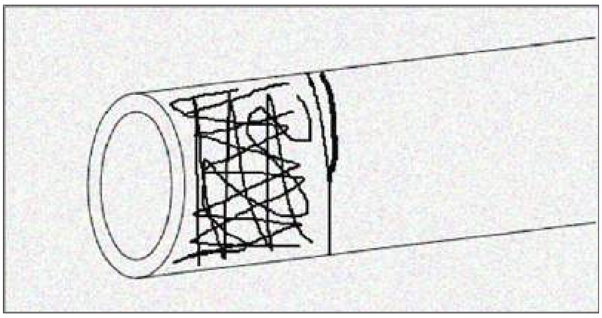
C. Mark the end of the pipe at least twice the length of the coupling. This mark indicates the length limit of the cleaned pipe surface that should not be exceeded during wiping with alcohol in later steps. The purpose of this mark is to prevent wipe from contacting the surface of the uncleaned pipe and contamination from spreading to the surface of the pipe that has already been cleaned. Clean this area with isopropyl alcohol and wipe in one direction only to avoid crossing the boundary of the marked area. Allow the pipe to dry. Discard the wipe and do not reuse.



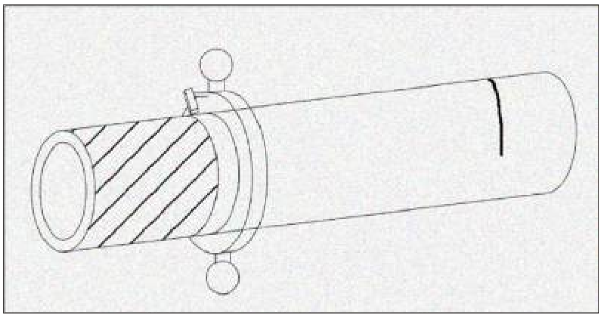
D. Make a second mark 1/2 inch longer than stab depth to be fused, based on the bagged fitting or using a tape measure. This mark indicates the length of the scrape or peel to ensure that only the peeled or scraped pipe touches the coupling inner surface. It is recommended to scrape or peel off slightly longer than required length as visual evidence of inspection.



E. Scribe witness marks on the pipe surface or mark the area to be scraped or peeled in a criss-cross pattern.

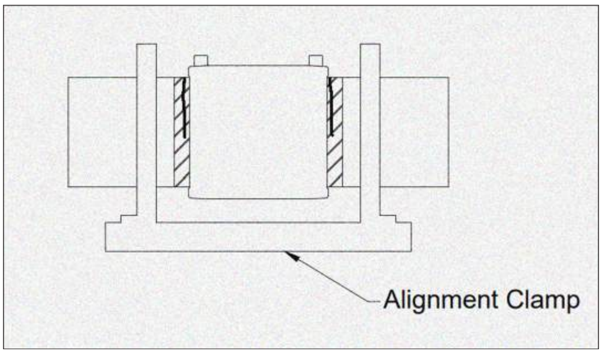


F. Remove the pipe surface layer by scraping or peeling to expose the clean virgin pipe material. Break shavings or remove them as needed to prevent them wrapping around the scraped or peeled pipe surface.



G. Thoroughly inspect the scraped or peeled pipe surface to ensure all marks are removed and only virgin pipe surface is exposed. Remark the stab depth onto the pipe end. This mark provides a visual indication that the end of pipe is fully inserted into the center of coupling.

H. Insert the end of pipe into the coupling, up to the stab depth mark. Secure the pipe and fitting assembly to the alignment clamp.



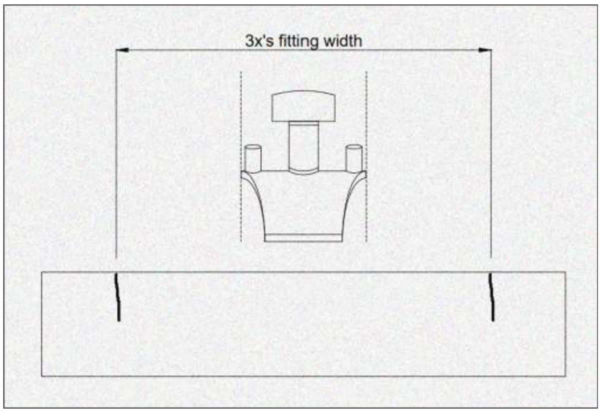
I. Connect the control box leads to the fitting, verify that the proper fusion time and voltage are displayed on the control box, and fuse the joint. Do not leave the fusion unattended.

J. Do not move or disturb the joint for the minimum cooling time indicated in the control box after the fusion cycle has been completed. The control box can be disconnected from the fitting at this time. Mark the amount of time the clamp can be removed. Mark the joint location with any other information required by the pipeline owner.

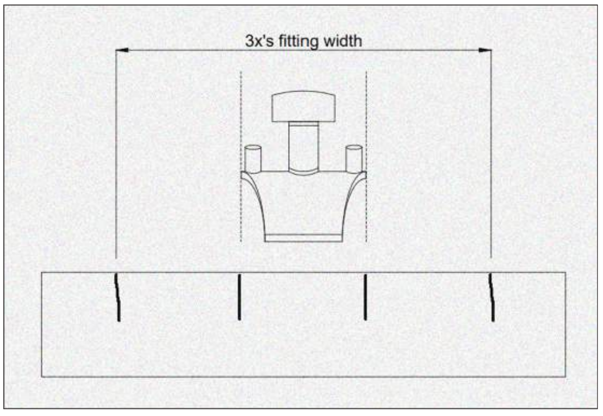
K. Pressure test and backfill only after the minimum cooling time required for the fittings has been reached.

– Saddle Installation

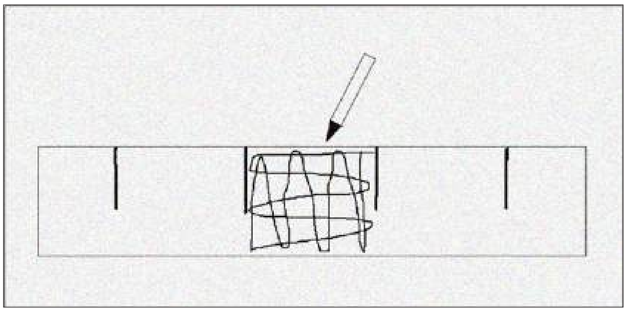
A. Mark at least three times the width of the saddle base on the pipe, centering on the intended fusion position between the marks. These marks indicate the length limit of cleaned pipe surface that should not be exceeded when wiping with alcohol in later steps. The purpose of this mark is to prevent wipe from contacting the surface of the uncleaned pipe and contamination from spreading to the surface of the pipe that has already been cleaned. Clean this area with isopropyl alcohol and wipe in one direction only to avoid crossing the boundary of the marked area. Allow the pipe to dry. Discard the wipe and do not reuse.



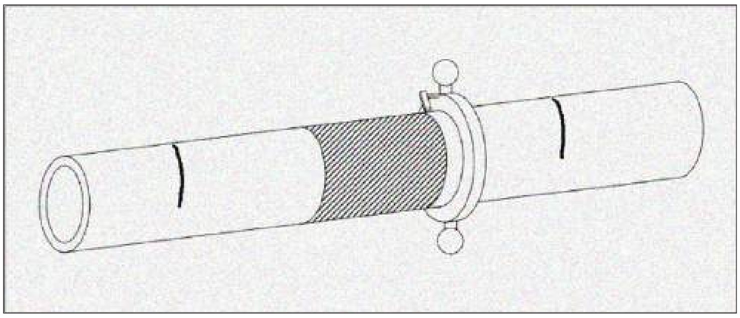
B. Mark slightly larger than the width of saddle to be installed. These marks indicate the scrape or peel length required to ensure that only scraped or peeled pipe touches the saddle fusion surface. It is recommended to scrape or peel slightly longer than required outside the fusion zone as visual evidence that proper preparation has been made.



C. Scribe witness marks on the pipe surface, or mark the area to be scraped or peeled in a criss-cross pattern.



D. Remove the surface layer by scraping or peeling the pipe to expose the clean virgin pipe surface.



E. Thoroughly inspect the scraped or peeled pipe surface to ensure all marks are removed and only virgin pipe surface is exposed. Remove the saddle from the bag and place it on the surface of the scraped or peeled pipe. Secure the pipe and saddle fitting assembly using a suitable clamping device.
F. Connect the control box leads to the fitting, verify that the proper fusion time and voltage are displayed on the control box, and fuse the joint. Do not leave the fusion unattended.
G. Do not move or disturb the joint for the minimum cooling time indicated in the control box after the fusion cycle has been completed. Mark the amount of time the clamp can be removed. Mark the joint location with any other information required by the pipeline owner.
H. Pressure test, tap, and backfill only after the minimum cooling time required for the fitting has elapsed.

- Re-fusion

If the fusion cycle is not completed due to an incorrect assembly or fitting fault, the fusion cycle must be refused. Refer to the Operating and Manufacturing guidance from your company to see if you can restart the fusion. If prohibited, follow the O&M guidance.
The fitting can be only refused if input power is interrupted. These events are typically associated with generator power loss to the control box or unintentional disconnection of the fusion cable from the fitting during the fusion cycle. Any defective fittings due to other termination causes should be removed or discarded and replaced with new fittings.

Re-fusion Procedure:
A. Allow the fitting and pipe assembly to cool completely same with ambient temperature. This cooling period depends on the size and style of the fitting and can take up to several hours. Heat is not transferred to the fitting surface immediately after the fusion attempt, so that it may feel cool to the touch. After the fusion is completed, wait a few minutes for internal heat to move to the fitting surface before checking the fitting temperature.
B. Using a pyrometer, verify that the fitting and surrounding pipe temperatures are equal to temperatures of the pipe at least two feet away from the fitting.
C. Re-fuse for the entire fusion cycle defined for the fitting. Do not attempt to reduce the time based on the first fusion attempt.

- Tapping

After sufficient cooling on the pressurized pipe, the electrofusion tapping tee can be tapped. The tapping tee contains a cutter that can be threaded downward by using the appropriate tapping tool until it pierces the main pipe and removing the cap. The tapping tool has stop indicators that provide a maximum cutter depth. The cutter retains the pipe coupon and is retracted to its final service position at the top of the tapping tee chimney. Do not remove the cutter from the tapping tee. For a service tee, the cutter should be located at the same height as the top of the fitting chimney. For large size tapping tee (1-1/4" or 2" IPS outlet), the cutter should be located in contact with the upper O-ring seal as described in the following instruction. Replace the cap by hand tightening only.

Cap O-rings are lightly coated with a dry film lubricant to prevent possible contamination of the fusion surface during manufacturing. Additional lubrication of the cap O-ring after the fusion process has been carried out is an acceptable practice and can be beneficial in initial seal.

Do not tighten the threaded caps with a wrench. Wrenches can cause overtightening and long-term failure of the plastic threads. Tighten with your hands only.

Do not exceed the maximum cutter depth of the tapping tool stop. The cutter can bottom out and strip fitting threads.

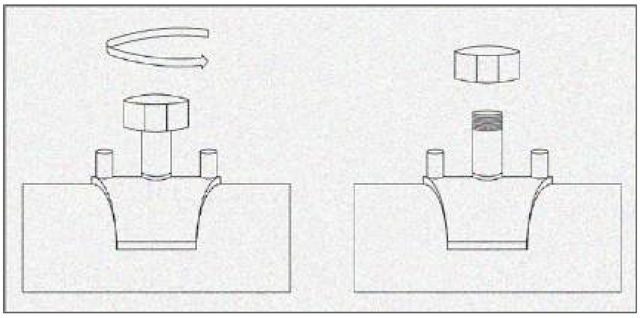
Do not tap using power tools. Excessive heat from friction can cause the fitting threads to melt or strip.

Do not remove the self-tapping cutter from the fitting. Removing cutter while the system is pressurized may result in personal injury or leakage of pipeline.

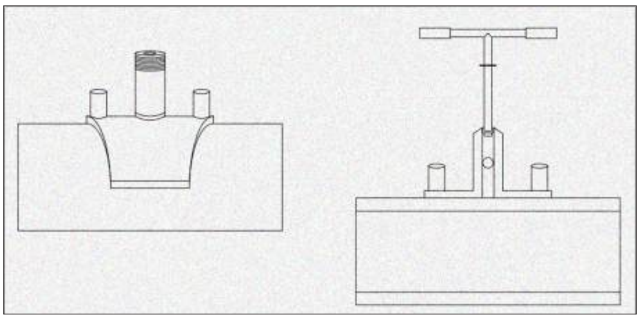
When working in a flammable gaseous environment, follow all safety rules and protocols for grounding and static discharge.

- Service Tapping Tee:

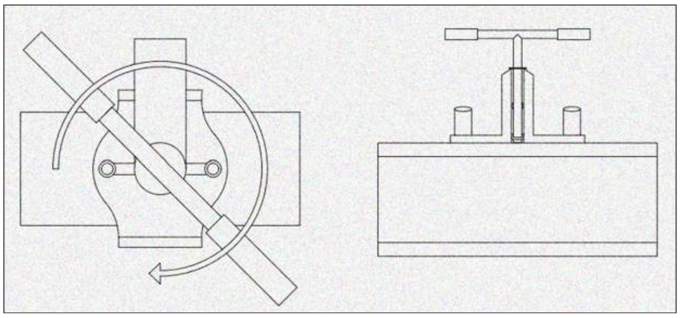
A. Remove the cap to expose punch.



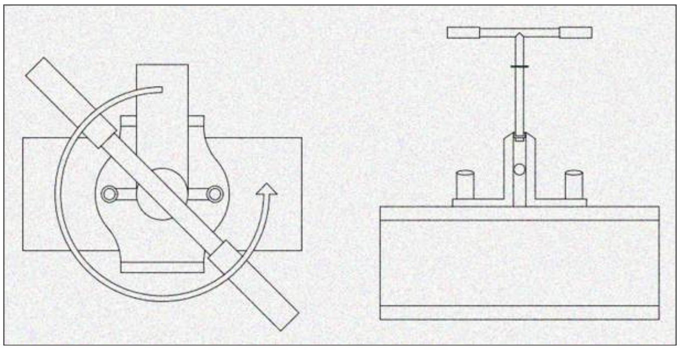
B. Insert tapping tool into punch.



C. Rotate the tapping tool clockwise until the stop is reached. Apply equal rotational force to the handle and avoid lateral pressure. Do not continue to rotate the punch after the stop has been reached.



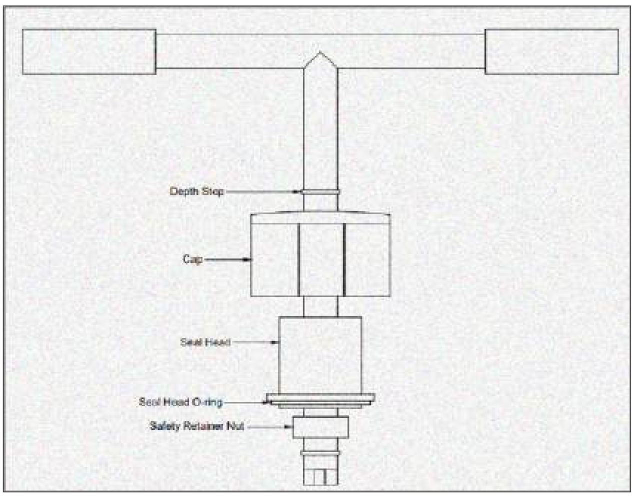
D. Punch upward by rotating counter-clockwise until the punch is level with the top of the fitting chimney. Do not remove punch from chimney.



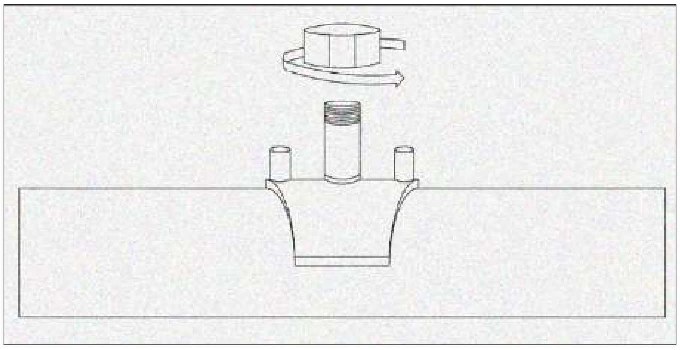
E. Remove the tapping tool. If necessary, lubricate the cap and chimney O-ring and replace the cap. Tighten cap hand tight only, do not use wrenches. Check for leaks per normal procedures.

- High volume tapping tee:

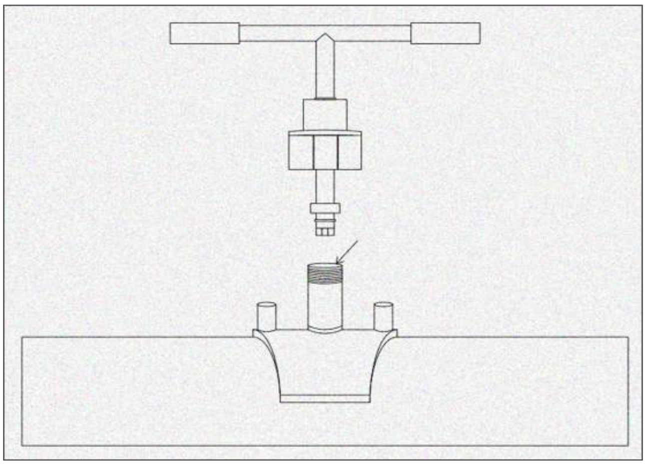
A. Inspect the tapping tool to ensure that the parts are free to move and are not damaged. Inspect the seal head to ensure that the O-ring is in place and in good condition. This O-ring must always be in place and sealed. Otherwise, the punch seal O-ring will be replaced and will not be sealed in the final steps. If the seal head O-ring is missing, the O-ring on the fitting cap is the same size and can be used during tapping.



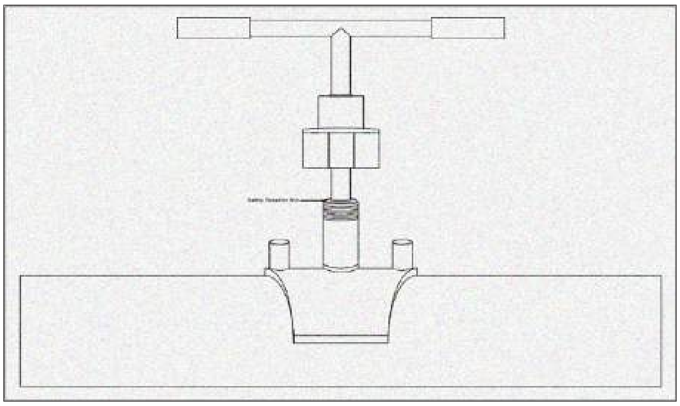
B. After fusion is completed and properly cooled and pressure tested, remove the cap to expose the tapping tee punch.



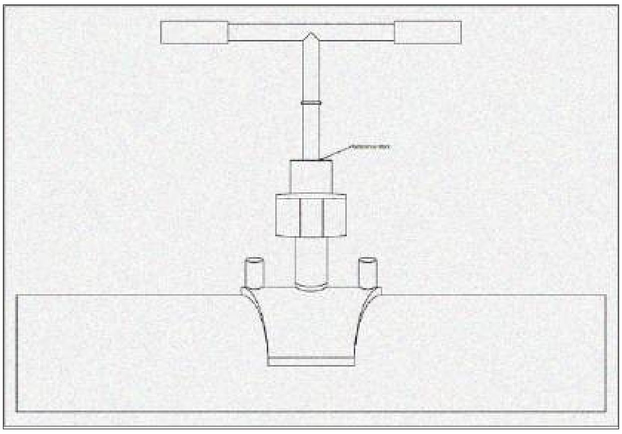
C. The punch is located in the center of the outlet bore at the factory to allow for unrestricted flow during pressure testing. It must be moved to the top of the fitting, using the tapping tool hex wrench. Rotate the punch counter-clockwise until the punch is seated against the O-ring inside the tapping tee. Be careful not to pinch or deform the O-ring.



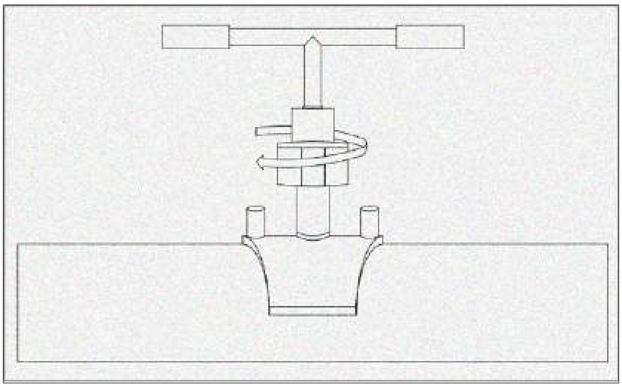
D. Install the safety retainer nut from the tapping tool into the thread on the top of the punch.



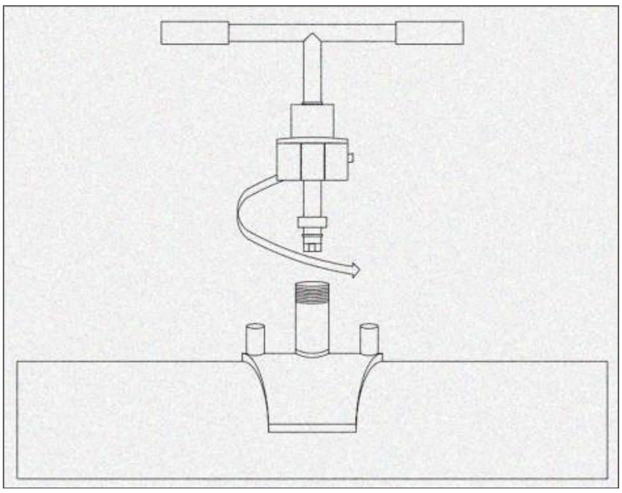
E. Slide the seal head and cap down and thread the cap of the fitting. Tighten the cap firmly by hand. At this point, a reference mark can be made on the tapping tool shaft to indicate when the cutter has returned to its position against the O-ring after the tapping operation has been completed.



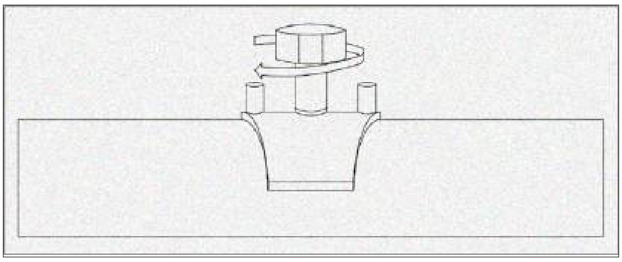
F. Rotate the tapping tool clockwise until it contacts the depth stop ring. After the first few turns, re-tighten the cap as needed and make sure it is firmly seated throughout the tapping process. If you hear a gas leak through the cap, tighten the cap again. When the depth stop was reached, the punch reached the maximum depth and the main has been tapped.



G. Rotate the tapping tool counterclockwise to raise the cutter back to the top of the fitting. Continue to ensure that the cap is tight when lifting the cutter. Rotate the tool until it reaches the stop or reference mark created in step E is visible. Remove the tapping tool. Inspect the O-ring seal against the punch to ensure it is in place and sealed.



H. Replace the tapping tee cap and tighten by hand. Do not use a wrench. Check for leaks per normal procedure.



Attempts to seal the cutter against the internal O-ring while under pressure will fail if the seal head O-ring is missing or the seal head is leaking when the punch makes initial contact with the O-ring. If there is a leak, the O-ring will extrude out of the groove and is caught between the punch and the fitting chimney. To correct a pinched O-ring, back the punch down until the O-ring can be reset into the groove, reinstall the seal head, then return the punch to contact with O-ring.

9) Inspection and Qualification

- Pressure Testing

Hydrostatic pressure testing can be performed in accordance with recommended by the pipe manufacturer or described in ASTM F2164 standard practice for field leak testing of polyethylene (PE) pressure piping systems using hydrostatic pressure, and generally 1.5 times of the rated working pressure not exceeding 8 hours in duration for a single test.

Pneumatic pressure tests can be performed in accordance with the pipe manufacturer's recommendations or described in ASTM F2786 - Field leak test standard practice for polyethylene (PE) pressure piping systems using gaseous testing media under pressure.

When performing pneumatic tests with gaseous media, understand and take appropriate safety measures and exercise caution due to the potential for sudden release of stored energy of compressed gases.

- Recommended training curriculum

We recommend that operators who make electrofusion joints should qualify to a jointing procedure through personal classroom instruction, witnessed application of instructed procedures while making test fusions, and qualification of test fusion through destructive tests. Qualification should be conducted using an electrofusion coupler and saddles independently for the qualification of both methods.

Qualification size range:

Qualifications for using 2" IPS or larger fittings qualifies the installer for all sizes of fittings through 12" IPS.

The frequency of re-qualification may be defined by a pipeline operator or regulatory code. As a best practice, we recommend that installers who have not performed fusion joint within the last 12 months should requalify through a minimum of visual examination and destructive testing before attempting fusions that will be put into service. Failure of any fusion that has been placed into service should be examined and, if found to have been caused by installer procedural error, shall require re-qualification of that installer.

- Destructive tests

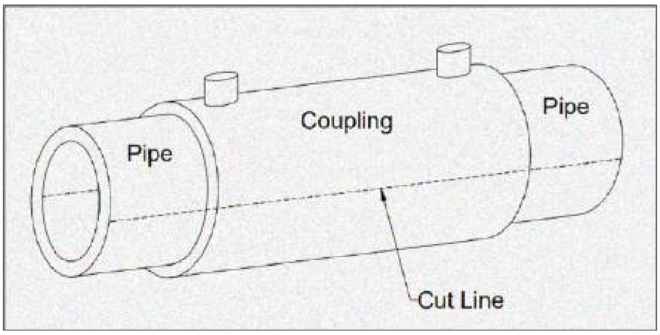
The destructive tests for qualifying fusion joints and fittings are described in section 9 of ASTM F1055. The tests for a coupling are minimum hydraulic burst pressure test, sustained pressure test, tensile strength test and joint integrity test. On the other hand, the destructive tests for saddle joint are minimum hydraulic burst pressure test, sustained pressure test, impact test(F905) and joint integrity test.

Passing results for visual inspection and any one of the above tests on specimen joints for couplings and saddles qualifies the installer to the requirements of Part 192.285.

A. Couplings

The joint evaluation tests are conducted by cutting the pipe and fitting specimen. Bend test, peel test and crush test are useful for finding fusion weaknesses.

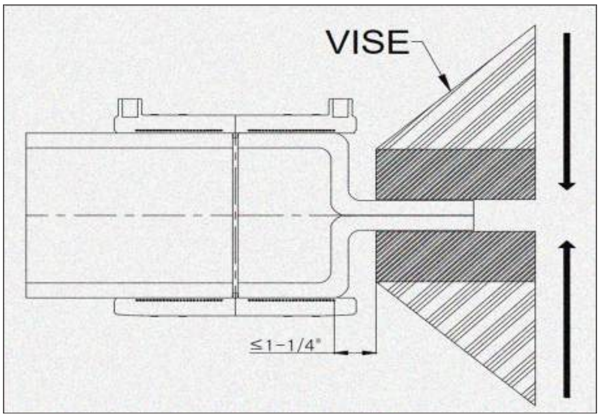
To prepare a specimen for crush testing, the pipe and coupling should be cut in half lengthwise as close to the centerline as possible as shown on the below.



Crush test cut

It is preferred to leave at least 3" of pipe length for 2" and smaller diameter pipes and 8" of pipe length for up to 12" diameter pipes at each end of the coupler for gripping by the vise.

Place a specimen half in a vise or press so that the outermost wire of the fusion zone is approximately 1-1/4" from the vise jaws. Close the vise jaws until the pipe walls meet. Repeat this process for both ends of the coupling.

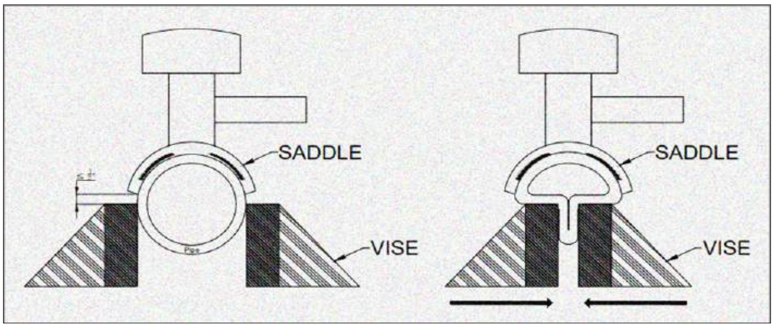


Crush test cut

Inspect the crushed specimen for separation of the fusion joint. Minor separation of fusion interface may be seen in the outermost region of the fusion region, which does not constitute a fault. 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 beyond the 15% at the outermost edges.

B. Saddles

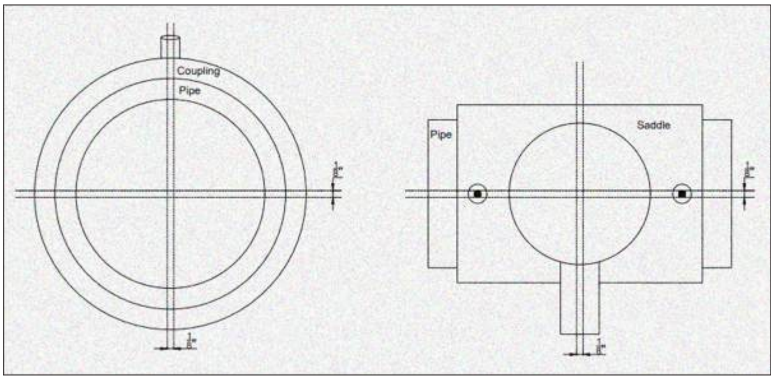
The tapping tee must be left intact for compression testing. The pipe length can be cut to the edge of the fitting base. Place the pipe and fitting into the vise so that the jaws are within 1/2" of the saddle floor. Close the vise until the inner pipe wall meet.



Crush test cut

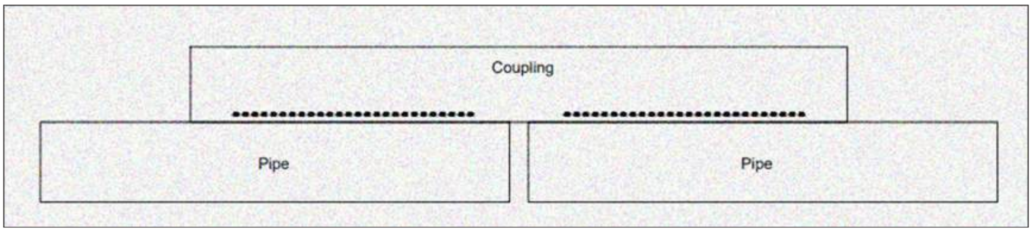
Inspect the crushed specimen for separation of the pipe and fitting to the fusion joint. Minor separation may be seen in the outermost region of the fusion region, which does not constitute a fault. Ductile failure of the pipe, fitting or PE insulation around the wires is acceptable. There should be no separation at the fusion interface of the pipe and fitting beyond the 15% at the outermost edges.

FET test (ASTM F1055 9.4.3): cut the coupling or saddle into four sections as shown below. If desired, cut the socket in half radially along the joint centerline. The pipe extending from the fitting can be reduced to approximately 1" from the fitting edge.

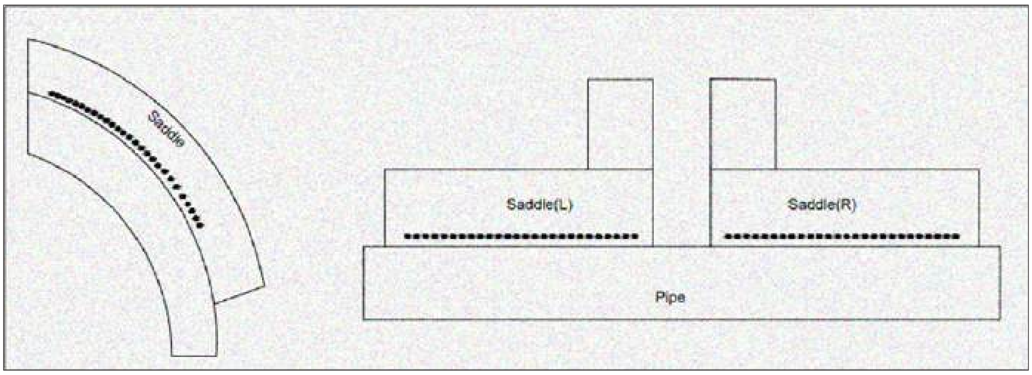


Crush test cut

Cut the FET specimen to a width of approximately 1/16" to 1/8" wide from each fusion or joint half. A minimum of four FET strips must be cut from each end of the coupling and from the saddle spaced approximately 90 degrees apart.

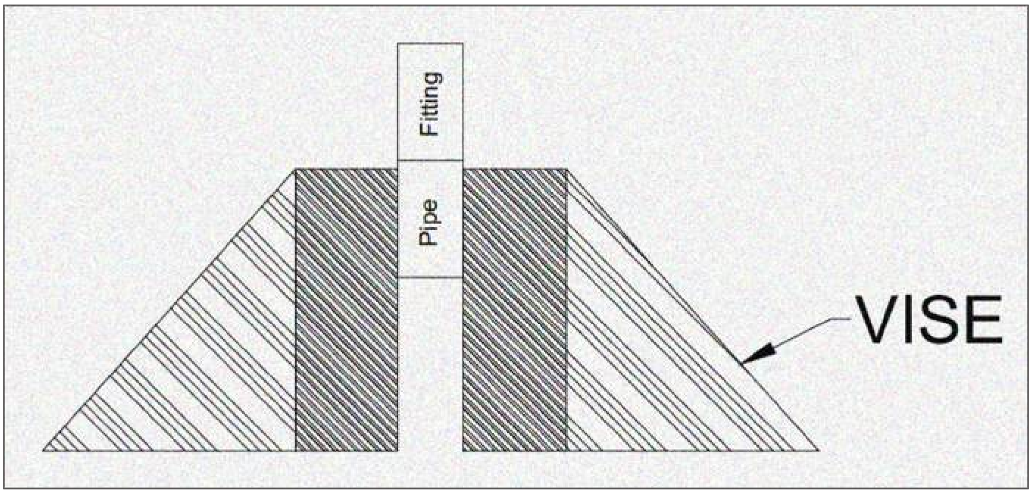


Crush test cut



Saddle specimen

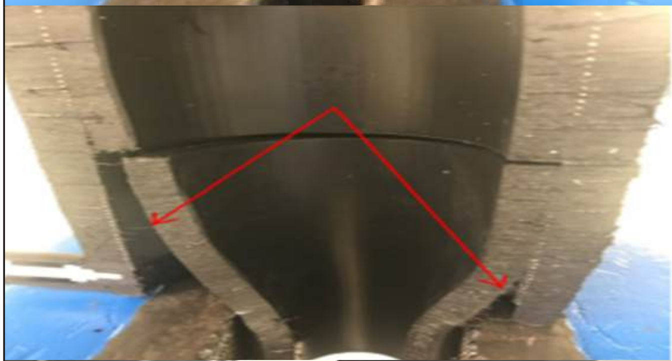
Hold the FET specimen with a vise or clamping device so that the joint line between pipe and fitting is at least 1/16" from the edges of the vise jaws. Flex the specimen four times 90 degrees in both directions so that the bending moment is applied directly along the length of the fusion interface joint line. For small specimens pliers may be used in lieu of a vise as long as the entire length of the fusion is flexed.



FET test

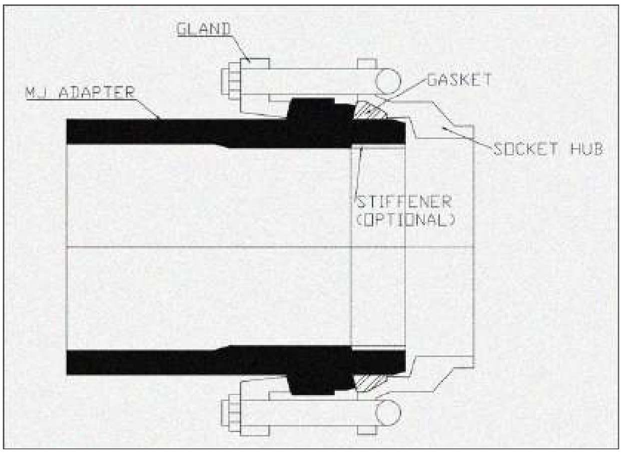
Separation of the specimen along the joint line constitutes failure of the specimen. Some minor separation at the outer limits of the fusion heat source may be seen or there may be voids between wires. This does not constitute failure as long as the void does not exceed 10% of the total fusion length, or in the case of multiple voids, 20% of the total fusion length when combined. Ductile failure in the pipe, fitting, or the wire insulation material is acceptable as long as the joint interface remains intact.

– Images of acceptable and unacceptable destructive test results :

Appearance	Description
	•Coupling Crush Test – Acceptable
	•Coupling Crush Test – Unacceptable
	•Saddle Crush Test – Acceptable
	•Saddle Crush Test – Unacceptable
	•FET Test – Acceptable
	•FET Test – Unacceptable

3. Mechanical Joint Adapter Connection

COSMO I&D MJ Adapters are manufactured in IPS and DIPS standards for connecting polyethylene pipe to mechanical joint pipe, fittings and appurtenances that meet AWWA C111. COSMO I&D MJ Adapters seal against leakage and restrain against pullout. No additional external clamps or tie rod devices are required.



- Alignment

During installation, MJ adapters must be aligned straight to the socket hub before tightening the gland bolts. Do not draw the MJ Adapter into alignment by tightening the gland bolts. If hand-tight gland bolt and nut is fitted, the gap between the socket hub flange and the gland must be the same all around the joint. The difference between the widest gap and the narrowest gap should not exceed 3/16".

- Assembly

A. Ensure that all components are included in the MJ adapter kit. The MJ adapter kit includes a stiffener, gasket, gland, extended-length gland bolts and nuts.

B. Fit the gland over the fusion end of the MJ adapter and slide it to the slope. The gland projection fits against the slope of the adapter.

C. Join the MJ Adapter to polyethylene pipe. When the gland is against the MJ Adapter slope, the butt fusion end of the MJ Adapter is long enough to be clamped in a butt fusion machine and make the butt fusion. Ensure that the joint is properly cooled before handling.

D. Socket hub and end of the MJ Adapter must be clean. Completely remove all rust and foreign material from the inside of the socket hub. Wipe the mating end of the MJ Adapter with a clean, dry cloth to remove all dirt and foreign material.

E. Install the gasket on MJ Adapter. Align the thick section of the gasket with the inside of MJ Adapter slope.

F. Lubricate the gasket, the end of the MJ Adapter, and the inside of the socket hub with an approved lubricant meeting AWWA C111. Do not use soapy water.

G. Insert the MJ Adapter into the socket hub. Make sure it is uniformly and fully fitted in the socket hub. The MJ Adapter and the socket hub must be aligned straight with each other.

H. Insert the gland bolts, and tighten the nuts firmly with your finger.

I. Tighten the gland bolts evenly to 75 – 90 ft-lb. Tighten in torque increment of about 15 – 20 ft-lb each and follow a crossing pattern. Tighten the bottom bolt, then tighten the top bolt, then tighten the bolts of right and left side, and finally the remaining bolts in a crossing pattern from one side to the other. Tighten all bolts through the pattern with one time torque increment, and then increase the torque once more to tighten through the pattern. It is recommended to tighten using a torque-measuring wrenches During tightening, maintain approximately the same gap between the gland and the face of the socket hub flange at all points around the joint.

4. Reference

1) TR-33, Generic Butt Fusion Joining Procedure for Polyethylene Gas Pipe, 2006. Plastics Pipe Institute.
2) TR-41, Generic Saddle Fusion Joining Procedure for Polyethylene Gas Piping, 2002. Plastics Pipe Institute.
3) TN-42, Recommended Minimum Training Guidelines for PE Pipe Butt Fusion Joining Operators for Municipal and Industrial Projects, 2009. Plastics Pipe Institute.
4) ASTM F2620. Standard Practice for Heat Fusion Joining of Polyolefin Pipe and Fittings.
5) ASTM F1056. Standard Specification for Socket Fusion Tools for Use in Socket Fusion Joining Polyethylene Pipe or Tubing and Fittings.
6) Pipeline Safety Regulations. U.S Department of Transportation. CFR 49. Washington, June 2011.
7) ASTM D2513. Standard Specification for Polyethylene(PE) Gas Pressure Pipe, Tubing and Fittings
8) ASTM F1055. Specification for Electrofusion Type Polyethylene Fittings for Outside Diameter Controlled Polyethylene and Crosslinked Polyethylene (PEX) Pipe and Tubing.
9) PP 812-TN. MJ Adapter Connections. Chevron Phillips Chemical Company LP.
10) Images of Butt Fusion Process, McElroy Manufacturing, https://www.mcelroy.com/it/university/whatisbuttfusion.htm

COSMOIND USA

Quality Certification

Quality Certification

All products of COSMOIND has been maintaining KS(Korea Industrial Standards) Certification and ISO 9001 Quality management system through inspection and examination every year by Korea Standard Association which is authorized from government. Through this, We try to produce and supply high quality products to meet our customer's requirements on product design, development, material purchase, production, shipment, and after service.
Also, We keep trying research and develop to provide valuable new products for our customers.

ISO 9001
ISO14001
KSA


PE Valve CE Products Certificate


PE Valve CE System Certificate


NSF Certification Company


NSF Certification Facility


PE Valve China TSG type test report


TUV Certificate PE E/F ASTM F 1055


TUV Certificate PE E/F Gas EN 1555-3


TUV Certificate PE Valve Gas EN 1555-4


TUV Certificate PE E/F Water EN 12201-3


TUV Certificate PE Valve Water EN 12201-4

COSMOIND USA

Head Office and Factory: 12, Eumdammal-gil, Jeonui-Myen, Sejong-Si, Korea
Tel. +82-44-863-2337 **Fax.** +82-44-864-2337
www.cosmoind.com