



# Standard Practice for Heat Fusion Joining of Polypropylene (PP) Pipe and Fittings<sup>1</sup>

This standard is issued under the fixed designation F3722; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reappraisal. A superscript epsilon (ε) indicates an editorial change since the last revision or reappraisal.

## 1. Scope

1.1 This practice describes procedures for making joints with pressure-rated polypropylene (PP) pipe and fittings by means of heat fusion joining in, but not limited to, a field environment. This standard does not purport to address all possible heat fusion joining procedures or to preclude the use of qualified procedures developed by other parties that have been proven to produce reliable heat fusion joints.

1.2 The parameters and procedures are applicable only to joining PP pipe and fittings of related polymer chemistry that is either solid wall, monolithic in nature, or multilayer in nature containing one or more layers of PP-based reinforcement. They are intended for PP pipe and fittings manufactured in accordance with Specification F2389, CSA B137.11, or ISO 15874. Consult with the pipe manufacturer to make sure they approve this procedure for the pipe and fittings to be joined.

NOTE 1—The parameters and procedures shown within this practice are consistent with the parameters and procedures provided in DVS German Welding Society Technical Code 2207-11.

1.3 Parts that are within the dimensional tolerances given in current ASTM, CSA, or ISO specifications are required to produce sound joints between polypropylene pipe and fittings when using the joining techniques described in this practice.

1.4 The values stated in either SI units or inch-pound units are to be regarded separately as standard. The values stated in each system are not necessarily exact equivalents; therefore, to ensure conformance with the standard, each system shall be used independently of the other, and values from the two systems shall not be combined. The values given in parentheses are mathematical conversions that may not be exact equivalents to either SI units or inch-pound units and that are provided for information only.

1.5 The text of this practice references notes, footnotes, and appendices which provide explanatory material. These notes and footnotes (excluding those in tables and figures) shall not be considered as requirements of the practice.

<sup>1</sup> This practice is under the jurisdiction of ASTM Committee F17 on Plastic Piping Systems and is the direct responsibility of Subcommittee F17.20 on Joining. Current edition approved Oct. 1, 2024. Published November 2024. DOI: 10.1520/F3722-24

1.6 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety, health, and environmental practices and determine the applicability of regulatory limitations prior to use.*

1.7 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

## 2. Referenced Documents

### 2.1 ASTM Standards:<sup>2</sup>

F412 Terminology Relating to Plastic Piping Systems

F2389 Specification for Pressure-rated Polypropylene (PP) Piping Systems

F3124 Practice for Data Recording the Procedure used to Produce Heat Butt Fusion Joints in Plastic Piping Systems or Fittings

### 2.2 CSA Documents:<sup>3</sup>

CSA B137.11 Polypropylene (PP-R & PP-RCT) pipe and fittings for pressure applications

### 2.3 DVS Documents:<sup>4</sup>

DVS 2207-11 Welding Thermoplastic materials - Heated element welding of pipes, piping parts and panels made of PP

DVS 2208-1 Machines and devices for the heated tool welding of pipes, piping parts and panels

### 2.4 ISO Documents:<sup>5</sup>

ISO 15874 Plastics piping systems for hot and cold water installations – Polypropylene (PP)

<sup>2</sup> For referenced ASTM standards, visit the ASTM website, [www.astm.org](http://www.astm.org), or contact ASTM Customer Service at [www.astm.org/contact](http://www.astm.org/contact). For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

<sup>3</sup> Available from Canadian Standards Association (CSA), 178 Rexdale Blvd., Toronto, ON M9W 1R3, Canada, <http://www.csagroup.org>.

<sup>4</sup> Available from DVS Media GmbH, PO Box 10 19 65, 400010 Düsseldorf, Germany, <http://www.dvs-media.eu>.

<sup>5</sup> Available from International Organization for Standardization (ISO), ISO Central Secretariat, Chemin de Blandonnet 8, CP 401, 1214 Vernier, Geneva, Switzerland, <http://www.iso.org>.

### 3. Terminology

3.1 Definitions and abbreviations are in accordance with Terminology F412 unless otherwise specified.

#### 3.2 Definitions of Terms Specific to This Standard:

3.2.1 *bead-up*—the heating step used to develop an initial melt bead.

3.2.2 *drag pressure*—the amount of pressure required to get the carriage on a butt fusion machine to move. Add this pressure to the theoretical fusion joining pressure to get the actual machine gauge pressure to set.

3.2.3 *electrofusion machine*—the apparatus placed between the power source and the electrofusion fitting to regulate energy input to an electrofusion fitting.

3.2.4 *leads*—the electrical cables used to attach the electrical connections on the electrofusion fitting to the electrofusion machine.

3.2.5 *peeler*—a pipe surface preparation device that uses a cutting blade to remove a controlled amount of outer pipe or fitting spigot material during the pipe preparation process for electrofusion joining.

3.2.6 *ramp-up time*—Time to achieve Fusion Pressure

3.2.7 *scraper*—a pipe surface preparation device with a blade that is used to remove the outer layer of pipe or fitting spigot material during the pipe preparation process for socket or electrofusion joining.

3.2.8 *weld line*—the interface or mating line of two beads from a butt fusion joint.

3.2.8.1 *Discussion*—See Figure Fig. X2.1 and Fig. X2.2.

### 4. Summary of Practice

4.1 The principle of heat fusion joining of polypropylene (PP) pipe is to heat two prepared surfaces to a designated temperature then fuse them together by application of a sufficient force. This force and pressure cause the melted materials to flow and mix, thereby resulting in a fused joint.

4.2 The heat-fusion procedures covered in this practice are socket fusion, butt fusion, sidewall fusion, and electrofusion.

4.2.1 *Procedure 1, Socket Fusion*—The socket-fusion procedure involves simultaneously heating the outside surface of a pipe end and the inside surface of a fitting socket, which is sized to be smaller than the smallest outside diameter of the pipe. The fusion bond is formed at the interface resulting from the interference fit.

4.2.2 *Procedure 2, Butt Fusion*—The butt-fusion procedure in its simplest form consists of heating the squared ends of two pipes, a pipe and a fitting, or two fittings, by holding them against a heated plate, removing the heater plate when the proper melt temperature is obtained, promptly bringing the ends together, and allowing the joint to cool while maintaining the appropriate applied force and pressure.

4.2.3 *Procedure 3, Sidewall Fusion*—The sidewall fusion procedure involves melting the concave surface of the base of a sidewall fitting while simultaneously melting a matching pattern on the outside surface of the pipe, bringing the two melted surfaces together, and allowing the joint to cool while maintaining the appropriate applied force and pressure.

4.2.4 *Procedure 4, Electrofusion*—Electrofusion is a heat-fusion joining process where a resistance wire is an integral part of the fitting. When electric current is applied to the fitting, heat is produced, resulting in melting and joining of the PP components.

### 5. Significance and Use

5.1 The procedures described in this practice are intended for joining of polypropylene (PP) pipe and fittings using suitable equipment and appropriate environmental control procedures. When properly implemented, strong leak-tight joints are produced.

5.2 Melt flow characteristics, average molecular weight, and molecular weight distribution are influential factors in establishing suitable fusion parameters. Therefore, consider the manufacturer's instructions in the use or development of a specific fusion procedure.

5.3 The socket fusion, butt fusion, sidewall fusion, and electrofusion procedures in this practice are suitable for joining pressure-rated PP pipe and fittings made to PP product specifications listed in 1.2 that are used in pressure-rated hot and cold-water distribution applications, water service line, building supply lines, hydronic heating and cooling, chilled water, industrial, and irrigation systems.

### 6. Operator Training or Qualification

6.1 Skill and knowledge on the part of the fusion operator are required to obtain a good quality joint. This skill and knowledge are obtained by making joints in accordance with proven procedures under the guidance of skilled operators. Evaluate operator proficiency by testing sample joints in accordance with manufacturer instructions or regulatory requirements.

6.2 The party responsible for the joining of polypropylene pipe and fittings shall ensure that detailed procedures developed in conjunction with applicable codes and regulations and the manufacturers of the pipe, fittings, and joining equipment involved, including the safety precautions to be followed, are issued before actual joining operations begin.

### 7. Procedure 1—Socket Fusion

#### 7.1 Apparatus:

7.1.1 *Socket Fusion Tools*—Socket fusion tools consist of a heating tool, heating tool heads, alignment clamp, cold ring, depth gauge, and chamfer tool sized to match the socket dimensions specified in ASTM F2389, CSA B137.11, or ISO 15874.

7.1.2 *Heating Tool*—In order to obtain a proper melt, a uniform temperature must be maintained across the heating tool heads. The heating tool shall have sufficient voltage, wattage, and control to maintain the specified surface temperature of the tool heads.

7.1.3 *Heating Tool Heads*—Heating tool heads consist of two parts, a male end for the interior socket surface and a female end for the exterior pipe surface. Both parts shall be made to such tolerances as to cause an interference fit. Heating tool faces are produced to specific dimensions and are labeled

with a non-stick material to keep melted pipe and fitting material from sticking to the head.

**7.1.4 Socket fusion alignment clamp**—The socket fusion alignment clamp is a tool which consists of two sets of devices holding the pipe and fitting in alignment to each other. One set of holding devices is fixed, and the other allows longitudinal movement for making the joint. An alignment jig is recommended for use for nominal diameter pipes 50 and larger.

**7.1.5 Cold ring**—This device is used to maintain roundness of small diameter pipe and to control the depth of pipe insertion into the socket during the joining operation when recommended by the pipe or fitting manufacturer.

**7.1.6 Depth Gauge**—This device is for determining the proper insertion depth of the pipe into the fitting. Proper insertion depth is per fitting manufacturer's instructions.

**7.1.7 Chamfering Tool**—This device is to bevel the end of pipes, when required.

NOTE 2—The depth gauge and chamfering tool may be combined into a single tool.

**7.1.8 Pipe Cutter**—This device is used to obtain a square end cut on the pipe without crushing or deforming the pipe while cutting it.

**7.1.9 Pipe Scraper**—This device is used to remove the outer layer of pipe when required.

## 7.2 Socket Fusion Procedure:

**7.2.1** The socket fusion joining procedure is depicted schematically in Fig. 1(a) and Fig. 1(b).

**7.2.2** Attach the proper size heating tool heads to the heating tool and bring the surface temperature of the heating tool heads to  $500\text{ }^{\circ}\text{F} \pm 18\text{ }^{\circ}\text{F}$  ( $260\text{ }^{\circ}\text{C} \pm 10\text{ }^{\circ}\text{C}$ ). Use a pyrometer or other external temperature measuring device before beginning the fusion process to verify the temperature of the pipe or fitting contact area on the heating tool heads. Select multiple checkpoints to ensure uniform surface temperature. Some heating tools have an integrated temperature indicator which shows internal temperature of the heating tool. This temperature reading shall not be used for the fusion temperature.

**7.2.3** Cut the pipe end squarely and clean the pipe end and fitting, both inside and outside, by wiping with 90 % or greater isopropyl alcohol and a clean, dry, lint-free, non-synthetic cloth such as cotton.

NOTE 3—Fusion quality may be impacted by dirty or contaminated fusion heater faces. Consult the pipe or fitting manufacturer for additional requirements and methods, beyond those outlined in this practice, by which to clean the fusion heater faces.

**7.2.3.1 Chamfering**—The pipe end may or may not require chamfering to create a bevelled edge per the pipe or fitting manufacturer's recommendation. See Fig. 2 and Table 1 for Pipe Bevel Dimensions, when required.

**7.2.3.2 Scraping**—The external pipe surface may or may not require scraping, per the pipe or fitting manufacturer's recommendation. Sandpaper and emery cloth shall not be used as a means for scraping pipes, as they might disintegrate and contaminate the joint interface.

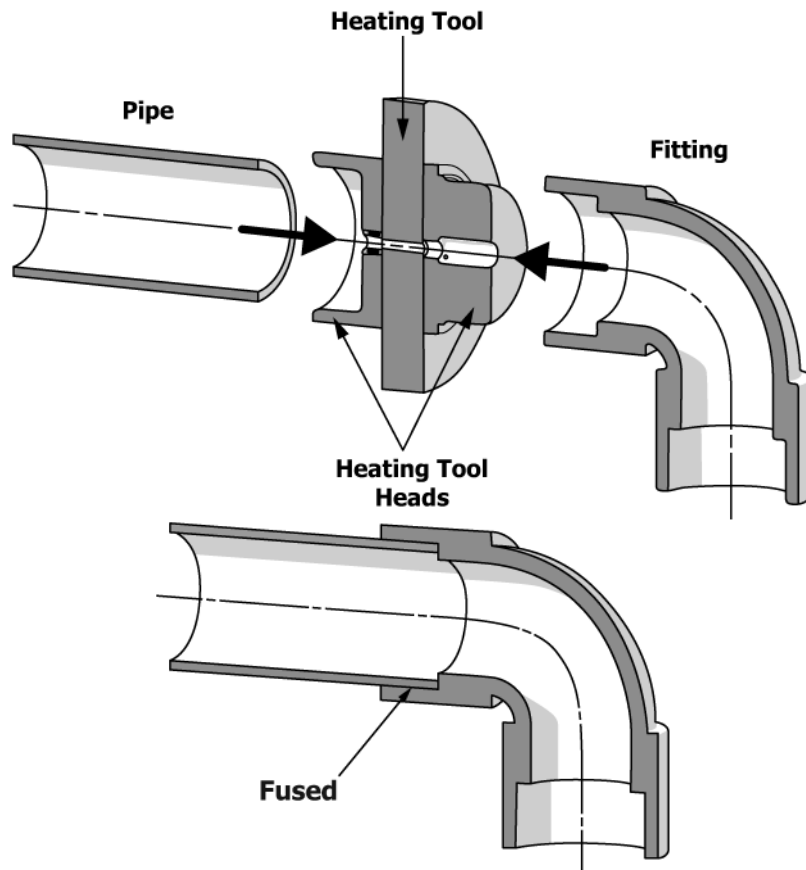


FIG. 1 (a) (top) Socket Fusion Components and Figure 1(b) (bottom) Completed Fitting Assembly

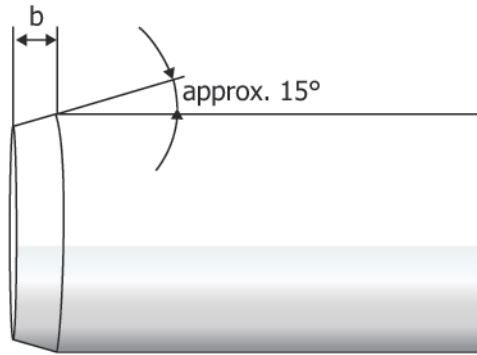


FIG. 2 Bevel diagram

TABLE 1 Pipe Bevel Dimensions

| Nominal size | Minimum Average OD,<br>in. (mm) | Pipe Bevel b<br>in. (mm) |
|--------------|---------------------------------|--------------------------|
| 16           | 0.630 (16)                      | 0.079 (2)                |
| 20           | 0.870 (20)                      | 0.079 (2)                |
| 25           | 0.984 (25)                      | 0.079 (2)                |
| 32           | 1.260 (32)                      | 0.079 (2)                |
| 40           | 1.575 (40)                      | 0.079 (2)                |
| 50           | 1.969 (50)                      | 0.079 (2)                |
| 63           | 2.480 (63)                      | 0.118 (3)                |
| 75           | 2.953 (75)                      | 0.118 (3)                |
| 90           | 3.543 (90)                      | 0.118 (3)                |
| 110          | 4.331 (110)                     | 0.118 (3)                |
| 125          | 4.921 (125)                     | 0.118 (3)                |

7.2.4 Clean the heating tool heads by wiping them with 90% or greater isopropyl alcohol and a clean, dry, lint-free, non-synthetic cloth such as cotton to remove any contamination from the surfaces.

7.2.5 Clean dust and particles from the fusion surfaces by cleaning the pipe or fitting ends with a clean dry lint-free, nonsynthetic cloth such as cotton. Once the pipe or fitting surfaces have been prepared for fusion and clean material has been exposed, clean the pipe surfaces using 90% or greater isopropyl alcohol.

7.2.6 When required, mark the insertion depth on the pipe using an appropriate depth gauge or other measuring device. Alternatively, when using a cold ring, place the cold ring at the appropriate insertion depth on the pipe.

7.2.7 Push the socket fitting onto the preheated heating tool's fitting-side head and push the pipe into the pipe-side head until the insertion depth mark is reached, or alignment clamps make contact with the heating heads.

7.2.8 Heat the pipe end and the fitting socket for the time required in Table 2.

7.2.9 At the end of the heating time, simultaneously remove the pipe and fitting straight out from the tool. Within the allowed changeover time in Table 2, insert the pipe straight into the socket of the fitting so the cold ring clamp is flush against the end of the fitting socket. If a cold ring is not used, insert the pipe into the socket fitting to the socket depth marked on the pipe. Secure the joint in place to cool for the time specified in Table 2. For ambient temperatures 100 °F (38 °C) and higher, additional cooling time may be needed.

7.2.10 Remove the cold ring clamp and inspect the end of the socket for a complete impression of the cold ring clamp in the melt surface. There shall be no gaps, voids, or unbonded areas. If a cold ring is not used, there shall be two weld beads, one on the pipe surface and the other on the socket fitting face, and the beads shall meet, creating equal beads around the circumference with no gaps or voids.

7.2.11 Allow for extremes in weather when making field joints. Heating times, dimensional changes, etc., are affected by extreme weather conditions.

### 7.3 Quality Assurance:

TABLE 2 Socket Fusion Time Cycles

| Nominal size | Heating Time – DR 5, 6, 7.4,<br>9, 11 sec | Heating Time – DR 17, 17.6<br>sec | Changeover time, sec | Cooling Time, min |
|--------------|-------------------------------------------|-----------------------------------|----------------------|-------------------|
| 16           | 5                                         | A                                 | 4                    | 2                 |
| 20           | 5                                         | A                                 | 4                    | 2                 |
| 25           | 7                                         | A                                 | 4                    | 2                 |
| 32           | 8                                         | A                                 | 6                    | 4                 |
| 40           | 12                                        | A                                 | 6                    | 4                 |
| 50           | 18                                        | A                                 | 6                    | 4                 |
| 63           | 24                                        | 10                                | 8                    | 6                 |
| 75           | 30                                        | 15                                | 8                    | 8                 |
| 90           | 40                                        | 22                                | 8                    | 8                 |
| 110          | 50                                        | 30                                | 10                   | 8                 |
| 125          | 60                                        | 35                                | 10                   | 8                 |

<sup>A</sup> Socket fusion is not recommended for these dimensions because of the extremely thin wall thickness.

7.3.1 Visually inspect the socket fusion joint for compliance with the quality assurance guidelines for the socket fusion procedure presented in [Appendix X1](#).

## 8. Procedure 2—Butt Fusion

### 8.1 Apparatus:

8.1.1 *Butt Fusion Machine*—At a minimum, a butt fusion machine consists of three primary parts: (1) a stationary clamping fixture and a movable clamping fixture for aligning and holding each of the two parts to be fused; (2) a facer or planer for simultaneously preparing the ends of the parts to be joined; and (3) appropriate inserts for clamping different pipe sizes or fitting shapes. Butt fusion machines are operated manually or are power-assisted (for example, hydraulically, pneumatically, or through electronic-servo means). Butt fusion machines may require a power supply to operate the machine. Some have their own power supply incorporated within the base machine and some require a separate power source (that is, generator or facility power supply). Butt fusion machines shall have a pressure/force indicator included within the basic operation of the butt fusion machine to show the welding force being applied to the fusion area. This indicator may or may not be integral to the base machine.

8.1.2 *Facer or Planer*—This is a rotating, cutting, or surfacing device used to prepare pipe or fitting ends to obtain uniformly smooth, clean, and parallel pipe/fitting faces for fusion joining. These devices can be electronically, hydraulically, or manually operated. A facer or planer device can be found integrally mounted to the basic machine or they can be supplied as accessory items.

8.1.3 *Heating Tool*—Electric heating tools come in a variety of sizes that match the fusion machines' capabilities. They are designed with enough wattage and electronic control to maintain the specified heater face temperature required in this procedure. The range of the heater control shall be larger than the heating temperature specification. The typical control range is 50 °F (30 °C) above and below the maximum and minimum required heating tool surface temperatures. Electric heating plates maintain consistent fusion temperatures when provided with an adequate power source. Heating plate surfaces shall be coated with a non-stick material and shall be kept clean and free of contaminants such as dirt, grease, and plastic build-up, which may cause excessive sticking and create unsatisfactory joints.

8.1.3.1 *Heating Tool Surface Maintenance*—After a period of time in service, non-stick coatings or non-stick fabrics designed for heat fusion will deteriorate and become less effective. Deteriorated fabrics should be replaced. Worn, scratched, or gouged non-stick coatings should be re-coated when they lose effectiveness. Heat fusion quality may be adversely affected by deteriorated non-stick surfaces. Spray-on chemicals, such as non-stick lubricants or oils should not be applied to heating iron surfaces as they will contaminate the joint.

8.1.4 *Pipe Support Stands*—Pipe support stands or racks are used to support the pipe at both ends of the butt fusion machine to assist with pipe loading and alignment when necessary.

8.1.5 *Data recording device*—an instrument that records the pressure, temperature, and time for individual joints and

additional manual input (for example, operator number, joint number, weather conditions, etc.).

### 8.2 Butt Fusion Parameters:

8.2.1 The surface temperature of heating tool faces shall be 410 °F ± 18 °F (210 °C ± 10 °C). A pyrometer or other surface temperature measuring device shall be used when required to ensure proper surface temperature of the heating tool faces.

8.2.2 An interfacial pressure (IFP) of 14.5 psi ± 1.45 psi (0.1 N/mm<sup>2</sup> ± 0.01 N/mm<sup>2</sup>, 1 bar ± 0.1 bar) is used to determine the force required to butt fuse the pipe components.

8.2.2.1 For manually and power-assisted fusion machines, the IFP is multiplied by the pipe face area ( $A_p$ ) (see [Eq 1](#)) to obtain the fusion force required in pounds.

8.2.2.2 For hydraulically operated fusion machines, the fusion force required is divided by the total effective piston area (TEPA) of the fusion machine carriage to obtain the theoretical fusion pressure (TFP) (See [Eq 2](#)).

(1) The drag pressure ( $P_D$ ) is then added to the TFP to obtain the fusion machine gauge pressure ( $P_G$ ) in (for example, psig, N/mm<sup>2</sup>, bar) required by the machine (see [Eq 3](#)). (TFP and IFP are *not* the same value.)

8.2.3 Heat soak gauge pressure shall be less than or equal to drag pressure and shall result in an interfacial pressure greater than 0 and not exceeding 1.45 psi. The equations used to calculate for the fusion machine gauge pressure are shown below.

NOTE 4—For other power-assisted fusion machines, refer to the manufacturer's instructions.

NOTE 5—Ensure consistency in units of measure when using the equations below (that is, all IP units or all SI units). Conversions: For purposes of this standard, pressure conversions are as follows: 14.5 psi = 1 bar = 0.1 N/mm<sup>2</sup>.

$$A_p = (O D - t) \times t \times 3.1416 \quad (1)$$

$$TFP = \frac{(A_p \times I F P)}{TEPA} \quad (2)$$

$$P_G = TFP + P_D \quad (3)$$

where:

- $P_G$  = Fusion Machine Gauge Pressure, psig (N/mm<sup>2</sup>, bar)
- =
- $TFP$  = Theoretical Fusion Pressure, psig (N/mm<sup>2</sup>, bar)
- $IFP$  = Interfacial Pressure, 14.5 psi ± 1.45 psi (0.1 N/mm<sup>2</sup> ± 0.01 N/mm<sup>2</sup>, 1 bar ± 0.1 bar)
- $TEPA$  = Total Effective Piston Area, in.<sup>2</sup> (mm<sup>2</sup>) – Supplied by fusion machine manufacturer
- $P_D$  = Fusion Machine Drag Pressure, psig (N/mm<sup>2</sup>, bar)
- $A_p$  = Pipe Area, in.<sup>2</sup> (mm<sup>2</sup>)
- $OD$  = Pipe Outside Diameter, in (mm)
- $t$  = Pipe Wall Thickness, in (mm)

NOTE 6—Interfacial pressure is used to determine butt fusion joining pressure settings for hydraulic butt fusion machines when joining specific pipe diameters and DRs. Interfacial pressure is not the gauge pressure. A slide rule or a gauge pressure calculator obtained from the machine's manufacturer can be used as a tool for the calculation.

NOTE 7—Drag Pressure ( $P_D$ ) is found by bringing the faced pipe ends within 2 in. (50 mm) of each other and increase the pressure on the carriage until it starts moving. Back off the pressure until the carriage is barely moving and record the drag pressure.

### 8.3 Butt Fusion Procedure:

8.3.1 The butt fusion joining procedure is presented schematically in Fig. 3, and the butt fusion steps are presented diagrammatically in Fig. 4.

8.3.2 PP pipe shall be cut to dimension using tools which do not introduce contamination to the pipe surfaces or the fusion equipment. Cutting shall be performed using tools such as hand saws, reciprocating saws, run-around pipe cutters, guillotine cutters, pipe shears, or oil-free chain saws. Liquid lubricants (for example, bar or chain oil) that can be transferred to the pipe ends during cutting, shall be avoided whenever possible. If soap, bar or chain oils are present, they must be removed in accordance with an approved cleaning procedure. Additionally, care shall be taken so that liquid lubricants do not transfer to fusion equipment and contaminate subsequent joints.

8.3.3 The pipe surfaces shall be cleaned using 90 % or greater isopropyl alcohol and allowed to dry prior to facing as moisture or contaminants on the pipe surface could impair joint quality. Clean the fusion face surface, inside and outside surfaces of the components to be joined with a clean, dry, lint-free, non-synthetic cloth such as cotton. Remove all foreign matter from the piping component surfaces where they will be clamped in the butt fusion machine.

NOTE 8—Fusion quality may be impacted by dirty or contaminated fusion heater faces. Consult the pipe or fitting manufacturer for additional requirements and methods, beyond those outlined in this practice, by which to clean the fusion heater faces.

8.3.4 If needed, support the pipe at both ends of the butt fusion machine and adjust the supports (for example, pipe support stands) to align the pipe with the fusion machine centerline. Install the pipes or fittings being joined in the stationary and movable clamps of the butt fusion machine. In accordance with the machine manufacturer's recommendations, leave enough pipe protruding through the clamps to allow for facing and clamping the pipe or fitting in the machine.

8.3.5 Take care when placing pipe or fittings in the butt fusion machine. Pipes shall be generally aligned before the clamps are closed and tightened.

8.3.6 Face or plane the piping component ends to establish clean, parallel mating surfaces between the pipe/fitting ends. Move the carriage to separate the pipe ends from the facer, remove the facer and all shavings and debris from the facing operation by brushing away with a clean, dry, lint-free, non-synthetic cloth such as cotton. Bring the pipe/fitting ends

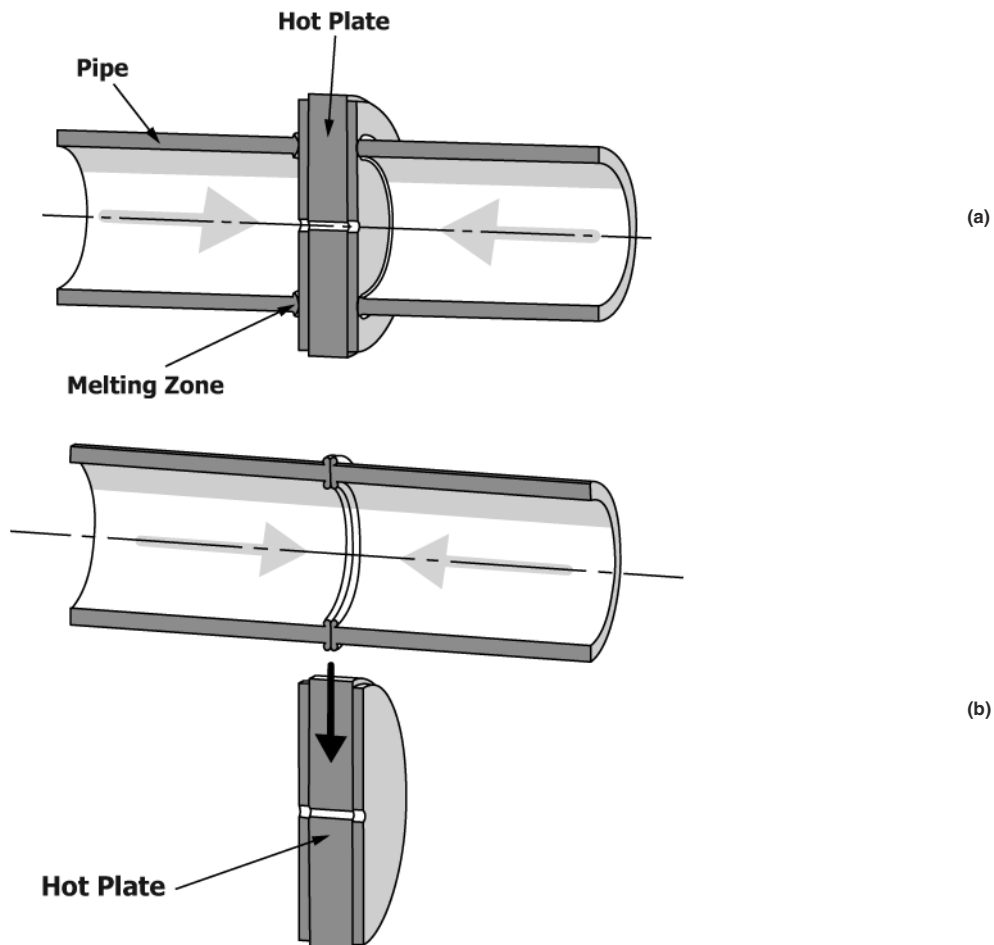
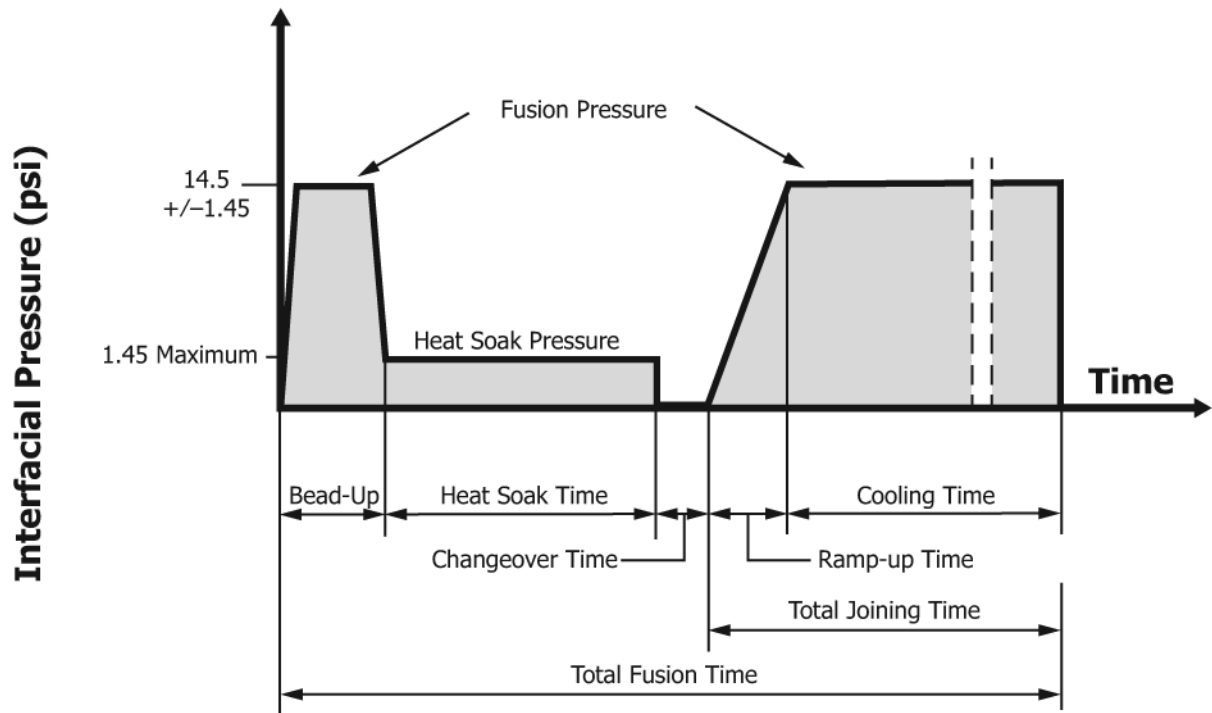


FIG. 3 (a) (top) Butt Fusion Components and 3 (b) (bottom) Completed Butt Fusion Fitting Assembly



See Note 4 for conversions from Psi to N/mm<sup>2</sup> and Bar

FIG. 4 Butt Fusion Joining – Graph of Interfacial Pressure over Time

together at fusion pressure. A visual inspection of this operation should verify a square face, perpendicular to the pipe centerline on each pipe end with any visible gap in compliance with Table 3.

8.3.7 Check the pipe ends for high-low alignment and out-of-roundness. If adjustment is needed, adjust by tightening the high side clamp to reshape the pipe to allowable tolerance for alignment which is  $\pm 10\%$  of the wall thickness. Do not loosen the low side clamp or slippage may occur during fusion. Any adjustment must be performed while there is no machine pressure on the pipe. If adjustment is needed, relieve machine pressure from pipes to be fused and adjust. Re-face the pipe or fitting ends if excessive adjustment is required and remove any shavings from the re-facing operation with a clean, dry, lintfree, non-synthetic cloth such as cotton. The maximum OD high-low misalignment allowed in the butt fusion procedure shall be 10 % of the pipe minimum wall thickness.

8.3.8 Many butt fusion machines are equipped with a device to record the fusion parameters and the steps taken in the butt fusion procedure. If such a device is present, enter the necessary information into the data recording device per the manufacturer's instruction and start the fusion data logging device. Practice F3124 describes the requirements of such a

device. If no device is present and when the information is required, record the specific fusion parameters for the joint to be made.

8.3.9 Verify that the heater surface temperatures are in the specified temperature range of  $410\text{ }^{\circ}\text{F} \pm 18\text{ }^{\circ}\text{F}$  ( $210\text{ }^{\circ}\text{C} \pm 10\text{ }^{\circ}\text{C}$ ). (See Appendix X2.) A pyrometer or other surface temperature measuring device should be used before the first joint of the day and periodically throughout the day to ensure proper temperature of the heating tool head. All pyrometers are sensitive to usage techniques. Carefully follow the manufacturer's instructions for best results.

8.3.10 Clean the contact surfaces of the heating tool with a clean, dry, lint-free, non-synthetic cloth such as cotton. Place the heating tool in the butt fusion machine between the piping component ends and bring the pipe or fitting ends into full and uniform contact with the heating tool at fusion pressure. This initial contact with the heater plate at fusion pressure is referred to as the bead-up step. Maintain this fusion pressure until such time that a uniform bead has been developed around the entire circumference of both pipe ends to the dimensions shown in Table 4 for the specific nominal wall thickness of the pipe. A continuous melt bead shall be present around the full circumference of each pipe or fitting face during this step before proceeding to the heat soak step.

8.3.11 Once the melt bead is observed around the full circumference of the pipe or fitting, begin the heat soak cycle by reducing the gauge pressure to the heat soak pressure. Continue the heat soak cycle for the times shown in Table 4.

8.3.12 Upon completion of the heat soak cycle, quickly move the piping component ends away from the heating tool,

TABLE 3 Maximum Gap Width Between the Machined Butt Fusion Weld Contact Areas

| Nominal Pipe Size | Gap width in. (mm) |
|-------------------|--------------------|
| $\leq 355$        | 0.020 (0.5)        |
| 400 < 630         | 0.040 (1.0)        |
| 630 < 710         | 0.051 (1.3)        |