

PE 3408 EHMW Pipe  
**Butt Fusion Procedures**



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# Extra High Molecular Weight High Density Polyethylene PE 3408 Pipe

## Over 50 Years of Quality Service

This manual is a training guide for the butt (heat) fusion technique for joining PLEXCO PE 3408 Extra High Molecular Weight (EHMW) High Density Polyethylene Pipe. Butt fusion is the preferred method for joining high density polyethylene pipe. It has been an accepted procedure in the gas and municipal service industries for over 30 years.

The PLEXCO P34CH resin used in making PLEXCO PE 3408 Pipe has been specially engineered to provide a quality piping material that can be easily fused to form tough, strong joints. The average molecular weight is in the extra high molecular weight range (250,000 - 1,500,000) and is comparable to that of any other polyethylene piping material on the market. The broad molecular weight distribution of this resin makes it possible to easily produce quality butt fusion joints with greater control than is possible with pipe made from resins having the same molecular weight but a narrow weight distribution. This means that in PLEXCO EHMW High Density Polyethylene PE 3408 Piping, you have the pressure rating and abrasion resistance of a high density, extra high molecular weight material plus easy assembly by butt fusion joining.

Described here are the recommended procedures for using heat fusion to form strong and durable joints with PLEXCO PE 3408 Pipe. Experience has shown that a joint made by a properly trained person, using a proven fusion procedure, which passes a visual inspection based on proper bead formation, will have strength characteristics comparable to the pipe itself. Heat fused pipe sections become, in effect, a single piece of pipe.

*NOTE: Butt fusion procedures recommended by Plexco have been qualified in accordance with Title 49, Code of Federal Regulations, Part 192.283. Under the Title 49 regulations, gas pipeline operators are required to have qualified joining procedures, and per Part 192.285, to ensure that persons making joints in their gas piping system are qualified to make joints using the gas pipeline operator's qualified joining procedure.*

This bulletin is intended to be used as a guide for butt fusion techniques. 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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## Key Features of Butt Fusion Procedures

PLEXCO PE 3408 EHMW High Density Polyethylene Pipe is joined by a simple heat fusion process. The basic steps in this process are:

1. Be sure that the surfaces of the fusion tools, pipe and fittings are free of contaminants.
2. Heat the surfaces to be joined – both the pipe and fittings – simultaneously at a prescribed temperature for a specified time.
3. Remove the heater – bring melted surfaces together.
4. Hold until solidified.

A correctly made fusion produces a joint that is as strong as the pipe itself and has a record of proven performance.

Before you begin fusing, here are some points to remember:

1. All heater surfaces have a thin layer of non-stick coating that is easily scratched or scraped off. This coating prevents melted polyethylene from adhering firmly to the heater surfaces, but occasionally it also must be cleaned.

Metal tools should NEVER be used to clean the heater surfaces because they scratch and remove the coating.

Wooden implements and clean, dry, lint-free rags are recommended for cleaning. All-cotton rags are recommended because rags containing a substantial amount of synthetic fibers may melt and char against the heater surface.

If the non-stick coating becomes worn or scratched, the heating unit should be recoated.

Melted polyethylene adheres firmly to the heating iron and is more difficult to remove at places where the coating has been scraped off. In addition, since the coating acts as an insulator, heat transfer in these uncoated areas is greater, and local overheating can occur.

2. Just before using, wipe heaters to remove dirt and foreign material. As soon as possible after use, clean heaters with wooded implements and clean rags to remove melted or charred plastic.

3. At the end of every heating cycle, quickly observe the parts to be joined to insure sufficient and uniform melting patterns.

Join parts within 3 seconds.

If a non-uniform pattern is obtained, allow the pipe to cool, cut off the pipe ends, and repeat the procedure.

4. Check heater surface temperature at least once a day with a device such as surface pyrometer or crayon indicators for  $440 \pm 10^\circ\text{F}$  or  $500 \pm 10^\circ\text{F}$  fusion surface temperature. The heater thermometer will probably read a higher temperature than the fusion surfaces. Check the thermometer frequently for consistent readings.

5. NEVER lay a hot heating unit on the soil or grass when the heat cycle is completed.

Return it to the holder, if possible, or at least lay it on a board.

Soil can contaminate the joint and damage the coating; grass may burn and char the heater surface.

### Temperature for Butt Fusion

PLEXCO Technical Services personnel have conducted extensive testing to qualify the butt fusion procedure under laboratory conditions at a number of different temperatures over the range of  $350^\circ$  to  $525^\circ\text{F}$ . This work has shown that there are a number of “time-temperature-pressure” conditions that can be used to make acceptable joints.

The laboratory proven procedures have been modified based on field experience to provide two heater iron surface temperatures that are recommended for butt fusion of PLEXCO Polyethylene Pipe and Fittings:  $440^\circ\text{F}$  and  $500^\circ\text{F}$ . The choice of temperature should be based on the operating procedures and operating conditions of the individual installer.

The principal difference in the procedures used for  $440^\circ\text{F}$  and  $500^\circ\text{F}$  is the heating time necessary before making a joint. The lower temperature requires a slightly longer heating time. This extra time does allow some advantages in control and reproducibility of bead size.

## Butt Fusion Procedure

Butt fusion of PLEXCO PE 3408 EHMW High Density Polyethylene Pipe and Fittings is easily performed utilizing the equipment available today. For pipe sizes 4" IPS and larger, hydraulic fusion machines are normally used, and the following procedures are presented for such machines. Pipe sizes of 4" IPS and smaller are fused using manually operated equipment. The procedures and principles for manual fusion equipment are essentially the same as those which follow.

# Fusing PLEXCO PE 3408 Pipe to Other Manufacturers' Pipe

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 issued a document, PPI Technical Note TN-13, on "General Guidelines for the Heat Fusion of Unlike Polyethylene Pipes and Fittings." PLEXCO recommends that these guidelines be utilized when joining different polyethylenes. However, the mixing of different polyethylenes should not be done indiscriminately — optimum conditions will be achieved when joining pipe and fittings from the same manufacturer's system.

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

## Preparation Procedure for Hydraulic Fusion Machines\*

Butt fusion machines are available from several manufacturers. Various machines will have slightly different procedures for use, care, set-up, and operation. Consult the equipment manufacturer's manuals for correct instructions on the use, care, set-up, and operation of the butt fusion machine.

Hydraulic fusion machines typically have controls for setting pressures used for facing, heating, and fusing. It may be necessary to add pressure to overcome machine internal drag pressure or external forces acting on the pipe.

- Facing should be conducted at a pressure that produces properly faced pipe ends.
- Heating pressure should be set so that the pipe ends maintain contact against the heater, but are not forced against the heater (zero contact pressure).
- Fusing pressure may be determined using the interface pressures presented below.

### Fusion Interface Pressure Guidelines

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

Install appropriate inserts in the pipe clamps as necessary. IPS sizes are for IPS (steel) pipe diameters; DIPS sizes are for ductile iron pipe sizes.

Heater surfaces must be clean and free of contaminants such as dirt, oil, grease, and melted or charred plastic. To clean the heater, use only wooden implements and clean, dry, lint-free non-synthetic cloths. Take care not to damage coated surfaces.

With a surface pyrometer, check the heater for uniform surface temperature. Adjust the heater as necessary for 400°F ± 10°F or 500° ± 10°F surface temperature. (Heater thermometers indicate internal, not surface temperature.)



## Butt Fusion Procedure

With a clean dry cloth wipe both inside and outside surfaces of the two ends to be joined to remove dirt and foreign material. It is important that the ends protruding past the jaws be absolutely clean and free of contaminants.

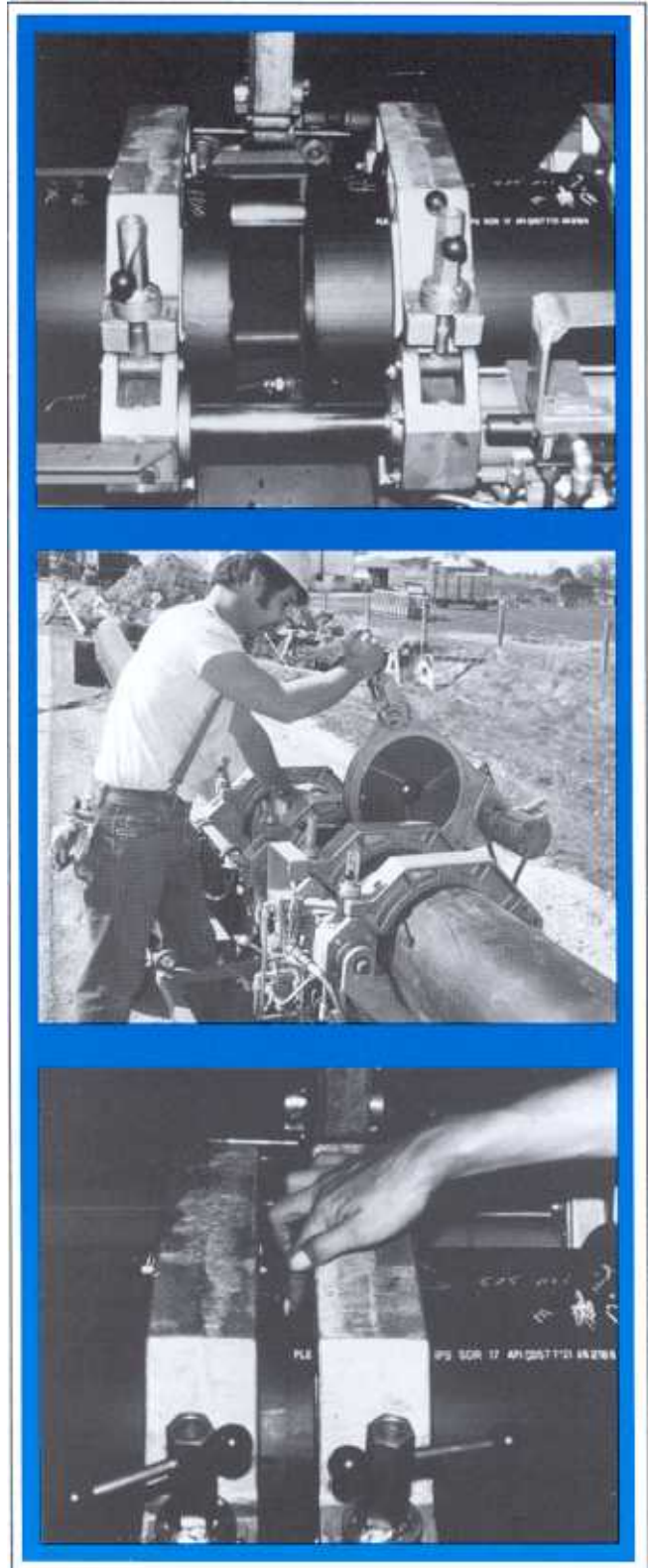
1. Install pipe in machine. Ends should extend approximately an inch past alignment clamps for facing. Check alignment and adjust as necessary.

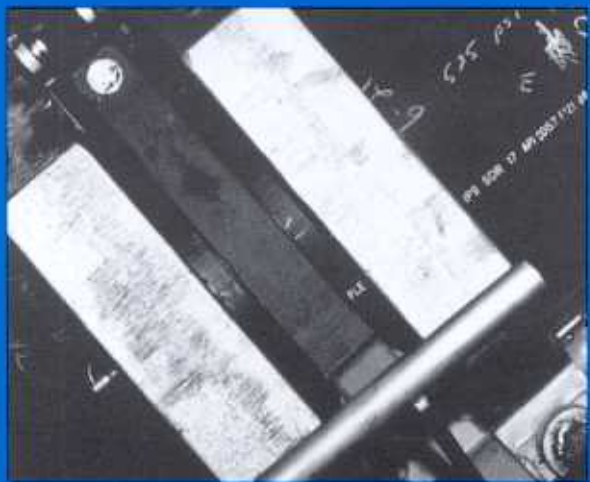
2. Place the facer between the pipe ends. Face the pipe ends until continuous ribbons are produced on both side or the facer. Turn off the facer, move the pipe ends apart, and remove the facer. Clean out ribbons and shavings from around and inside the pipes. Do not touch the newly faced surfaces with the hands, as perspiration and body oils could contaminate the surfaces.

**IMPORTANT:** *The pipe ends are properly faced when continuous ribbons are produced on both sides of the facer unit. If the facing stops are reached before continuous ribbons are produced, re-install the pipe ends in the machine (Step 1), and continue facing until continuous ribbons are produced on both pipe ends. Facing down to the stops is preferred.*

3. Bring the two pipe sections together and, with the fingers, feel for any high-low difference at the junction of the two ends. If necessary, tighten the appropriate inside clamp until the two sections are aligned as closely as possible. Tighten the high side, never loosen the low side.

**IMPORTANT:** *After facing the pipe ends, if any adjustment at all is made on one or both inside clamps, then the facing unit should be re-installed and the pipe ends given several turns with the cutter until the motor speeds up, before continuing with heating and fusing.*





4. Separate the two pipe sections. Slide heater to a position where it will come between pipe ends. Use caution in this operation to avoid coming in contact with pipe. Bring the movable pipe section against the heater until both pipe ends are in firm contact with the heater.

**IMPORTANT:** *As soon as the pipe ends are firmly against heater, immediately move control valves to a neutral position to remove pressure of pipe against heater.*

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.

5. Heat the pipe ends until properly sized melt beads are formed on both pipe ends. As the pipe ends are melted against the heater during the heating period, the molten plastic will swell and form melt beads around the pipe ends. The melt beads should be the same size on both pipe ends, and uniformly sized all the way around.

#### Approximate Melt Swell Bead Size

Pipe Size	Melt Bead Size
Less than 3"	1/16"
3" - 6"	1/8"
8" - 10"	3/16"
12" - 24"	1/4"
26" - 36"	7/16"
38" - 54"	9/16"

Depending upon wall thickness, melt swell bead size may vary.

6. After melting has been completed as above, separate the pipe ends just enough to remove the heater. Quickly observe the parts to be joined to ensure sufficient and uniform melting patterns. Then quickly bring the pipe ends together with the pressure recommended by PLEXCO. Join parts within 3 seconds. If melted plastic sticks to the heater, don't join the two ends – discontinue making the joint, let cool, and start over again from Step No. 1.

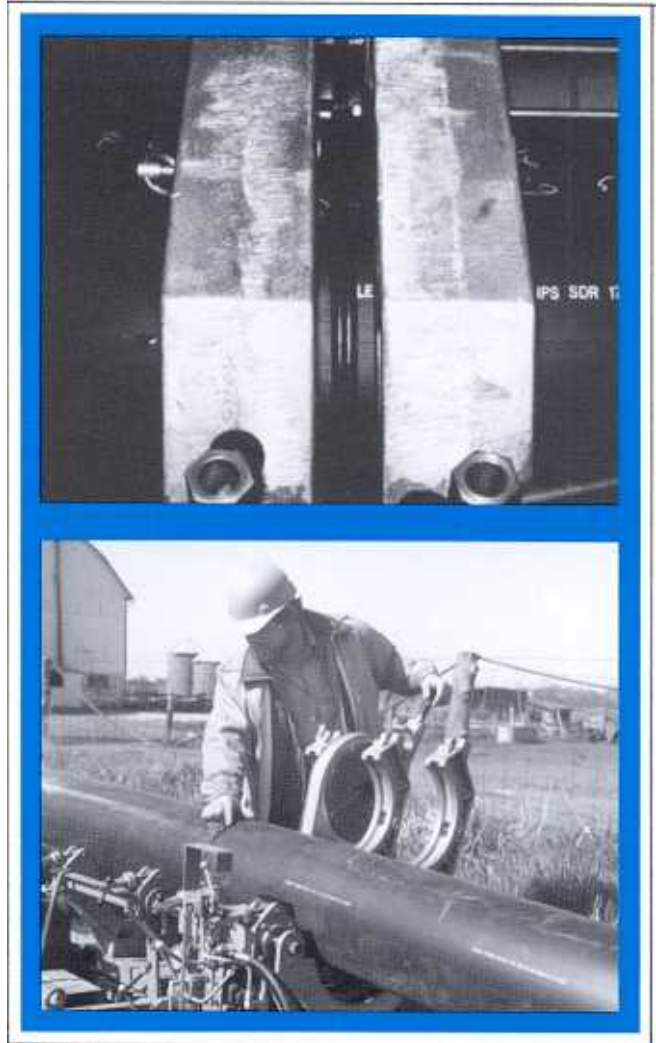
**IMPORTANT:** *Do not use pressures above the range indicated. Excessive pressures will squeeze too much melt out of the fusion area and result in a weakened joint.*

The force applied will cause each bead to roll back onto the pipe as shown. Insufficient rollback is one indication of a faulty joint.



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7. While maintaining the pressure used in making joints, allow the joint to cool for 30 to 90 seconds per inch of pipe diameter before removing from machine. Heavier walled pipes (lower SDR) will require more cooling time. If upon examination the joint appears faulty, cut open and start again with Step No. 1.



8. Remove fused pipe sections from fusion machine. Allow joint to cool at least 20 minutes after removal before subjecting it to testing, bending or backfilling stresses. Reposition fusion machine so that end of the newly fused section lies in the stationary clamps while a new pipe section is placed in the movable clamps. Repeat fusion procedure beginning with Step No. 1.