Designation: F3722 – 24

An American National Standard

Standard Practice for Heat Fusion Joining of Polypropylene (PP) Pipe and Fittings[1]

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 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 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.

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:*[2]

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:*[3]

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

2.3 *DVS Documents:*[4]

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:*[5]

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

[1] 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.

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

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

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

[5] Available from International Organization for Standardization (ISO), ISO Central Secretariat, Chemin de Blandonnet 8, CP 401, 1214 Vernier, Geneva, Switzerland, https://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 coated