



Designation: F3372 – 20

Standard Practice for Butt Fusion Joining of PA12 Pipe and Fittings¹

This standard is issued under the fixed designation F3372; 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 reapproval. A superscript epsilon (ϵ) indicates an editorial change since the last revision or reapproval.

1. Scope

1.1 This practice describes procedures for making butt fusion joints with Polyamide 12 (PA12) pipe and fittings by means of heat fusion joining in, but not limited to, a field environment. Procedure A is for environmental temperatures of 40 °F (4 °C) and higher. Procedure B is for site temperatures below 40 °F (4 °C). Other suitable heat fusion joining procedures are available from various sources including pipe and fitting manufacturers. 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 proved to produce reliable heat fusion joints.

1.2 The parameters and procedures are applicable only to joining PA12 pipe and fittings and are not applicable to other polyamide types. They are intended only for PA12 fuel gas pipe per Specification [F2785](#) and PA12 butt heat fusion fittings in accordance with Specification [F1733](#). Fusion to other polyamide types (that is, cross-fusion) is not permitted under this practice, and this practice does not apply to other polyamide types. Consult with the pipe and fittings manufacturers to make sure they recommend this procedure for the pipe and fittings to be joined (also see [Appendix X1](#)).

1.3 The procedures in this practice apply to the butt fusion of PA12 pipe and butt fusion fittings in accordance with [1.2](#) having like diameter and wall thickness.

NOTE 1—Refer to [X1.5](#) for guidance regarding dissimilar wall thicknesses.

1.4 Other suitable heat joining procedures are available from various sources including pipe and fitting manufacturers. Melt characteristics, average molecular weight and molecular weight distribution of PA12 compounds are influential factors in establishing suitable fusion parameters; therefore, consider the manufacturer's recommendations in the use or development of a specific fusion procedure.

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

¹ This test method 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 June 1, 2020. Published July 2020. DOI: 10.1520/F3372-20

1.6 The values stated in inch-pound units are to be regarded as standard. The values given in parentheses are mathematical conversions to SI units that are provided for information only and are not considered standard.

1.6.1 Non-conformance with this specification is possible if values from the two systems are combined. Values in parentheses are conversions that are appropriately rounded for accuracy and precision; that are not exact equivalents, and that are for non-mandatory informational purposes.

1.7 *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.*

1.8 *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:²

[F412 Terminology Relating to Plastic Piping Systems](#)
[F1733 Specification for Butt Heat Fusion Polyamide\(PA\) Plastic Fitting for Polyamide\(PA\) Plastic Pipe and Tubing](#)
[F2785 Specification for Polyamide 12 Gas Pressure Pipe, Tubing, and Fittings](#)

3. Terminology

3.1 *General*—Definitions and abbreviations are in accordance with Terminology [F412](#), unless otherwise specified.

3.2 Definitions of Terms Specific to This Standard:

3.2.1 *drag force, n*—the force required to overcome the static and dynamic resistance to motion of the movable carriage.

3.2.2 *fusion force, n*—the force applied between the melted polymer pipe ends.

² For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

3.2.3 *total effective piston area, n*—the surface area of the piston face that drives the hydraulic fusion machine moveable carriage.

3.2.4 *fusion machine gauge pressure, n*—the pressure indicated on the hydraulic system pressure gauge on a hydraulic butt fusion machine.

3.2.5 *facer*—a rotating cutting device used to square-off the pipe or fitting ends to obtain properly mating fusion surfaces.

4. Summary of Practice

4.1 The principle of heat fusion joining of PA12 pipe is to heat two prepared surfaces to a designated temperature, then fuse them together by application of a sufficient force. This force causes the melted materials to flow and mix, thereby resulting in fusion.

4.2 Only butt heat-fusion procedures are covered in this practice.

4.3 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 is obtained, promptly bringing the ends together, and allowing the joint to cool while maintaining the appropriate applied force.

4.4 An appropriately sized butt fusion machine is used to clamp, align and face the pipe or fitting ends and to apply the specified fusion force. See Fig. 1.

4.5 This practice describes procedures for making butt fusion joints with Polyamide 12 (PA12) pipe and fittings by means of heat fusion joining in, but not limited to, a field environment using suitable equipment and appropriate environmental control procedures. When properly implemented, strong, pressure/leak-tight joints are produced.

4.6 For fuel gas applications, regulated oil and gas applications, and some industrial applications, qualification of the procedure by testing joints made using the procedure in accordance with regulations from the authority having jurisdiction is required.

4.7 The party responsible for the joining of PA12 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.

5. Operator Experience

5.1 Skill, and knowledge, and proficiency on the part of the operator are required to obtain a good quality joint. This skill and knowledge is obtained by making joints in accordance with proven procedures under the guidance of skilled operators. Evaluate operator proficiency by testing sample joints.

6. Butt Fusion Apparatus

6.1 *Heating Tool*—The heating tool shall have sufficient area to adequately cover the ends of the size of pipe to be joined. This electrical tool shall have sufficient wattage and control to maintain the specified temperature of the tool faces within the required control range when used in cold weather conditions with the largest diameter and lowest DR specified for the butt fusion machine. See Section 8 for cold and adverse weather considerations. Heating tool faces shall be coated with a non-stick material to keep melted material from sticking to the surface.

6.1.1 *Heating Tool Faces*—PA12 material may stick to hot metal heating tool surfaces. Sticking is minimized by applying a non-stick coating to the heating tool surfaces. The heating

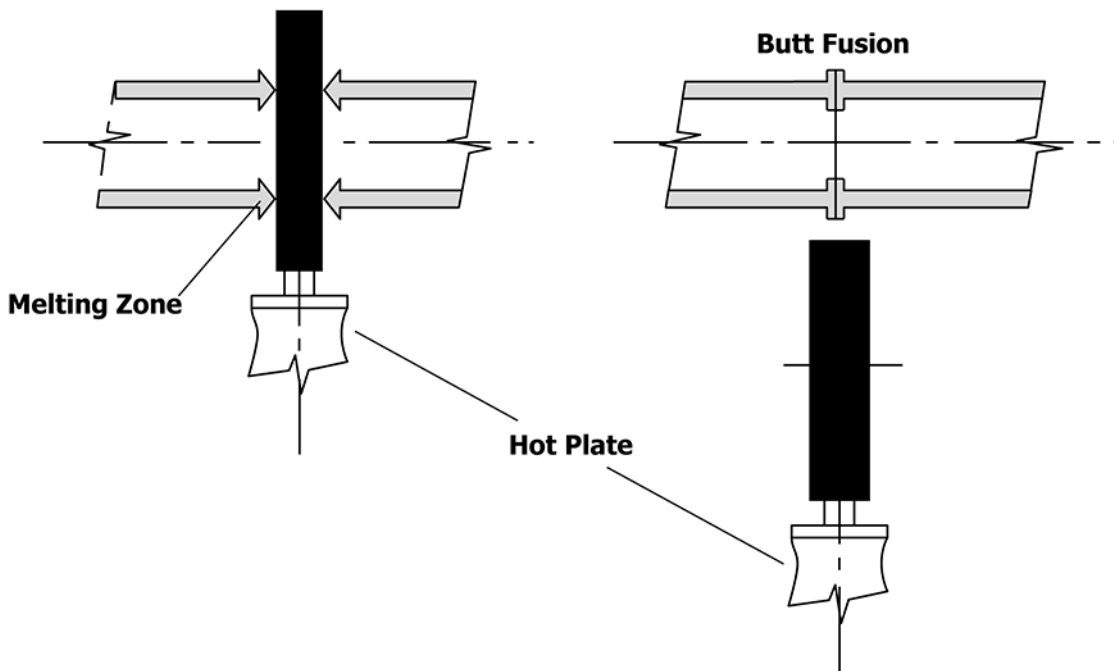


FIG. 1 Butt Fusion

tool surfaces 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. Most contaminants are removed from the hot or cold heating tool surfaces by using a clean, dry, lint-free, non-synthetic cloth such as cotton. Do not use synthetic fabrics that char and stick to the heating tool surface.

6.1.2 After a period of time in service, non-stick coatings will deteriorate and become less effective. Worn, scratched, or gouged non-stick coatings shall be re-coated when they lose effectiveness. Heat fusion quality is adversely affected by deteriorated non-stick surfaces. Spray-on chemicals, such as nonstick lubricants or oils shall never be applied to heating iron surfaces as they will contaminate the joint.

6.1.3 *Temperature Indicator*—Heating tools shall be equipped with a thermometer or other built-in temperature indicating device. This device indicates the internal temperature of the heating iron, which is not necessarily the temperature of the heating tool surfaces. Use a pyrometer, or other surface-temperature measuring device to measure the heating tool surface temperature, at the time of the first joint of the day and periodically during the day to verify the temperature of the tool face surfaces at the pipe or fitting contact area. Select multiple checkpoints around the diameter of the pipe contact area to ensure uniform surface temperature.

NOTE 2—An infrared pyrometer can be calibrated by comparison to a calibrated surface pyrometer and adjusted to match on each heating tool.

NOTE 3—A significant temperature variation, that is, cold spots, on the heating tool surfaces may indicate a faulty heating iron which should not be used.

6.2 *Butt Fusion Machine*—A butt fusion machine has three basic parts: (1) a stationary clamping fixture and a movable clamping fixture for aligning and holding each of the pipe or fitting ends to be fused, (2) a facer for simultaneously machin-

ing and squaring the ends of the pipe or fitting to be joined; and (3) appropriate inserts for clamping different pipe sizes or fitting shapes. Butt fusion machines are operated manually or hydraulically. Butt fusion machines are available for various pipe and tubing size ranges.

6.3 *Pipe Support Stands*—Optional 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.

7. Procedure A-For Site Temperature of 40 °F (4 °C) and Higher

NOTE 4—For site temperatures lower than 40 °F (4 °C) see Section 8.

7.1 Setup:

7.1.1 Butt fusion machine setup parameters for manual and hydraulic machines are prescribed in Table 1.

7.1.2 *Manual butt fusion machine*—An interfacial pressure (IFP) of 60 to 90 psi (0.41 to 0.62 MPa) is used to determine the fusion force required to butt fuse the pipe components. Fusion force is applied to achieve the required bead height and width. For a manually operated fusion machine the IFP is multiplied by the pipe area (A_p) to obtain the fusion force required in pounds. (See Eq 3.) A torque wrench may be used to apply the proper force. Consult the manual butt fusion machine manufacturer’s operating manual for the correct conversion of torque to force. If a torque wrench is not used the visual guidelines in 7.2 shall apply.

NOTE 5—The drag force on manual machines should be considered when determining the torque necessary to achieve the correct IFP. See Note 6 regarding the components of drag force which for hydraulic machines is expressed as drag pressure. On manual machines a torque wrench may be used to measure the drag force. The torque value when the carriage starts moving is the drag force.

7.1.3 Hydraulic butt fusion machine:

TABLE 1 Butt Fusion Machine Setup Parameters Summary

Setup Parameter		Required Condition
Manual Butt Fusion Machine	Hydraulic Butt Fusion Machine	
Set heating tool temperature and heat to specified temperature	Set heating tool temperature and heat to specified temperature	The surface temperature of heating tool faces must be 470 to 500 °F ±10 °F (243 to 261 °C ±6 °C). A pyrometer or other surface temperature measuring device should be used periodically to ensure proper surface temperature of the heating tool faces.
Install Inserts	Install Inserts	Install inserts for the pipe OD or the fitting being fused.
Electric Power Supply	Electric Power Supply	Check that the field generator has adequate power for the equipment per the manufacturer’s instructions, and that the generator’s fuel supply is sufficient to complete the fusion joint.
Manual Pressure	Determine Drag Pressure	See Note 5 for manual machines. See 7.1.3.2 for hydraulic machines.
Manual Pressure	Set facing pressure	As required. Observe butt fusion machine manufacturer’s instructions for setting facing pressure.
Manual Pressure	Set heating pressure	Observe the pipe and butt fusion machine manufacturer’s instructions for setting heating pressures.
Manual Pressure	Set fusion joining pressure	See 7.1.2 for manual machines See 7.1.3.1 for hydraulic machines