

**Recommended Minimum Training Guidelines
for PE Pipe Butt Fusion Joining Operators
for Municipal and Industrial Projects
TN-42/September 2009**

Foreword

This technical note was developed and published with the technical help and financial support of the members of the PPI (Plastics Pipe Institute, Inc). The members have shown their interest in quality products by assisting independent standards-making and user organizations in the development of standards, and also by developing reports on an industry-wide basis to help engineers, code officials, specifying groups, and users.

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PURPOSE

The purpose of this document is to provide a general outline of PPI's recommended minimum guidelines for training an operator in properly and safely making good quality butt- fusion joints in PE pipe systems. This training guide is intended to recommend a consistent minimum level of fusion operator proficiency; certain installations may require additional operator training and proficiency.

SCOPE

Butt fusion joining of PE pipe is a relatively simple, forgiving, and dependable process. However, as with any kind of pipe installation, proper procedures and diligence must always be used to consistently make satisfactory joints. Fusion machine operators should demonstrate an aptitude for using mechanical equipment and be generally familiar with laying pipe. They should have a demonstrated ability to follow procedures and be conscientious in their work. The amount of time it takes to provide the specified training can vary greatly and depends on the number of individuals being trained as well as their aptitude and willingness to follow directions. However, participants shall not be considered "trained" until they have demonstrated proficiency on at least two test joints made under circumstances and field conditions representative or similar to those of the project.

PE Pipe Sizes and SDR/DR

PE pipe for use in industrial and municipal applications is produced in accordance with applicable industry standards (ASTM, AWWA, API). In AWWA, the pipe outside diameters (ODs) conform to the OD dimensions of iron pipe IPS, or to equivalent OD for DI pipe (DIOD). In general, pipes are manufactured and measured based on OD (outside diameter) and wall thickness. The ratio of outside diameter to minimum wall thickness defines the pipe's SDR (Standard Dimension Ratio) or DR (Dimension Ratio) number. These numbers also define the pipes pressure rating at 80°F (27°C) in AWWA standards. And, because of the importance of the information these numbers convey, they are required to be included in the pipe markings specified by the applicable industry standard. These standards require that all pipes be clearly marked at specified intervals with the following information:

- Name or trademark of the manufacturer
- Production code number to identify location and date of manufacture.
- Nominal pipe size
- IPS or DIPS
- SDR or DR number, or pressure rating, or both

- The applicable industry standard(s) with which the pipe complies e.g. ASTM, AWWA, API or a combination of those specifications to which the pipe may have been manufactured, (e.g. ASTM F714 / AWWA C-906).
- Use the Pipe Size and SDR/DR to determine the proper fusion pressures applicable for the fusion machine and product being joined. In the event this information is not immediately available the user is advised to consult with either the fusion equipment or pipe supplier.

Links to PPI and the major equipment suppliers are listed as follows:

- Plastics Pipe Institute www.plasticpipe.org
- Connectra Fusion Equipment <http://www.connectrafusion.com/fusion-calculator.php>
- McElroy Manufacturing Fusion Equipment <http://www.mcelroy.com/fusion/calculate.htm>
- RITMO America <http://www.ritmoamerica.com>

MACHINE QUALIFICATION

The selected fusion equipment shall be capable of meeting all parameters of the job. The equipment shall have jaws or reducing inserts designed to properly hold the size of the pipes being fused, and it shall have enough hydraulic force to reach the required fusion pressure during all fusion conditions. The fusion operator shall be thoroughly familiar with and trained on the equipment being used. Such training shall include at least the following:

- 1) Safety
- 2) Operator's manual & checklist
- 3) Basic maintenance and troubleshooting
- 4) External power requirements
- 5) Features
- 6) Components and how they operate
- 7) Hydraulic operation (if applicable)
- 8) Determining required fusion pressure and how to set on machine
- 9) Heater operation and temperature requirements and adjustment
- 10) Data logging device (if applicable)

Job Set-up Guidelines

Weather Guidelines: Successful butt fusions can be accomplished in a broad range of weather temperatures. Pipe ends and the fusion equipment must be dry and sheltered from rain and wind. The limitations are driven by products and the equipment being used.

While PE pipe has very good impact resistance even in sub-freezing conditions; nonetheless its impact strength is reduced as temperatures drop into these ranges. Therefore, avoid dropping pipe in sub-freezing conditions. Also, keep in mind that butt fusion, when temperatures are below -4°F (-20°C), generally requires special provisions such as portable shelters or trailers or other suitable protective measures with auxiliary heating. Here are some general guidelines to address different weather conditions:

Cold Temperatures, Down to 32°F (0°C): When butt fusing PE pipe under these conditions, it is recommended that a temporary wind barrier be set up around the operator and fusion equipment. It is also recommended that the pipe ends be closed off by use of end caps or other means to prevent the flow of cold air. These measures will help greatly to reduce the heat loss in the heater plate and provide for a more uniform heating cycle and improved operator efficiency.

Cold Ambient Temperatures Below 32°F (0°C): In addition to the above, the following preparations should be undertaken before fusing pipes. Pipe ends should be pre-heated using a heating blanket or warm air devices to elevate the pipe temperature to improve the heat cycle starting condition. With pipe mounted in the fusion machine, an alternate method of pre-heating is to position the pipe ends within ¼ to ½ inch of the heater plate face to allow the pipe ends to warm for 30 seconds to 2 minutes, depending on the pipe size and wall thickness. Before starting pipe fusion, the operator needs to ensure that the ID of the pipe is clear of moisture possibly due to frost that is being melted during the warming operations.

Notice: The use of direct application open flame devices, such as torches, for heating PE pipe is prohibited due to the lack of adequate heating control and the possibility of oxidative damage to the pipe ends and even ignition of the pipe. The warming temperature should not be continuous nor exceed 120°F (49°C).

Warm (Hot) Environment, 32° F (0°C) to 120° F(49°C): . Elevated temperature conditions can be mitigated by shading of the operator and the equipment where applicable.

Wind: Exposure of the fusion heater plate and pipe to wind can result in unacceptable temperature variations during butt fusion and possible joint contamination. When unfavorable wind conditions exist, the provision of a suitable shelter is required to protect the pipe and the fusion heater plate to ensure more consistent work performance. Unfavorable wind conditions can also flow through the pipe bore and cause unacceptable temperature variations during the fusion process, therefore open pipe ends may require plugs or covers to prevent this condition.

Additional Considerations:

- PE pipe and fittings will expand and contract with changes in temperature so in such an event be prepared to make necessary adjustments.
- Where pipes are to be clamped in the fusion machine, make sure pipe, fitting and clamp surfaces are dry, clean and free of ice, frost, snow, dirt and other contamination.
- When butt fusion is done in cold weather, **DO NOT INCREASE THE HEATING TOOL SURFACE TEMPERATURE** to attempt to compensate. **THE REQUIRED SURFACE TEMPERATURE MUST BE WITHIN THE SPECIFIED RANGE BETWEEN 400-450°F (204-232°C) with 425°F (218°C) being the target temperature.** Some butt fusion equipment is operated hydraulically through the use of motor and hydraulic oils. When operating such hydraulically assisted equipment at ambient temperature extremes, read operators manuals to make necessary viscosity adjustments to aide in the equipment's performance. The same holds true for generators supporting the butt fusion equipment.
- In cold conditions, it will take longer to develop an indication of melt around the pipe circumference at fusion pressure and longer to develop the final bead size in the heat soak cycle.
- **DO NOT** apply "fusion pressure" during the heat soak cycle. When proper melt has been obtained, the pipe and heater should be separated in a rapid, snap-like motion on manually operated equipment. The melted surfaces should be inspected (looking for a smooth melted surface) then be joined immediately in one smooth motion so as to minimize cooling of the melted pipe ends.

Pipe Handling Guidance: The jobsite pipe storage area should be relatively level and smooth. It should be large enough to allow for safe movement of the pipe and pipe handling equipment. The optimum situation is to have the pipe stored in close proximity to where the fusion equipment will be used for joining. The pipe should be placed on wooden beams or other type supports to keep it out of the dirt, mud etc.. Where ground is level, the pipe or bundles of pipe can be stacked as high as about 6 ft. but not more. Where the ground is not very level, pipe should not be stacked in bundles but should be placed individually next to one another. Likewise, coils of pipe should not be stacked on each other but should be placed individually on protective supports on the ground.

Coils should be stored in such a manner as to prevent any possibility of rolling or falling over.

DANGER: Coils, bundles, and even individual lengths of pipe are very heavy and by falling or rolling over can result in property damage, serious injury or even death.

For lifting pipe whether it be single pieces, coils or bundles it is extremely important to use only properly weight rated fabric slings capable of handling the load. DO NOT use wire rope or chains to lift or move pipe, they will damage it.

Special care should be taken when cutting tie bands on coils or on bundled pipe. As mentioned earlier, falling, rolling, or springing pipe can be extremely dangerous. First, cut only the bands on the outside and work carefully to extract the pipe pieces as needed.

Pipe Stands and Supports:

When butt fusing lengths of pipe it is necessary that pipe support stands be used. These pipe support stands work best when they are positioned on either side of the fusion machine approximately 20' from the pipe ends. Adjust the height of the stands so that the pipes are level; this will help to reduce pipe drag. The more stands that are used the more freely the pipe(s) move into and through fusion machine.

Other devices such as carts, racks etc. can be used to aide in supporting and feeding pipe into and through fusion units.

Do's and Don'ts in Pipe Handling:

DO's

- Make sure the pipe is secure and balanced prior to moving
- Store pipe on a level surface prior to use if possible
- Read and adhere to all published safety procedures on the subject of PE pipe handling
- When installing PE pipe do take into consideration that in locations that may experience large temperature swings between day and night, exposed pipe that is not restrained will change in length due to expansion and or contraction. For the condition of a drop in temperature, the pipe contraction could affect any lateral connections installed in the line; if the line contains bell and spigot or mechanical joints with insufficient pull-out resistance, then there exists the potential for joint separation. Exposed pipe that is anchored has a different response to the condition of a drop in temperature; namely, the generation of longitudinal loads that result in increased tensile stress. Temperature increases have the opposite and other effects. Therefore, it is

very important that the effects of thermal change be taken into account when installing pipe. For additional information on this subject the reader is referred to the PPI PE Handbook, Chapter 6 - Section 4. Once the pipe is buried and compacted in the ditch, (not free floating or unrestrained) temperature change has very little effect on the pipe.

- Before pulling pipe, do check for its maximum allowable pulling load. The safe pulling load depends on the pipe's OD its wall thickness and material grade. For the recommended safe values the user is referred to the Tables on this subject in Chapter 12 in the PPI PE Handbook.

DON'TS

- While PE pipe is an extremely tough material it can be scratched or gouged, therefore, it should not be pulled or dragged over sharp objects. Pipe is generally not acceptable for installation if it contains damage that exceeds about 10% of the minimum wall thickness of the pipe designed for the application. For more details on this subject, the reader is referred to the PPI's PE Handbook, Chapter 2, section entitled 'Damage Inspections' or consult with the pipe manufacturer.
- Ignore recommended handling and installation procedures
- Bury the pipe with large sharp rocks, tree roots or other rigid objects against the surface of the pipe
- Kink the pipe during handling or installation.
- Perform rough handling of a fusion joint for at least 30 minutes after it has come out of the fusion machine. Additional time may be required for pipes with wall thicknesses greater than 2 inches, especially if the prevailing ambient temperature is above 90°F.
- Stick the forklift forks into the side of the pipe.
- Stand under or anywhere close to the pipe while it is being unloaded from a truck
- Fuse pipe in a dust storm without a shelter (Dust can contaminate the fusion joint)⁽¹⁾
- Fuse pipe in a rain storm without a shelter (Water can contaminate the fusion joint)⁽¹⁾

⁽¹⁾ For additional information on this topic please refer to the discussion under the Job Set-up Guidelines Section

Safety

- PE Pipe is an inert substance that poses no known health risk. Polyethylene (PE) is used to wrap the food you eat and PE pipe is used extensively for transporting potable water, so touching the pipe is completely safe.
- Always wear personal safety gear including hard hat, steel toed shoes and safety glasses.
- Do not stand in the path of the pipe being loaded or moved. Miss-handled, rolling or falling pipe can result in serious injury or death.
- Before starting or performing any work with the fusion equipment, it is very important that the operator carefully read and accept the equipment manufacturer's instructions on safety and operation that are published in the Manufacturer's Owners Manual. This is emphasized particularly because of the fact that while most heat fusion equipment is electrically powered, it is not explosion proof. Therefore, special attention is needed when performing fusions in an atmosphere that may be volatile, such as when gas or coal / grain dust may be present. Also, handling of the heating irons deserves special care insofar as they are very hot, greater than 400°F (204°C).
- Before unloading, reloading or moving pipe or equipment, carefully read and adhere to all published procedures and safety related documents. (PPI's PE Pipe Handbook, PPI's Materials Handling Guide publication and the pipe manufacturers literature.)
- Keep hands out of harm's way when loading pipe into, or removing it from the fusion machine. Likewise, for working with any other related pipe assembly or installation equipment, carefully follow all established safety procedures

Butt Fusion – A Six Step Process

This section outlines the Butt Fusion Procedure, per ASTM F2620, Standard Practice for Heat Fusion Joining of Polyethylene Pipe and Fittings and PPI TR-33, Generic Butt Fusion Joining Procedure for Field Joining of Polyethylene Pipe.

Please read carefully and fully understand equipment set-up and all six steps before beginning the fusion process. Also, before operating the fusion equipment, carefully read and understand the equipment manufacturer's published instructions on safety and operation and refer also to the highlights listed under the preceding Safety Section of this document.

Butt Fusion Machine Set-up

The operator should be familiar with these concepts before starting the 6-step Butt Fusion Procedure.

Heating Pressure: Carriage pressure during the heating process is a two step process. Initial contact is made at the pre-set fusion gauge pressure. After a melt bead is observed all around the pipe, this pressure should be lowered to the drag pressure (called “soak pressure”) for the remainder of the heat cycle. During this time the hydraulic valve system should “lock” the carriage into position where it can neither move forward nor backward.

Facing Pressure: With pipe ends clamped into the fusion unit, apply just enough pressure to bring the two pipes into contact with the rotating facer, being careful not to slam into and possibly bog down or jam the facer unit.

Fusing Pressure: Take the drag pressure and add it to the calculated fusion pressure to obtain the fusion gauge pressure; see ASTM F 2620 and/or pipe distributor.

Drag Pressure: Drag Pressure is something that needs to be considered when butt fusing PE pipes and or fittings together. Drag is the amount of gauge pressure needed to overcome the frictional resistance of the hydraulic unit itself (called “static drag,” and usually amounts to around 30-50 psi) combined with the amount of pressure needed to overcome the resistance of the pipe that is being pulled into the facer and heater (called “dynamic drag”). This amount can vary from very little to an amount that could potentially exceed the hydraulic capacity of the fusion unit (e.g., if fusing a long spool of pipe that is not well supported). The amount of drag pressure in PSI needs to be added to the theoretical fusion pressure to get the final calculated fusion gauge pressure. After facing the pipes, move the carriage so that the pipe ends are approximately 2” apart. To determine the drag pressure, adjust the pressure on the carriage so that it is not moving at all. Gradually increase the pressure until the carriage barely moves, observing the pressure gauge. Repeat if necessary. The pressure being indicated to just move the carriage is the drag pressure. (If fusion conditions change, this procedure must be repeated.)

Butt Fusion Procedure

NOTE: When using hydraulic fusion equipment, correct operation of hydraulic controls for carriage movement and pressure regulator selection is essential to produce quality butt fusions. Improper hydraulic control operation can seriously compromise butt fusion joint quality.

STEP 1 - Securing the Pipe SECURE THE PIPE IN THE JAW CLAMPS OF THE FUSION MACHINE TO ENSURE CORRECT ALIGNMENT. THERE SHOULD BE NO SLIPPAGE OR UNINTENDED MOVEMENT OTHERWISE CORRECT FACING WILL NOT BE ACHIEVED.

a) **Adjust, Align and Secure.**

- i) Adjust and align the pipe ends to minimize any parallel misalignment (high / low) or angular misalignment when the pipe ends are brought together.
- ii) Adequately tighten the clamps so as to prevent any unintended movement or slippage of the pipe when the pipe ends are brought together.
- iii) On a four-jaw fusion machine, first clamp the outer-jaws to secure the pipes, then the inner-jaws to allow for high / low adjustment during “Step 2 Facing the Pipe Ends”.

b) **Clean, Clean and Clean**

- i) Clean the exposed pipe ends approximately three inches back along the pipe's inner and outer walls.
- ii) Clean to remove any surface contaminants.
- iii) Always use a clean, dry cotton cloth when cleaning pipe ends to be fused.
- iv) Never use a synthetic cleaning cloth; a lint-free cotton cloth is required.
- v) All fusion surfaces must be completely clean and dry to achieve a proper fusion.

c) **Allow for the pipe ends to extend through the jaw clamps to permit complete facing.**

- i) Assure that pipes are cut as square as possible so as not to damage facer pivot arms.

STEP 2 - Facing the Pipe Ends TO PREPARE FOR HEATING IN STEP 4, THE PIPE ENDS MUST BE PREPARED BY FACING OFF MATERIALS TO PROVIDE SMOOTH, PARALLEL AND CLEAN MATING SURFACES.

- a) Position the facing tool into the fusion machine between the secure and aligned pipe ends.
- b) Activate the facing tool.

- c) Bring the pipe ends into contact with the rotating facing tool.
- i. With manual machines use only minimal pressure to initiate and maintain the cutting process between the pipe ends and the rotating surface of the facing tool. Hydraulic machines should be set to “facing pressure”.

Note - Excessive pressure may create too much of a load on the facer motor causing the facing tool to “bog down”, and potentially damaging both the facing tool and the fusion equipment.

- ii. The correct facing process will have complete ribbons of polyethylene that are shaved from the pipe ends.
- d) Facing is complete when:
 - i. Complete ribbons of polyethylene have been shaved from the pipe ends, **AND**
 - ii. The pipe ends have smooth, clean and parallel surfaces, **AND**
 - iii. The “stops” on the facing tool and the jaw clamps are in contact, **AND**
 - iv. The rotating surface on the facing tool is able to “freewheel”; there is no resistance from the facer blades being in contact with the pipe ends.
- e) Stop the facer motor and move the pipe ends away from the facer.
- f) Remove the facing tool and clear away all shavings, cuttings and debris. Lightly brush away loose debris from the pipe ends with a clean lint-free cotton cloth.
- g) Avoid any contact with the pipe ends other than above step “f” during and after the facing process.
 - i. Any contact with the faced, fusion surface other than the facing tool or the cleaning device requires the operator to repeat the cleaning process as described in Step 1 “Securing the Pipe”.
 - ALWAYS FACE TO THE STOPS!
 - AVOID ANY CONTAMINATION of the faced pipe’s ends.

STEP 3 - Aligning the Pipe Ends ALIGNING THE PIPE ENDS VERIFIES THAT THEY ARE READY FOR THE FUSION PROCESS.

- a) Bring the newly faced pipe ends together at facing pressure to check for parallel alignment (high / low), angular alignment, slippage and unintended movement.

- i) Inspect the contact of the two pipe ends to ensure that there are no gaps or voids.
 - ii) Visually check for any misalignment (high/low) around the complete outer surface at the point of contact between the two pipe ends.
 - iii) Use a clean straight edge tool to check for any outer surface misalignment (high/low) between the outer surfaces of the two pipe ends.
- b) Adjust any misalignment (High / Low) by tightening the “High”-side jaw clamp. Never loosen the low-side.
- c) NOTE: If **ANY** adjustments are made, redo Step 2 “Facing the Pipe Ends”.
- d) Bring the pipe ends together at the calculated fusion pressure to check for possible slippage or unintended movement. NOTE: If **ANY** slippage or unintended movement occurs, redo Step 2 “Facing the Pipe Ends”.
- e) NEVER ATTEMPT TO HEAT OR FUSE PIPE THAT IS NOT CORRECTLY ALIGNED. Misalignment that exceeds 10% of the pipe wall thickness is incorrect and is not acceptable.

STEP 4 - Melting the Pipe Ends MELTING THE PIPE ENDS AT THE RECOMMENDED TEMPERATURE FOR THE REQUIRED DURATION IS REQUIRED TO CREATE A STRONG, ACCEPTABLE FUSED JOINT.

- a) Check the heater tool surface temperature with a calibrated infrared or surface pyrometer to insure the temperature is within the recommended range: 400°F – 450° F (204°C – 232°C). Follow the manufacturer’s instructions.
- b) Clean the heater surfaces with a clean lint free cotton cloth.
- c) Follow the correct Butt Fusion Joining Procedures for the fusion equipment and pipe material on the jobsite. (ASTM F2620-06 and PPI TR-33 2006 are suggested guidelines):
 - i) Briefly bring the pipe ends into contact with the heating tool surfaces at the fusion pressure.
 - ii) Maintain fusion pressure” only until first indication of melt is visible around the complete outer edge of both pipe ends indicating that the pipe ends are in full contact with the heater plate around the full circumference.

iii) Immediately reduce pressure from “fusion pressure” to drag pressure without releasing contact between the melted pipe ends and the heating tool surfaces. Once the pressure is at drag pressure, lock the movable carriage so it can’t move in either direction for the “heat soak cycle”. On manual machines, this will be only enough pressure to maintain contact between the pipe ends and the heating surfaces.

Caution: Care should be taken that pressure never exceeds the drag pressure during the heat soak cycle. **THIS IS CRITICAL FOR A GOOD FUSION.** During the heat soak cycle the melt bead will form due to the thermal expansion of the melted ends, **NOT** by any external pressure being applied to the heater plates.

iv) Maintain contact between the pipe ends and the heating tool surfaces until an acceptable melt bead is achieved per Table 1.

Table 1: Approximate Melt Bead Size (Pipe Ends)

Pipe Size	Approximate Melt Bead Size
Above 1-1/4” to 3”	About 1/16”
Above 3” to 8”	1/8” - 3/16”
Above 8” to 12”	3/16” – ¼”
Above 12” to 24”	¼” - 7/16”
Above 24” to 36”	About 7/16”
Above 36” to 63”	About 9/16”

STEP 5 - Joining the Pipe Ends THE PROCESS OF BRINGING THE PIPE ENDS TOGETHER USING the PRE-SET PRESSURE.

a) When the correct melt bead is formed, per the ASTM standard summarized in Table 1, **QUICKLY** separate the pipe ends from the heating tool and remove the heating tool without coming into contact with the melted pipe ends. Next, **QUICKLY** inspect the pipe ends, which should be flat, smooth, free of contamination and completely melted.

Concave pipe ends (caused by heating under pressure) are **UNACCEPTABLE** – see Figure A for a photograph representative of this condition. If acceptable, **QUICKLY**

bring pipe ends together and apply fusion pressure. This process should take no longer than 9 seconds for pipes 3” – 24” and 9-15 seconds for 24” and larger pipe. For manual machines, apply enough force to have the melted ends roll back to the pipe surface. Hold that force until the pipe ends cool to the touch per ASTM F2620.

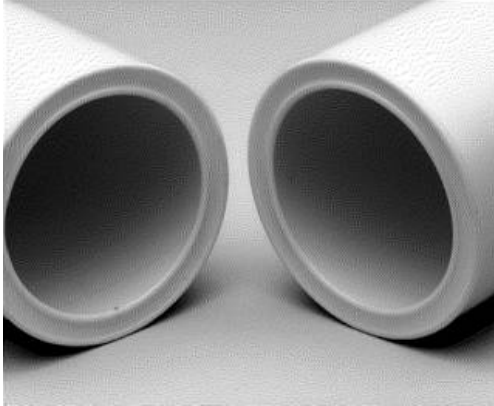


Figure A. UNACCEPTABLE APPEARANCE – Improper Concave Melt Surfaces after Heating; probably caused by heating under pressure.

- b) If there is any indication of an incorrect melt or contamination, **DO NOT CONTINUE.**
 - i) Allow the pipe ends to cool and start over with Step 1 “Securing the Pipe”.
- c) A good fusion will form a double roll-back bead onto the pipe surface. Refer to Figure B for bead appearance evaluation.

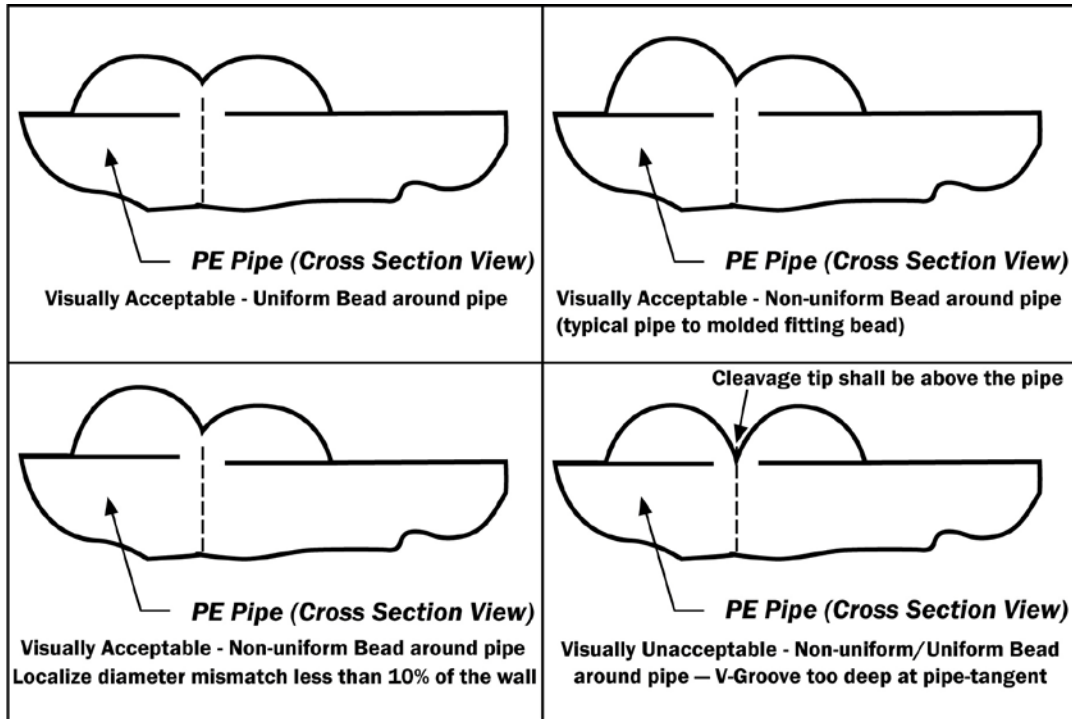


Figure B: Butt Fusion Bead Acceptance Guideline

Notes to Figure B:

- When fusing PE 4710, a slight gap may be present between the pipe OD and the bottom of the bead after cooling. When fusing PE 4710 to PE 3608/3408, the bead on the PE 3608/3408 pipe may roll all the way over the pipe wall, but the bead on the PE 4710 may not roll out completely.
- The top right quadrant in Figure B might also be seen if fusing pipes with different DRs

f) If the visual inspection of the fusion joint is not as described, it should be cut out and the process should begin again with Step 1 “Securing the Pipe”.

STEP 6 - Holding the Pipe HOLDING THE PIPE, AND ALLOWING IT TO COOL COMPLETELY, IS NECESSARY FOR JOINT STRENGTH.

- a) Maintain the correct fusion pressure until the joint has cooled.
 - i) Allow the joint to cool for 30 to 90 seconds per diameter inch or until the surface of melt bead is cool to the touch- Note that in accordance with ASTM F 2620

recommendations, “Pouring water or applying wet cloths to the joint to reduce cooling time is not acceptable. Applying chilled air is acceptable only as part of a controlled cooling cycle procedure where testing demonstrates that acceptable joints are produced using the controlled cooling cycle procedure.”

- ii) Heavier wall thicknesses require longer cooling times
- b) Avoid pulling, installation, pressure testing, or rough handling of the fused pipe for an additional 30 minutes or longer past completion of the last joint in the pipeline.
- c) Re-inspect the butt fusion joint.
 - i) Both sides of the double roll-back bead should be rolled to the pipe surface.
See Figure B above for proper bead appearance
- d) The depth of the “v groove” (see Figure B, bottom right) should be no more than 50% of the bead height.

Making and Testing Sample Butt Fusion Joints.

In order to verify the quality of the fusion process, including fusion operator skills and machine function, it is required that sample fusion joints be made for testing using the fusion procedures described in ASTM F2620-06 and in PPI TR 33 in conjunction with those outlined in this document. These test samples are for pipe with a wall thickness of 1” or less. For thicker wall applications, contact the pipe manufacturer for the appropriate test. The following describes the preparation of the test samples and the details of the testing procedure

- 1) Complete a minimum of two butt fusion joints for test using the procedures described in this document,
- 2) Complete a visual inspection of the joints to confirm their suitability for testing
- 3) Allow the fusion joint samples to cool to a temperature ranging between 65°F (18°C) and 80°F (27°C).
- 4) Cut a strip from each of the sample fusion joints for testing.
 - a) The fusion joint should be in the middle of the cut length specimen.
 - b) The overall length of the strip should be 15x the wall thickness (a minimum of 6”) on each side of the fusion

c) The overall width of the strip should be no less than 1-1/2x the wall thickness (a minimum of 1”).

5) Bend the strips in a “back and forth” motion, with the ends touching each other at the completion of each motion.

A correct fusion joint should not crack or fail, or produce gaps or voids during this testing procedure. However, It should be noted that if testing is performed when the temperature of the samples is outside the 65°F to 80°F range specified in 3) above, a false result may be obtained.

Training Record per PPI TN 42-2009 Recommended Minimum Training Guidelines for PE Pipe Butt Fusion Joining Operators for Municipal and Industrial Projects

Date of Training: _____

Name of Trainer: _____

Name of Trainer's Company or Employer: _____

Name of Trainee Fusion Operator: _____

Name of Trainee Fusion Operator's Employer: _____

Name and Location of Project: _____

Fusion Machine(s) Used:

1. Manufacturer: _____ Machine: _____ Serial No.: _____

2. Manufacturer: _____ Machine: _____ Serial No.: _____

Pipe Samples Fused:

1. OD _____ SDR/DR _____ Product ID/Manufacturer _____

2. OD _____ SDR/DR _____ Product ID/ Manufacturer _____

Training Completed

Number of Joints Tested: ____ Number Passed Test: ____ Number Failed Test _____

Training on Butt Fusion above ground _____ Training on Butt Fusion in ditch _____

Operator _____ Date: _____

Trainer _____ Date: _____

NOTES: 1. A Copy of this fully completed Training Record must be retained by the Fusion Operator and be available for inspection at all times while performing fusion joining operations on the project.

2. The Trainer must also retain a fully completed file copy of this Training Record for future reference.

APPENDIX

Butt Fusion Joints – Visual Appearance Guidelines



Figure 1. ACCEPTABLE APPEARANCE - Proper Double Roll-back Bead and Proper Alignment

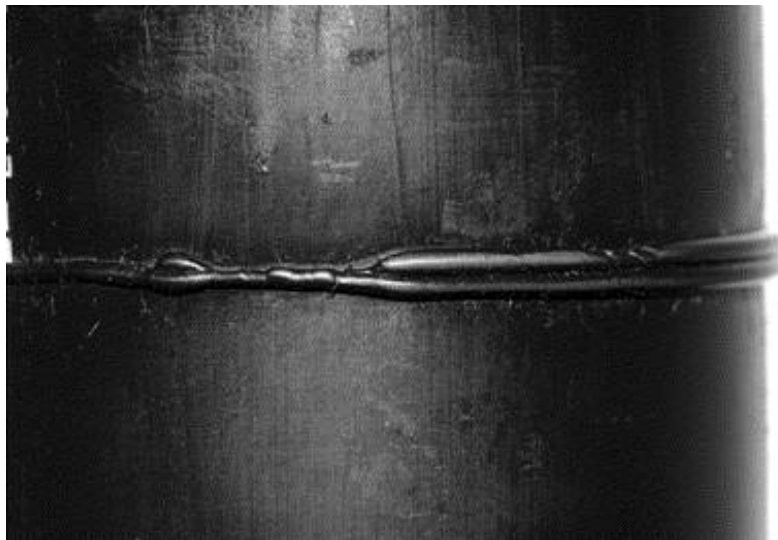


Figure 2. UNACCEPTABLE APPEARANCE – Incomplete Face-off



Figure 3. UNACCEPTABLE APPEARANCE – Mitered Joint – Improper ‘High-Low’ Pipe Alignment



Figure 4. UNACCEPTABLE APPEARANCE – Unintentional Mitered Joint – Improper Alignment in Fusion Machine



Figure 5. UNACCEPTABLE APPEARANCE – Contamination in Joint