



**Plexco**®



# Fusion Procedures for Joining PLEXCO® Polyethylene Pipe and Fittings

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This literature is written to assist Field Personnel in the use of PLEXCO procedures for joining PLEXCO polyethylene pipe and fittings by socket, saddle and butt fusion techniques. PLEXCO recommends these techniques as the preferred method for joining PLEXCO polyethylene pipe and fittings.

**PLEXCO POLYETHYLENE PIPING PRODUCTS CANNOT BE JOINED BY SOLVENT CEMENTING. THREADED JOINTS AND JOINTS MADE BY HOT AIR (GAS) OR EXTRUSION WELDING TECHNIQUES ARE NOT RECOMMENDED FOR PRESSURE SERVICE.** If you use compression fittings or other mechanical fittings or electrofusion fittings, instructions should be obtained from the fittings manufacturer.

When you buy the PLEXCO polyethylene piping system, you obtain quality products made to rigid specifications and the selection of socket or butt fittings for pipe sizes 4" IPS and smaller. 6" IPS and larger fittings are butt fusion type only.

This bulletin is intended to be used as a guide for heat fusion techniques for polyethylene pipe. It is not intended to be used as installation instructions, and should not be substituted in place of the advice of a professional design engineer.



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## PLEXCO® Polyethylene Pipe and Fittings for gas distribution, oil and gas gathering, waste water disposal, water, slurries, and other applications.

### Here's What Fusion is All About

PLEXCO Polyethylene Pipe and Fittings are joined by a simple heat fusion procedure. All PLEXCO socket fusions can be done by hand with the prescribed tools. However, it is recommended that fitting holders be used for fitting sizes 3" IPS and larger. Saddle application tools are recommended for applying tapping tees, service saddles and branch saddles. The PLEXCO butt fusion system requires tools for all fusion operations. Clean surfaces, accurate heating iron surface temperature, and a proper melt pattern are keys to a good joint.

### Fusion is Accomplished in Four Simple Steps.

1. Be sure that the surfaces of the fusion tools, pipe, and fittings are free of contaminants prior to use, and properly prepared for fusion.
2. The surfaces to be joined—both the pipe and fitting—are simultaneously heated by the fusion tool at a specified temperature for a specified time.
3. Remove the fusion tool, then bring the melted surfaces together.
4. Hold until solidified. The fusion yields a strong integral joint.

When PLEXCO polyethylene pipe is to be joined to another piping material, a transition fitting may be used to resist pull out forces due to seasonal sub-surface temperature changes or from anticipated external or internal loading. Compression or other mechanical type couplings may be used to join polyethylene to other piping materials; however, manufacturers of these fittings must be consulted regarding suitability and installation procedures necessary to meet system design requirements.

The quality of the Piping System is also dependent on proper handling of pipe and fittings. Polyethylene pipe should not be handled with chains or dragged over sharp rocks or other abrasive objects. Canvas slings or padded fork lifts should be used where contact is directly with the pipe surface. The pipe should be stored in a manner that minimizes the possibility of crushing or piercing.

**Important:** All fusion Equipment must be in proper working order. Consult the manufacturer's operating manual for maintenance and service procedures.

**Do not use defective equipment.**

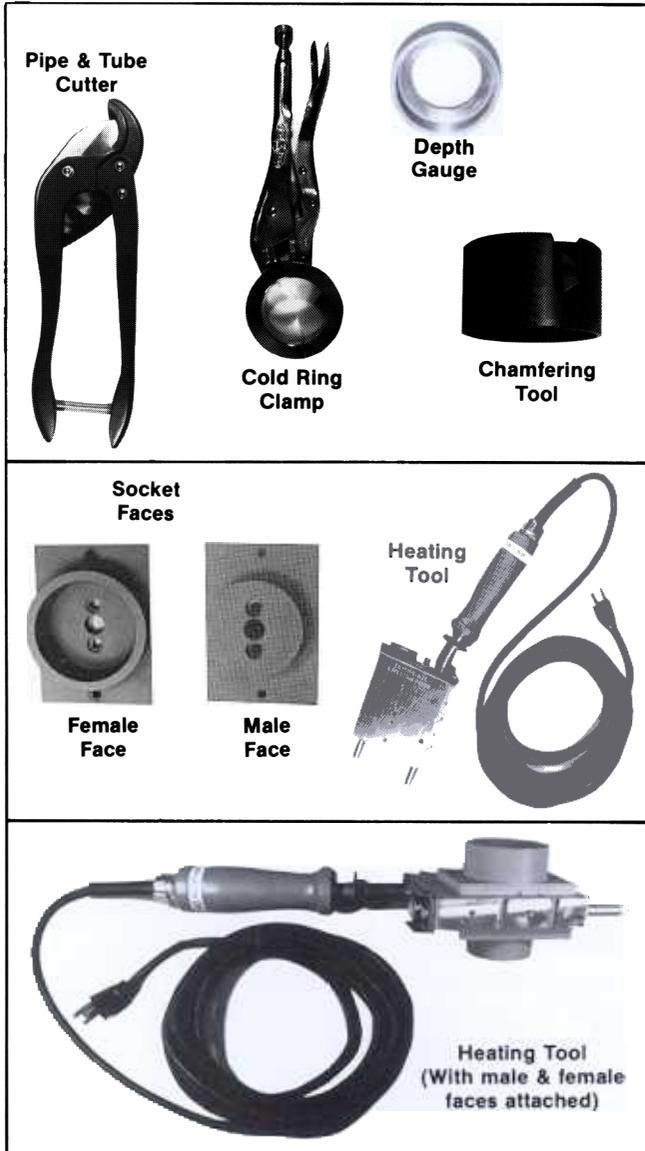
## Before You Start:

- Make sure all tools are clean and fit for the job.
- Inspect polyethylene pipe for cuts, gouges, and deep scratches, and remove these pipe sections before fusing the pipe.
- Remove tension\* in the line before making any connections.
- Make sure the correct time and temperature are used.
- Square pipe ends to remove any damaged or “necked down” surface.
- Wipe pipe ends with CLEAN dry cotton rag to remove any foreign substance and cuttings from I.D. (avoid rags of synthetic fiber that may melt and char against heater surface).
- See additional information on Page 18.
- Check heating iron fusion surface temperature with temperature indicating crayons or pyrometer.
- Clean heater faces after every joint with wooden implement (NEVER use metal tools).
- Do a trial fusion at the start of each day.
- To remove static electricity prior to cutting or tapping a pressurized gas line, spray polyethylene pipe with water/soap solution or water/glycol solution and ground with a solution wetted cloth.
- Fusion equipment may not be explosion-proof—take safety precautions if fusing in a combustible atmosphere.
- Shield fusing equipment from inclement weather and winds.

\*If direct burial, polyethylene pipe should be snaked in the ditch and the temperature of the pipe should be approximately the same as the soil at the installed depth before completing the tie-in. Fusion of coils should be done so that the joined coils form an “S” to reduce stress at the joint. If the polyethylene pipe has been inserted in an existing line, it should be allowed to cool to the casing pipe temperature prior to final tie-in. For each 10°F temperature drop, 100 feet of polyethylene pipe shrinks approximately one (1) inch.

## Fusing Sockets

You'll need these tools:



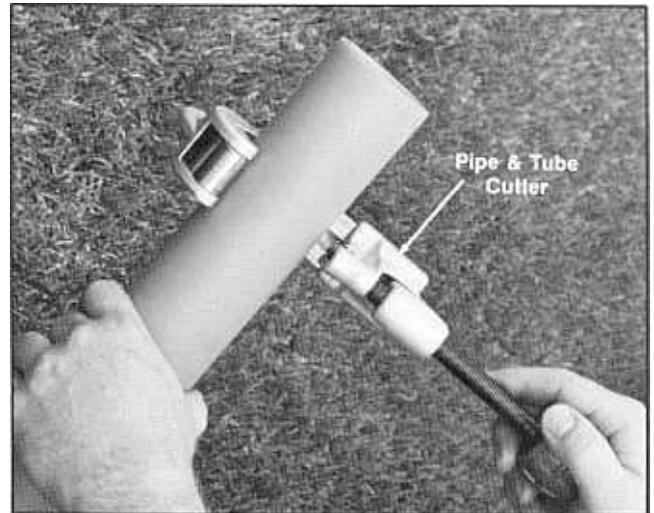
### Here's how to fuse Sockets

These socket fusion procedures should be followed carefully when joining PLEXCO pipe to socket type couplings, tees, ells, reducers, and end caps.

Pipe and fitting sizes 2" IPS and smaller are quickly joined by hand. When fusing pipe and fitting sizes 3" IPS and larger, *holding tools* are desirable.

To obtain quality fusions, a trial fusion should be made each day to check required heating times for prevailing ambient temperature and other weather conditions.

1. Square the ends of the pipe or tubing to be joined.



Use Pipe Cutter for cutting polyethylene pipe. (A hack saw may be used. Use particular care to produce a clean square cut end.)

2. Use Chamfering Tool on pipe ends to remove the sharp outer edge on the O.D. surface on all pipe sizes.



Remove any burrs from inside of pipe ends. Make sure both ends of pipe to be joined are clean, dry, and free of foreign substances. Wipe with clean, lint-free, dry rag.



3. To measure proper socket insertion depth, place Depth Gauge snugly over the chamfered end of the pipe.

4. Install Cold Ring Clamp on pipe O.D. surface immediately behind Depth Gauge. After securing Cold Ring Clamp, remove Depth Gauge.

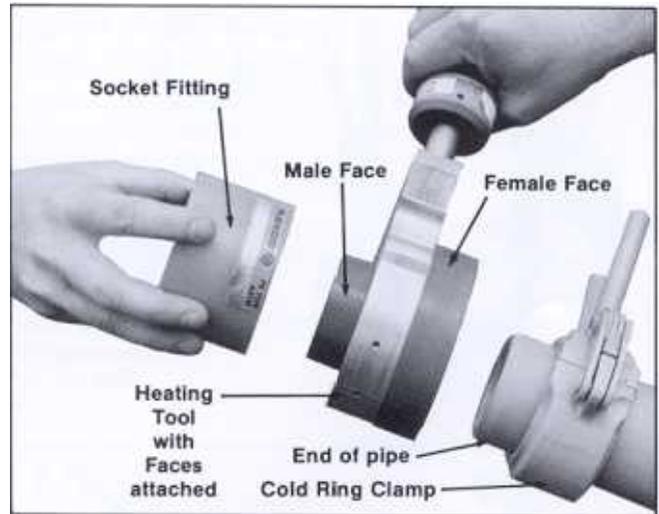
**ALTERNATE:**

4. In case where pipe joiner is being used, place the end of the laid pipe line in the fixed Cold Ring Clamp of the joiner and the free coil or joint in the movable Cold Ring Clamp. Use Depth Gauge as stated above.

5. Make sure fitting surfaces are clean and dry. Wipe again with lint-free, clean, dry rag if necessary. Avoid touching cleaned surface with your hands.

6. If you haven't already done so, heat Heating Tool with faces attached so that the faces are at  $500^{\circ}\text{F} \pm 10^{\circ}\text{F}$ . Make sure faces are clean. Use wooden tongue depressor (or comparable wooden implement) to remove any molten polyethylene from fusion faces. **DO NOT** use metal implements to clean non-stick, coated fusion faces as they will damage the surface.

7. When the Heating Tool fusion surfaces have reached a temperature of  $500^{\circ}\text{F} \pm 10^{\circ}\text{F}$  (as indicated by temperature crayon or pyrometer), you are ready for this step, not before.



Firmly seat the Socket Fitting on the male face of the Heating Tool. If pipe joiner is being used, this operation is accomplished in the same manner.

Place the female face of the Heating Tool on the end of the pipe firmly against the Cold Ring Clamp. If pipe joiner is being used, place the female face on the end of the pipe in the fixed Cold Ring Clamp of the joiner.

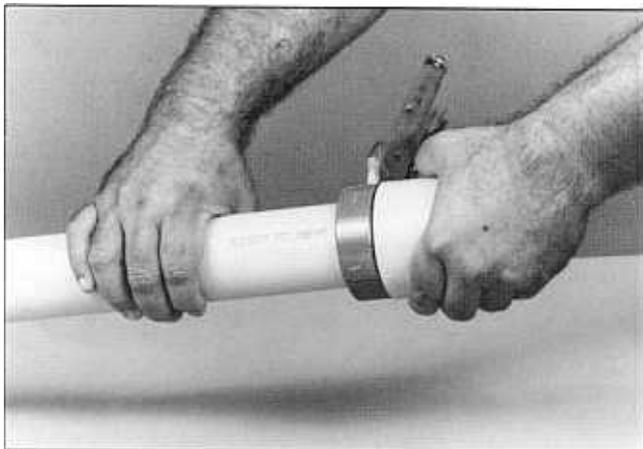
Heating time starts when the cold ring is bottomed out on the heater surface. Heat for prescribed period of time shown in Recommended Fusion Time Cycles chart on Page 19. **DO NOT TWIST PIPE, FITTING, OR HEATING TOOL.**

8. Snap the Heating Tool from the melted pipe and fitting by a sharp rap on the iron handle with free hand while holding upper part of tool handle in the opposite hand in such manner that the melt will remain intact.

9. Quickly check melt pattern on pipe surface and fitting—heated surfaces on fitting and pipe should be 100% melted with no cold spots. If melt is not complete, cut off melted pipe end, use a new fitting and repeat fusion Steps 1 through 8.



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10. Within 3 seconds after the Heating Tool has been removed, firmly push the melted fitting squarely onto the pipe end until it makes firm contact with the Cold Ring Clamp. **DO NOT TWIST PIPE OR FITTING.** Hold the fitting firmly in place for total cooling time (see Recommended Fusion Time Cycles on Page 19) to insure proper alignment. If pipe joiner is being used, this operation is performed in the same manner.

*NOTE: Misalignment will displace the melt and create a faulty fusion.*

After waiting an additional 3 minutes cooling time, remove the Cold Ring Clamp and inspect the joint. A good joint will have a flat, uniform melt ring and joining perpendicular to the pipe, with no gaps or voids between the fitting and the pipe.



#### ALTERNATE:

10. If the joiner is being used, repeat the fusion steps (from step 5) on the free coil or joint to be fused into the socket fitting. The handle is used to advance the pipe on and off the heater faces and finally into the melted socket fitting opening.

Hold the fused joint firmly in place the entire cooling time. Wait an additional 3 minutes cooling time. Remove the Cold Ring Clamp and inspect the joint. A good joint will have a flat, uniform melt ring joining perpendicular to the pipe, with no gaps or voids between the fitting and the pipe.

11. Wait an additional 10 minutes to complete cooling before the pipe joint is tested or stressed during burial. Be sure backfill is free of rocks and large clods of earth to prevent damage to pipe line. See PLEXCO Application Note No. 7—Pipe Embedment and Final Backfilling.

12. If the steps outlined in this fusion technique were followed carefully, an acceptable joint should have been made.

13. Consult PLEXCO Bulletin No. 105, "Qualification Procedures for Making PE 2406 Polyethylene Heat Fusion Joints," or PLEXCO Bulletin No. 106, "Qualification Procedures for Making PE 3408 Polyethylene Heat Fusion Joints" for techniques used to evaluate the quality of the joint.

14. Clean heater faces carefully after each fusion, with wooden tongue depressor or wooden stick. Do not use metal implements to clean heater faces.

#### CAUTION:

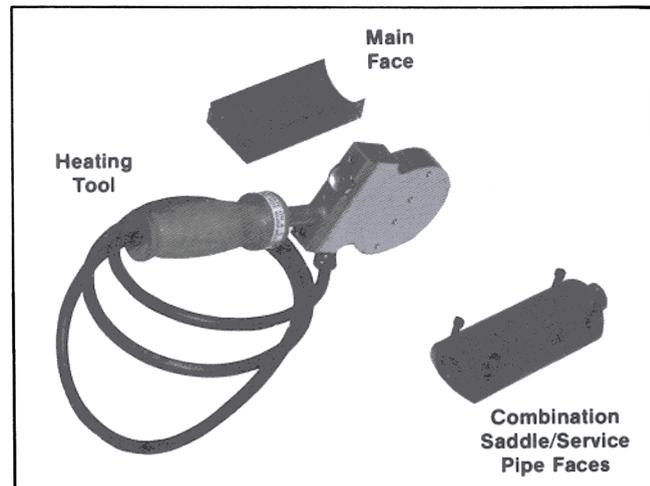
*The final tie-in of the line should not be made until the pipe has cooled to the temperature of the ditch bottom. On hot days, this allows pipe to shrink before the tie-in is made.*

#### CAUTION:

*In sections where a fitting is present, the bending radius should be limited to 120 to 125 times the pipe diameter. Polyethylene pipe without fittings can be permanently bent to a radius 20 to 25 times the pipe diameter without damage or effect on its physical properties.*

# Fusing Service Saddles and Tapping Tees

You'll need these tools:



## Here's how to fuse Service Saddles and Tapping Tees with an application unit.

When service line is to be connected to a main at system gas pressure, a Tapping Tee is recommended for the Hot Tap.

**IT IS RECOMMENDED THAT AN APPLICATION TOOL BE USED WHEN MAKING SADDLE FUSION JOINTS.** Variables in the installation procedure are more easily controlled when a tool is used than when the fusion is made manually.

**IMPORTANT**  
Various tool manufacturers' tapping tee fusion application units have slightly different operating procedures. Consult the manufacturer's operating manual for proper use of the tool.

When fusing on a pressurized main, the risk of blow-out can be reduced by using equipment that is in proper working order, following the manufacturer's operating instructions, using recommended fusion procedures and by using relieved-center heater faces when fusing High Volume Tapping Tees.

## Preparation

1. Place application unit on main according to manufacturer's instructions. Unit should be centered over cool, clean, dry location where the fitting will be fused. Secure unit to main. A bolster plate is recommended for 6" IPS and smaller sizes.
2. Install correct heating faces on heating tool and heat tool so that fusion surfaces are at  $500^{\circ}\text{F} \pm 10^{\circ}\text{F}$ .
3. Insert fitting in application unit and place fitting base on pipe. Secure fitting tightly in unit.
4. Raise fitting and abrade fusion surface of fitting base and main with utility cloth (50 to 60 grit). Periodic replacement of cloth is necessary.

After abrading, brush residue away with a clean, dry cloth.

## Heating

5. After heater faces reach  $500^{\circ}\text{F} \pm 10^{\circ}\text{F}$ , place heating tool on main centered beneath fitting. **WITHIN 3 SECONDS**, place fitting against **HEATING TOOL**, **AND QUICKLY** apply and maintain **CONTINUOUS** pressure during heating. (**LONGER THAN 3 SECONDS COULD CAUSE EXCESSIVE HEAT PENETRATION OF THE MAIN.**) Heating time starts after fitting and pipe are firmly seated against heater faces. Heat for prescribed period of time shown in Recommended Fusion Time Cycles chart on page 19, or until melt bead size shown below is visible on crown of main. During heating, the heating iron may be rocked slightly, about 2 deg., to assure full contact with the main. **DO NOT INTERRUPT HEATING TO INSPECT THE MELT PATTERN ON THE MAIN.**



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## FORCE APPLIED DURING HEATING AND COOLING

Pipe Size	Tapping Tees and Service Saddles		HVTT and Branching Saddles	
	Heating	Fusion/Cooling*	Heating	Fusion/Cooling**
1-1/4" thru 8"	60-80 lb <sub>f</sub>	60-80 lb <sub>f</sub>	120-140 lb <sub>f</sub>	120-140 lb <sub>f</sub>

\* When the main is not under internal pressure, a fusion/cooling force of 40-80 lb<sub>f</sub> is acceptable for all sizes of tapping tees and service saddles.

\*\* When the main is not under internal pressure, a fusion/cooling force: for 2" of 60-80 lb<sub>f</sub>, for 3" of 80-100 lb<sub>f</sub>; and for 4", 6" & 8" of 90-120 lb<sub>f</sub> is acceptable for HVTT and branching saddles.

Place fitting against heater faces. Apply and maintain pressure during heating. Heating time starts after fitting and pipe are firmly seated against heater faces. Heat for prescribed period of time shown in Recommended Fusion Time Cycles chart on Page 19 or until melt bead size shown below is visible on crown of main. During heating, the heating iron may be rocked slightly, about 2°, to assure full contact with the main.

### Approximate Melt Bead Size

Pipe Size	Bead Thickness
1-1/4"	1/32"
2"	1/16"
3" & Larger	1/8"

6. After proper melt bead has developed, remove fitting from heater and heated from main with quick snapping actions.

Quickly check melt pattern on pipe surface and fitting—heated surfaces on fitting and pipe should be 100% melted, no cold spots.

If surfaces are unacceptable, continue with steps 7 and 8, **do not reapply heater**, allow Standard Tapping Tee and Service Saddle fusions to cool an additional 10

minutes and High Volume Tapping Tee and Branch Saddle fusions to cool an additional 30 minutes, then cut off top of fitting to prevent use. **After proper cooling time, relocate fusion application unit and repeat procedure from Step 1.**

(A mirror may be used to check the melt on the under surface of the saddle base.)

## Fusion and Cooling

7. If melt patterns are satisfactory, press the fitting on the pipe very quickly (within 3 seconds after removing heater) with firm pressure until a melt bead of the following size appears around the entire base of the fitting:

Pipe Size	Approximate Fusion Bead Size
1-1/4"	1/16"
2"	1/8"
3" & Larger	Larger than 1/8"

Adjust fusion unit to maintain pressure of fitting on pipe. Allow fusion joint to cool for the time indicated in Recommended Fusion Time Cycles chart on Page 19.

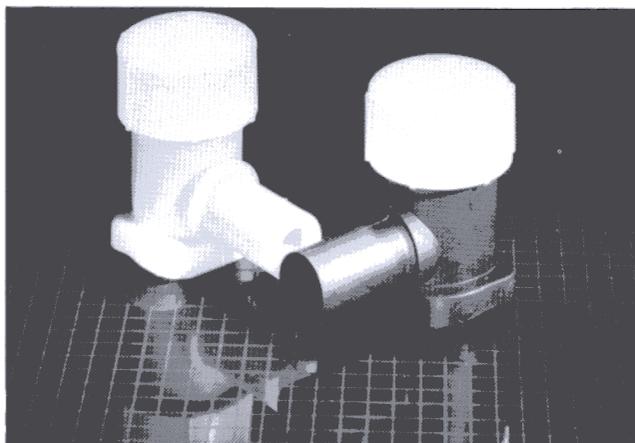
8. After letting joint cool an additional 3 minutes, remove application unit from pipe. Visually check fitting for fusion bead around entire fitting base. If bead pattern on fitting or pipe is unacceptable, allow Standard Tapping Tee and Service Saddle fusions to cool an additional 10 minutes and High Volume Tapping Tee and Branch Saddle fusions to cool an additional 30 minutes, then cut off top of fitting to prevent use. **After proper cooling time, relocate fusion application unit and repeat procedure from Step 1.**

9. For Standard Tapping Tees and Service Saddles, let fusion cool an additional 10 minutes prior to pressure testing or tapping the main. Allow an additional 30 minutes before tapping or pressure testing High Volume Tapping Tees or Branch Saddles.

10. If the steps outlined in this fusion technique were followed carefully, an acceptable joint should have been made.

11. Consult PLEXCO Bulletin No. 105, "Qualification Procedures for Making PE 2406 Polyethylene Heat Fusion Joints," or PLEXCO Bulletin No. 106, "Qualification Procedures for Making PE 3408 YELLOWSTRIPE® Polyethylene Heat Fusion Joints" for techniques used to evaluate the quality of the joint.

12. Clean heater faces carefully after each fusion, with wooden tongue depressor or wooden stick. Do not use metal implements to clean heater faces.





## The Use of Application Tools vs. Hand Application

PLEXCO recommends the use of application tools rather than hand application for the saddle fusion of PLEXCO Standard Tapping Tees, High Volume Tapping Tees, Service Saddles, and Branch Saddles.

### Branch Saddles

Branch Saddles may be applied in the same manner as Service Saddles. A Branch Saddle application unit is recommended for this operation.

### High Volume Tapping Tee

Fusion procedures for High Volume Tapping Tees are the same as for Standard Tapping Tees excepting heating and cooling times. Prescribed time cycles are shown in Recommended Fusion Time Cycles chart on Page 19.

### Procedure For Tightening Tapping Tee Caps

PLEXCO Tapping Tee Caps are designed for use without lubricants. Lubricants can lead to over-tightening which can damage the o-ring seal or lead to cap failure.

Standard Tapping Tee Caps should be secured by hand. Check to be sure the o-ring is in place at the top inside of the cap, and the threads and sealing surfaces are free of dirt and contaminants. Screw the cap down until resistance is felt, then about 1/6 to 1/3 turn more.

For service main pressures up to about 60 psig, High Volume Tapping Tee Caps should be secured by hand. Check to be sure the o-ring is in place at the top of the body, and the threads and sealing surfaces are free of dirt and contaminants. Screw the cap down about 12 turns then about 1/2 to 3/4 turn more to complete the seal.

For service main pressures above about 50 psig, a band or strap type wrench (such as an oil filter wrench) may be used to secure High Volume Tapping Tee Caps. Jaw type wrenches with teeth are not recommended as the cap may be damaged.

1. Check to be sure the o-ring is in place at the top of the body, and the threads and sealing surfaces are free of dirt and contaminants.

2. Place the cap on the body and turn counter-clockwise until the leading edges of the threads clear each other and the cap drops onto the second thread. With a marker such as a felt tip pen, mark the top of the cap in line with the service outlet.

3. Screw the cap clockwise about 12 to 12-1/2 turns. An additional 1/4 to 1/2 turn is permissible if necessary; however, tightening beyond 13 turns may over-tighten and damage the o-ring seal.

#### CAUTION:

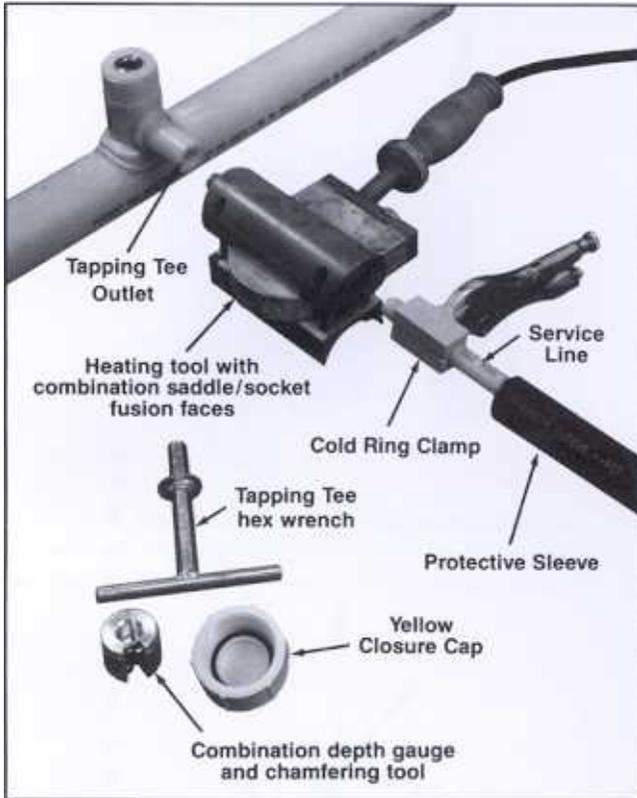
*In sections where a fitting is present, the bending radius should be limited to 120 to 125 times the pipe diameter. Polyethylene pipe without fittings can be permanently bent to a radius 20 to 25 times the pipe diameter without damage or effect on its physical properties.*





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## Tapping the Main: Standard & High Volume Tapping Tee— Hot Tap and Cold Tap



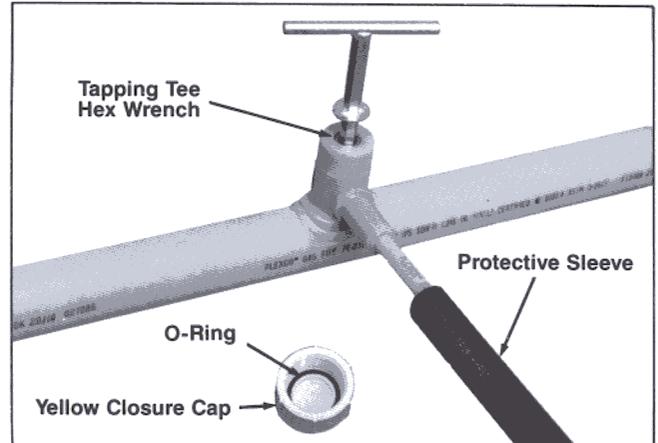
Prior to tapping the main, the service line should be fused to the Tapping Tee. Before fusing the service line to the Tapping Tee, slide a protective sleeve (sized to fit the Tapping Tee outlet) over the free end of the service line. Then fuse the service line to the Tapping Tee outlet. Fuse the opposite end of the service line to the meter riser or service connection.

Pressure test all fusions including the saddle base of the Tapping Tee and the service line at the tee and meter riser or service connection.

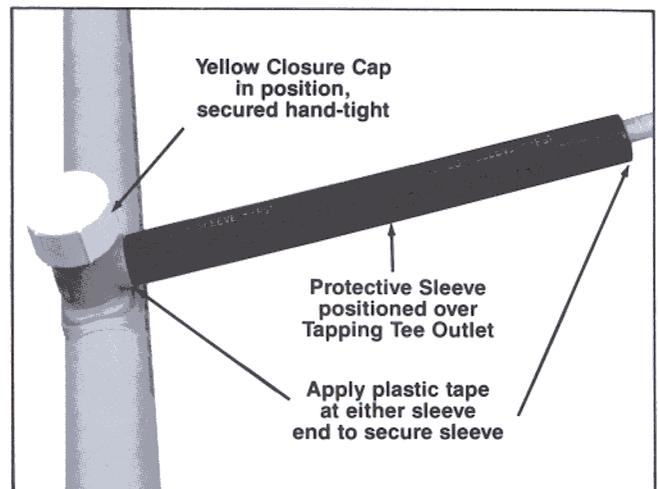
You are now ready to tap the main.

### CAUTION:

*After saddle fusing Standard Tapping Tees and Service Saddles, let fusion cool an additional 10 minutes prior to pressure testing or tapping the main. Allow an additional 30 minutes before tapping or pressure testing High Volume Tapping Tees or Branch Saddles.*



Place Tapping Tee Wrench in hex opening of cutter at top of tee. Turn wrench clockwise until washer contacts top of tapping tee—this will make the tap. The section cut from the pipe wall (coupon) will remain in the cutter. Turn wrench counterclockwise until top of cutter is even with top of tapping tee. Remove the wrench but **DO NOT REMOVE THE CUTTER**. Install cap in accordance with procedures on Page 10. Pressure test in accordance with company approved procedures.



Now slide protective sleeve over outlet end of the tapping tee and secure with plastic tape to avoid slippage of sleeve during backfill operation.

The installation is now complete and ready for backfilling.

## **Tapping the Main: Service Saddle and Branch Saddle–Cold Tap**

When the main is not pressurized, tapping can be done with a simple T-bar tool with cutter. Simultaneously push on the tool into the outlet end of the Service Saddle or Branch Saddle and turn clockwise. This taps the main. Rotate the tool counterclockwise and pull to withdraw the cutter—the section cut from the pipe will remain in the cutter and is removed by using a screwdriver as a probe or pry bar in the slot provided in the sidewall of the cutter. The cold tapping is completed. This tool has built-in stops to prevent damage to the inner wall of the main opposite the tap.

To fuse the service line to the Service Saddle, slide a protective sleeve over the service pipe. Socket fuse the service line into the Service Saddle outlet. Secure opposite end of the service line to the meter riser. Allow an additional 10 minutes prior to pressure testing or stressing. Pressure test all fusions including the saddle base and service line at the saddle outlet and meter riser. Slip the protective sleeve over the outlet end of the service saddle, and secure the protective sleeve with plastic tape to avoid slippage of sleeve during backfill operation.

To fuse a lateral line to a Branch Saddle (2" IPS outlet), socket fuse a coupling to the outlet, then socket fuse the lateral line to the coupling. Pressure test all fusions after required cooling time.

## **Tapping the Main: Branch Saddle–Hot Tap**

Due to the many tools and methods to produce a Branch Saddle hot tap, PLEXCO will supply appropriate information for this procedure upon request.

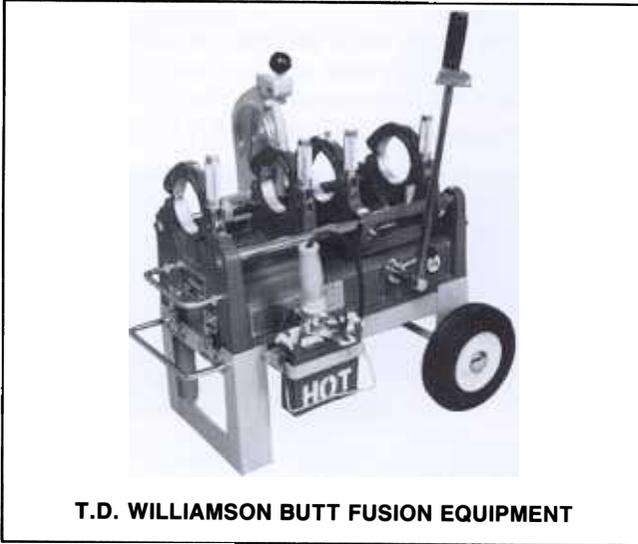




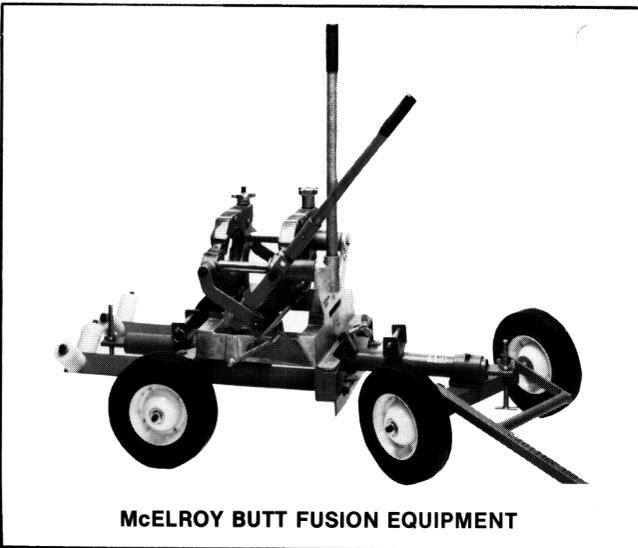
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## Butt Fusion

You'll need these tools:



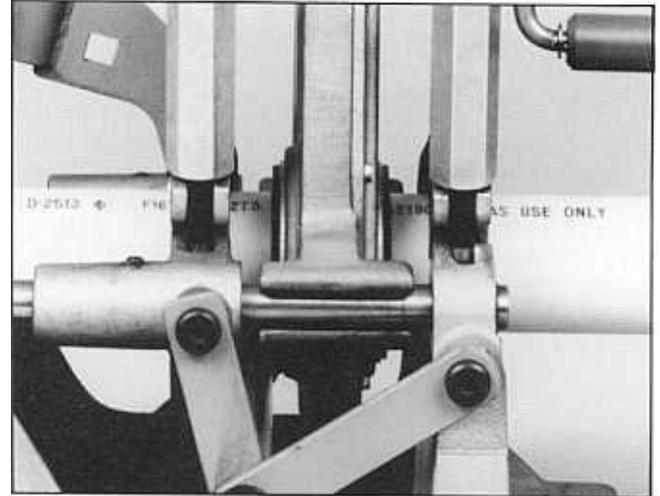
T.D. WILLIAMSON BUTT FUSION EQUIPMENT



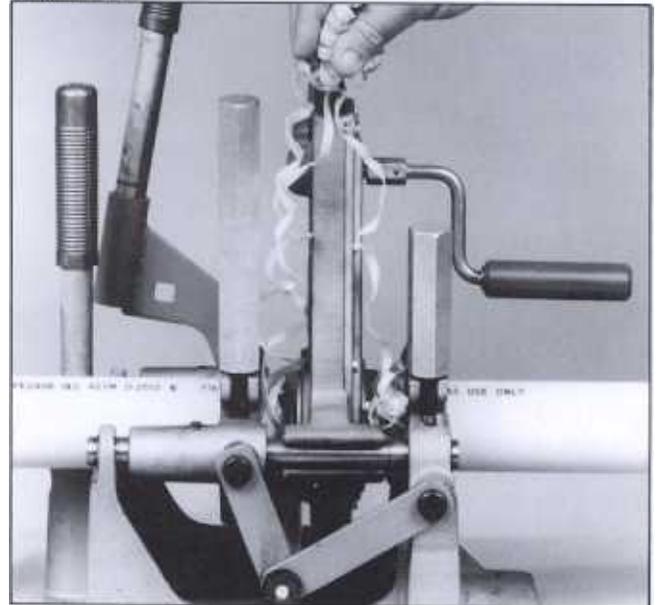
McELROY BUTT FUSION EQUIPMENT

### Butt Fusion...Here's how...

Prior to placing pipe in the butt fusion equipment, remove any badly flattened, damaged or "necked down" ends with pipe cutting equipment. Clean ends to be joined with a clean dry cloth.



1. Place pipe and/or butt fitting ends into fusion machine clamps. Ends should extend approximately an inch past alignment clamps for facing. With four-clamp machines, the outer clamps should be securely tightened to prevent pipe slippage. Inner clamps can be looser to allow easier high/low alignment adjustment. Check for alignment.

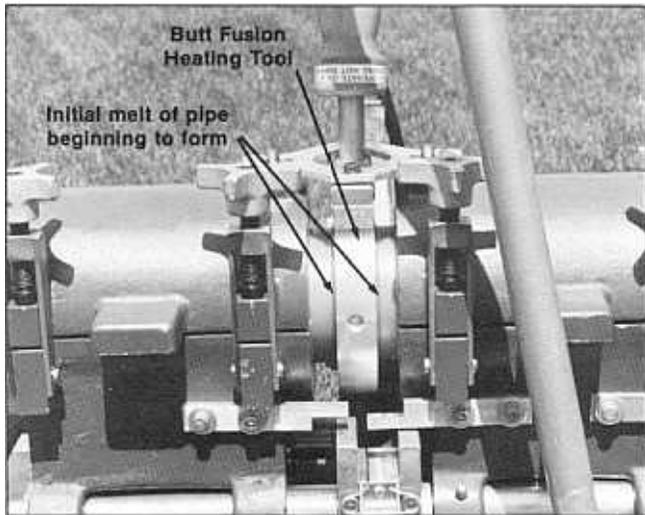


2. Insert facing unit. Close pipe (fitting) ends against rotating facing blades and machine pipe (fitting) ends to smooth, flat surfaces. Long continuous shavings will indicate proper facing of pipe (fitting) ends. Operate facer until machine has bottomed out against stops on facing unit.



3. Separate pipe (fitting) ends and remove facer. **POWERED FACERS MUST BE TURNED OFF BEFORE REMOVAL.** Check ends for full, complete facing. If facing is incomplete, repeat Steps 1 and 2.

4. Bring pipe (fitting) ends together and carefully check alignment. Adjust high side down by tightening clamp. **DO NOT LOOSEN LOW SIDE CLAMP.** Repeat Steps 2 and 3. In the case of coiled pipe, it may be necessary to rotate the pipe to accomplish alignment. If so, repeat Steps 1 through 4.



5. Insert Heating Tool between ends. **CLOSE ENDS AGAINST HEATER SURFACES STRONGLY ENOUGH TO INSURE FULL CONTACT, THEN RELAX TO CONTACT PRESSURE ONLY.\***

Hold pipe (fitting) ends in contact with heater until heating cycle is complete. During the heating cycle, a bead of molten polyethylene will form and expand as the polyethylene melts. Heat pipe (fitting) ends for the time cycle shown in Recommended Fusion Time Cycles chart on Page 19, or until the Melt Swell Bead Width is the size shown in the table below. Heating time starts when a complete, uniform bead of molten material is visible around the entire circumference of both ends.

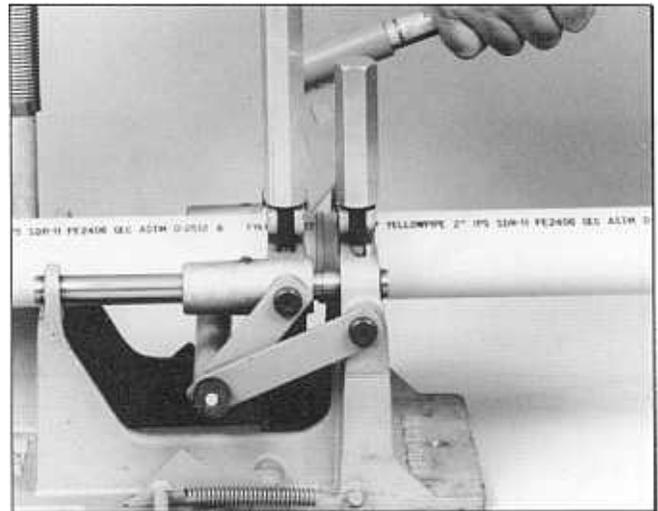
Melt Swell Bead Width Guidelines

Pipe Size	Bead Width
1-1/4" to 3"	About 1/16"
3" to 6"	1/16" to 1/8"
6" to 8"	1/8" to 3/16"
8" & Larger	3/16" to 1/4"

\*440°F ± 10°F and 500°F ± 10°F are acceptable heater face surface temperatures.

If pressure of the pipe against the heater is maintained during the heating period, melt will be squeezed away from pipe ends, causing a concave effect in the heated pipe ends. This could result in a weakened joint after fusing.

6. Open pipe (fitting) ends and remove heater, being careful not to displace melt when removing heater. Manual machines may require quick snapping actions to open the pipe ends and remove the heater.



7. Bring pipe (fitting) ends together quickly (within 3 seconds). Do not slam together as this may cause excessive displacement of melt, resulting in a poor quality fusion. Use enough pressure to roll the melt swell beads over to the pipe (fitting) surface.\*\* HOLD THIS PRESSURE FOR THE COOLING CYCLE TIME shown in Recommended Fusion Time Cycles chart on Page 19, or about 30 seconds per inch of pipe diameter. Each bead after fusion should be equivalent to the following thicknesses (diameters):

Pipe Size	Bead Thickness
1-1/4" IPS to 2" IPS	1/16" to 1/8"
3" IPS to 4" IPS	1/8"
6" IPS	3/16"
8" IPS & Larger	3/16" to 1/4"

The double bead width should be about 2 to 2-1/2 times its height, and uniform in size and shape all around the joint.



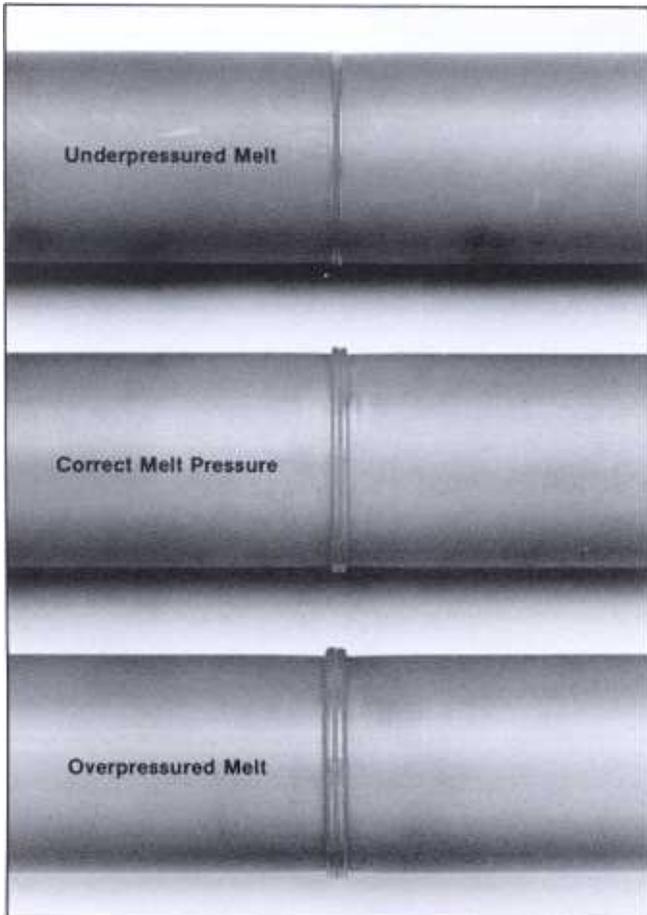


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\*\*Hydraulic machine fusion pressures may be determined using the fusion interface pressures below:

Fusion Interface Pressure Guidelines	
Heater Surface Temperature	Interface Pressure
500°F ± 10°F	80 ± 15 psi
440°F ± 10°F	60 ± 15 psi

Over-pressuring the melt will cause the bead to overlay itself and could result in a sub-quality fusion since the melt would be pushed to the O.D. and I.D. of the fusion, creating a possible "cold ring" in the center section of the fusion. Under-pressuring could result in inadequate fusion due to insufficient contact in the melt area. Also, extreme care should be exercised not to reduce pressure during fusion cooling even if the bead exceeds the desired width. Reversing the pressure will cause porosity in the fused area.



8. The fused joint may be very carefully removed from the equipment following an additional three minutes cooling time.

9. AFTER REMOVAL FROM FUSION EQUIPMENT ALLOW AN ADDITIONAL 10 TO 60 MINUTES COOLING TIME BEFORE ROUGH HANDLING OR TESTING (longer times for larger sizes).

10. If the steps outlined in this technique were followed carefully, an acceptable joint should have been made.

11. Consult PLEXCO Bulletin No. 105, "Qualification Procedures for Making PE 2406 Polyethylene Heat Fusion Joints," or PLEXCO Bulletin No. 106, "Qualification Procedures for Making PE 3408 YELLOWSTRIPE® Polyethylene Heat Fusion Joints" for techniques used to evaluate the quality of the joint.

12. Clean heater faces, being careful not to damage coated surfaces—use wooded implement and clean, dry, lint-free non-synthetic rags. Do not use metal implements to clean heater faces.

*NOTE: Butt fusion machines from different manufacturers or different designs from the same manufacturer may require different gauge pressures to obtain proper interfacial pressure for fusion. It is recommended that fusion conditions be established for each of the various designs of fusion machines to be used. On request PLEXCO will provide guidelines for torque requirements on selected manually operated McElroy and Ridgid P&S, butt fusion equipment, and pressure gauge settings for selected McElroy, Ridgid P&S, and Christie hydraulically operated butt fusion equipment.*

**CAUTION:**

*In sections where a fitting is present, the bending radius should be limited to 120 to 125 times the pipe diameter. Polyethylene pipe without fittings can be permanently bent to a radius 20 to 25 times the pipe diameter without damage or effect on its physical properties.*

# Cold Weather Fusion (Below 55°F)

First remove all frost, ice, or snow from O.D. and I.D. surfaces of areas to be fused. This should be done by lightly tapping or scraping the solids until they flake off the pipe ends. Wipe dry with clean white paper towels or rags. Shield areas to be fused with wind break or cover. Ice or snow should also be removed from areas where cold ring clamps will be applied.

In cold weather, pipe diameters and socket fitting entrances will normally contract. Keep fittings in cab of truck, thus reducing exposure to extremely low temperatures. This will reduce contraction, making it easier to place socket fittings on heater faces.

When performing socket fusions, the Cold Ring Clamp will fit loosely on the pipe end. Place a backup Cold Ring Clamp behind the loose cold ring which is in the normal position behind the Depth Gauge. The backup clamp should be shimmed with tape to prevent slippage. The loose Cold Ring Clamp will allow the pipe to expand to the proper O.D. as it is heated.

It is recommended that only electrically heated tools be used (plugged into their power source), since the surface temperature of gas-heated tools cannot be maintained long enough to produce the proper melt. If gas-fired tools are used, they should be near 525°F when removed from the heat source to compensate for heat loss. **TO OBTAIN PROPER MELT PATTERNS, INCREASE MELT TIME CYCLES—DO NOT INCREASE TEMPERATURE OR PRESSURE OF PIPE AND/OR FITTINGS ON HEATING TOOL FACES.**

When fusing in cold weather conditions, the time required to form the proper melt will vary. For Socket and Saddle Fusions, a few trial melt patterns should be made on the pipe under field conditions to establish the required melt time. Increase the standard melt-time cycles by 5-second intervals until the proper time is established. Avoid time cycles in excess of that required to get a good melt pattern. After establishing the proper cold weather melt-time cycle, begin the fusion operation by placing the female face on the pipe, start counting the established cold-weather time cycle. The socket fitting should then be pushed on the male face.

Although it may take several seconds to fully engage the fitting on the male face, there should be no problem in obtaining a melt in the fitting since the fit will be snug at the outset. After removal of Heating Tool, melted surfaces should be quickly checked and immediately joined (within 3 seconds) to avoid cooling of the melted surfaces. Continue with the remaining steps in the procedure to complete the fusion.

When applying a saddle-type fitting, first place the heating tool on the main, then place the saddle base on the tool and apply the necessary pressure to obtain complete contact of the pipe and saddle with the heating tool surfaces. Heat for the previously determined cold-weather time cycles if the saddle fittings are stored inside the heated cab of the service vehicle; it may be necessary to briefly preheat the pipe with the heating iron before placing the fitting onto the iron.

**BUTT FUSION:** The time required to form the initial melt bead will automatically extend the total melt time cycle. After the melt forms, follow the standard butt fusion time cycle.



# Plexco®

## Fusing PLEXCO® Products with Other Types of Pipes:

Industry studies indicate that polyethylene of different trade names and/or different polyethylenes, such as 2306, 2406, 3406, and 3408 materials, can be successfully joined by heat fusion.

**MELT TIMES PRESCRIBED AT 500°F BY EACH MANUFACTURER FOR HIS PRODUCT SHOULD BE USED.** Apply the Heating Tool first to the material requiring the longest melt time. Then apply the product requiring the lesser melt time to the heater so the melt cycle for both products will be completed at the same time. All other fusion conditions and procedures remain the same as when joining PLEXCO products.

The Plastics Pipe Institute has established a set of "Criteria for Joining Various Polyethylene Materials to One Another by Heat Fusion Techniques," Statement E, April 3, 1974. Of particular importance applicable to the PLEXCO System would be the following:

**Section 1.** All pipes and fittings should meet the established applicable standards of the American Society for Testing and Materials.

**Section 2.** PE joints made by heat fusion techniques should only be made by properly trained personnel whose competency has been determined by adequate testing. The equipment used to make heat fusion joints should also be checked at intervals to assure that it is in proper operating condition.

**Section 3.** Polyethylene pipe and fittings made from the same commercial designation of polyethylene produced at different plants, and formed by different extrusion and injection molding machines, can be joined by the same procedure provided the products meet the current ASTM component standards.

**Section 4.** The polyethylene pipe materials presently on the market can be joined to one another provided the proper technique is used for the specific materials and the type of joint. The important parameters are time of heating and temperature of the fusion tool for butt and socket joints. The pressure used to join the fused parts is also important for butt fusion. Ambient conditions should also be taken into consideration.

PLEXCO recommends that the above criteria should be paramount considerations when joining different polyethylenes. However, **DIFFERENT POLYETHYLENES SHOULD NOT BE MIXED INDISCRIMINATELY—** optimum conditions will be achieved when joining pipe and fittings from the same manufacturer's system.

For more information regarding fusion of materials from different manufacturers, see PPI Technical Notes TN-13 1/81 "General Guidelines for the Heat Fusion of Unlike Polyethylene Pipes and Fittings."

On request, PLEXCO will provide additional information and technical assistance in proper fusion procedures for joining the PLEXCO system with polyethylene systems of other manufactures and material designations.

**CAUTION:**

*In sections where a fitting is present, the bending radius should be limited to 120 to 125 times the pipe diameter. Polyethylene pipe without fittings can be permanently bent to a radius 20 to 25 times the pipe diameter without damage or effect on its physical properties.*

## Fusion Time Cycles

Heating iron temperature and heating times are for ideal field conditions at temperatures ranging from 55°F to 85°F and no wind. As ambient temperatures and wind conditions change, heating times must be altered—see cold weather operating instructions.

A crayon temperature indicator or pyrometer should be used daily to check the tool surface temperature against the tool thermometer. **ALL HEATING TOOL TEMPERATURES ARE THE TEMPERATURES ON THE SURFACE OF THE TOOL FACE THAT ACTUALLY CONTACTS THE PIPE OR FITTING.** There will usually be a significant temperature difference between the tool faces and the tool thermometer, with the faces being cooler. Therefore, the thermometer reading will need to be higher than the recommended heating tool face temperatures. In some cases, especially saddle fusion, the surface temperature on one face may vary significantly from that on the other face. In this case, the lower temperature surface should be at the recommended temperature.

HEATING TIME CYCLES start as follows:

**Socket Fusions**—Time starts after fitting and pipe are fully inserted on heater faces.

**Saddle Fusions (Tapping Tee, Service Saddle, Branch Saddle)**—Time starts after fitting and pipe are tightly seated against heater faces.

**The following times apply when using smooth heater faces. If serrated heater faces are to be used, reduce heating time by approximately five (5) seconds.**

**Butt Fusion**—Time starts after a bead of molten material is first visible around the complete circumference of both pipe and/or fitting ends.

COOLING TIME CYCLES specified are the minimum times that the pipe and/or fitting must be held firmly in place. At least 3 minutes additional cooling time is required before removing the fused joint from the equipment. Light handling or making an additional fusion on the same fitting may be performed after this cooling period.

**CAUTION: An additional 10 to 60 minute cooling time (depending upon procedure and pipe size) is required after removing the joint from the fusion equipment before testing or subjecting the joint to bending, burying, pressure testing, or similar handling and backfill stresses.**

The heater iron temperature of 500°F ± 10°F is based on construction crews using the same fusion irons for socket, saddle and butt fusion. However, if the heater iron is used exclusively for butt fusion, then a temperature of 440°F ± 10°F can be used.



# GUIDELINES

## PLEXCO PE 2406 POLYETHYLENE

## PLEXCO PE 3408 YELLOWSTRIPE® OR PLEXCO EHMW PE 3408 POLYETHYLENE

Heater Face Temp. 500°F	Pipe Size	Heating Time (seconds)	Cooling Time (seconds)
Socket	1/2" CTS	6-7	20
	3/4" CTS	6-7	20
	1" CTS	9-10	20
	1-1/4" CTS	10-12	20
	1/2" IPS	6-7	20
	3/4" IPS	8-10	20
	1" IPS	10-12	30
	1-1/4" IPS	12-14	30
	1-1/2" IPS	14-17	30
	2" IPS	16-19	30
Standard Tapping Tee & Service Saddle	3" IPS	40	60
	4" IPS	40	60
	6" IPS	40	60
	8" IPS	40	60
	1-1/4" IPS (Fitting)	40	60
HVTT & Branch Saddle	2" IPS	50-60	120
	3" IPS	70-80	180
	4" IPS	70-80	180
	6" IPS	80-90	180

Heater Face Temp. 500°F	Pipe Size	Heating Time (seconds)	Cooling Time (seconds)
Socket	1/2" CTS	9-10	30
	3/4" CTS	9-10	30
	1" CTS	14-16	30
	1-1/4" CTS	14-16	30
	1/2" IPS	9-10	30
	3/4" IPS	12-14	30
	1" IPS	15-17	40
	1-1/4" IPS	18-21	40
	1-1/2" IPS	20-23	40
	2" IPS	24-28	40
Standard Tapping Tee & Service Saddle	3" IPS	50	70
	4" IPS	50	70
	6" IPS	50	70
	8" IPS	50	70
	1-1/4" IPS (Fitting)	45	70
HVTT & Branch Saddle	2" IPS	55-65	150
	3" IPS	75-90	180
	4" IPS	75-90	180
	6" IPS	85-100	180

Pipe Size	440°F Heating Time (sec.)	500°F Heating Time (sec.)	Cooling Time (sec.)	
	† 1/2" CTS	12-14		6-7
† 3/4" CTS	14-17	8-10	40	
† 1" CTS	16-19	10-12	40	
† 1-1/4" CTS	18-22	12-14	40	
† 1/2" IPS	14-17	8-10	40	
† 3/4" IPS	16-19	10-12	40	
Butt	† 1" IPS	18-22	12-14	40
	1-1/4" IPS	25-30	14-17	60
	1-1/2" IPS	35-42	15-18	60
	2" IPS	40-48	16-19	60
	3" IPS	50-60	20-24	75
	4" IPS	55-66	24-29	90
	6" IPS	90-108	40-48	180
	8" IPS and Larger—Use Sight Fusion Procedure			

Pipe Size	440°F Heating Time (sec.)	500°F Heating Time (sec.)	Cooling Time (sec.)	
	† 1/2" CTS	15-18		6-7
† 3/4" CTS	16-19	8-10	50	
† 1" CTS	18-22	14-17	50	
† 1-1/4" CTS	20-24	16-19	50	
† 1/2" IPS	16-19	8-10	50	
† 3/4" IPS	18-22	14-17	50	
Butt	† 1" IPS	20-24	16-19	50
	1-1/4" IPS	35-42	18-22	70
	1-1/2" IPS	50-60	26-31	90
	2" IPS	55-66	28-34	90
	3" IPS	65-78	30-36	120
	4" IPS	75-90	35-42	120
	6" IPS	105-126	55-66	180
	8" IPS and Larger—Use Sight Fusion Procedure			

\*Use heat shield on pipe surface for first 15 seconds of this time cycle.

†Socket fusion recommended for these sizes.

\*Use heat shield on pipe surface for first 15 seconds of this time cycle.

†Socket fusion recommended for these sizes.