Designation: F3565 – 23

An American National Standard

Standard Practice for Electrofusion Joining Polyethylene (PE) Pipe and Fittings for Pressure Pipe Service[1]

This standard is issued under the fixed designation F3565; 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 suitable for pressure service with polyethylene (PE) pipe and fittings by means of electrofusion joining techniques in, but not limited to, a field environment. Other suitable electrofusion joining procedures are available from various sources including fitting manufacturers. This standard does not purport to address all possible electrofusion joining procedures, or to preclude the use of qualified procedures developed by other parties that have been proven to produce reliable electrofusion joints. (Note 1)

NOTE 1—Reference to the manufacturer in this practice refers to the electrofusion fitting manufacturer.

1.2 The parameters and procedure are applicable only to joining polyethylene pipe and fittings (Note 2) which are intended for PE fuel gas pipe per Specification D2513 and PE potable water, sewer and industrial pipe manufactured per Specification F714, Specification D3035, Specification F2619, and AWWA C901 and C906.

NOTE 2—Commercially available materials classified with a thermoplastic pipe material designation code beginning with PE 14, PE 23, PE 24, PE 27, PE 33, PE 34, PE 36, and PE 46, and PE 47 in accordance with Specification D3350 and Terminology F412 are generally acceptable for electrofusion joining using this practice. Consult with the pipe or fitting manufacturer for specific compatibility information.

1.3 Parts that are within the dimensional tolerances given in present ASTM specifications are required to produce sound joints between polyethylene pipe and fittings when using the joining techniques described in this practice.

1.4 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.

1.5 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]

D1600 Terminology for Abbreviated Terms Relating to Plastics

D2513 Specification for Polyethylene (PE) Gas Pressure Pipe, Tubing, and Fittings

D3035 Specification for Polyethylene (PE) Plastic Pipe (DR-PR) Based on Controlled Outside Diameter

D3350 Specification for Polyethylene Plastics Pipe and Fittings Materials

F412 Terminology Relating to Plastic Piping Systems

F714 Specification for Polyethylene (PE) Plastic Pipe (DR-PR) Based on Outside Diameter

F1055 Specification for Electrofusion Type Polyethylene Fittings for Outside Diameter Controlled Polyethylene and Crosslinked Polyethylene (PEX) Pipe and Tubing

F2619 Specification for High-Density Polyethylene (PE) Line Pipe

2.2 *PPI Documents:*[3]

TR-49 Generic Electrofusion Joining Guide for Field Joining of Polyethylene Gas Pipe

[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.

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[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] Available from Plastics Pipe Institute (PPI), 105 Decker Court, Suite 825, Irving, TX 75062, http://www.plasticpipe.org.

2.3 *AWWA Documents:*[4]

AWWA C901 Standard for Polyethylene (PE) Pressure Pipe and Tubing, ½ in. (13 mm) through 3 in. (76 mm), for Water Service

AWWA C906 Standard for Polyethylene (PE) Pressure Pipe and Fittings, 4 in. (100 mm) through 63 in. (1575 mm), for Water Distribution and Transmission

3. Terminology

3.1 *Definitions*—Definitions are in accordance with Terminology F412, and abbreviations are in accordance with Terminology D1600, unless otherwise specified.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *control box, also referred to as processor*—the apparatus placed between the power source and the electrofusion fitting to regulate voltage or current input to the fitting for the specified time or energy defined by the electrofusion fitting fusion parameters.

3.2.2 *operator*—an individual that has been evaluated and found to be qualified to make electrofusion joints in accordance with this standard.

3.2.3 *pipe end*—the end of a length of pipe or fitting spigot end having pipe dimensions such as a tee, elbow, valve, etc.

3.2.4 *peeler*—a pipe surface preparation tool that is designed to remove a controlled amount of outer pipe surface or pipe end material in a continuous ribbon during the pipe preparation process for electrofusion joining.

3.2.5 *scraper*—a pipe surface preparation tool that uses a smooth or serrated blade that is dragged over the pipe surface to scrape away outer pipe or pipe end material during the pipe preparation process for electrofusion joining.

4. Significance and Use

4.1 Using the procedures and apparatus in Sections 8 and 9 and the manufacturer's instructions, pressure-tight joints as strong as the pipe itself can be made between manufacturer-recommended combinations of pipe and fittings. See Specification F1055 for performance requirements of polyethylene electrofusion fittings.

5. Operator Experience

5.1 Skill and knowledge on the part of the operator are required to obtain a good quality joint. The skill and knowledge are obtained by making joints in accordance with proven procedures under the guidance of qualified evaluator.

5.2 Each operator shall be qualified in accordance with recommended procedures and any regulatory agency or industry organization that has jurisdiction over these practices. For gas applications, qualification of the procedure by testing joints made using the procedure in accordance with regulations from the authority having jurisdiction are required.

5.3 The party responsible for the joining of polyethylene 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.

5.4 These procedures require the use of electrical and mechanical equipment. The operator shall ensure that recommended procedures developed for the electrofusion fittings involved, including the safety precautions to be followed, are issued before joining operations commence. It is especially important that the operator be aware of specific instructions regarding the use of electrical equipment in the presence of a potentially explosive environment.

6. Electrofusion Joining Processes

6.1 Electrofusion is a heat-fusion joining process where the heat source is a resistance wire heating element that is an integral part of the fitting. Energy is supplied to the resistance wire by a control box that supplies voltage determined by input of fusion parameters through *(1)* a barcode on the fitting that is scanned by the control box or *(2)* an identification device that is integral to the fitting and sensed by the control box or *(3)* manual entry of the fusion parameters by the operator. When energy is applied, heat is produced, melting and joining the components. As the polyethylene pipe and fitting surfaces melt they undergo volumetric expansion that closes annular spaces between the pipe and fitting. Continued melt expansion generates pressure within the heated zones. The expanding melt reaches areas within the fitting where heat is not produced, called cold zones, allowing the leading edges of melt flow to cool and solidify, thereby blocking any further melt movement or escape. The heating process continues for a predetermined time so that substantial pressure is reached through continued melt expansion in the contained melt pool of the pipe and fitting surfaces, also known as the joint. Fusion occurs when the pipe and fitting materials mix together and the joint cools below its melt temperature co-crystallizing into a homogenous monolithic structure. Maximum joint strength has occurred when the joint reaches ambient temperature

6.2 Electrofusion fitting manufacturers establish and qualify ambient temperature joining limitations for their fitting designs. Verify the acceptable installation temperature limit with the fitting manufacturer.

7. Classification

7.1 *Technique 1: Socket Type*—The electrofusion socket technique involves heat fusion of pipe or pipe ends with a fitting utilizing socket ends with a pipe section or pipe end inserted in each end of the fitting. The sockets contain a resistance wire coil located on the inner surface that acts as an internal heat source. When voltage is applied, heat is produced to melt the inside of the fitting and the outside of the pipe. An alignment device or method shall be used to secure the joint and hold it in axial alignment during the joining process. The device or method may be either external or one that is integral to the fitting itself.

7.2 *Technique 2: Saddle Type*—The electrofusion saddle technique involves heat fusion of a saddle fitting to the outer surface of a pipe. The heat source is a resistance coil and is

[4] Available from American Water Works Association (AWWA), 6666 W. Quincy Ave., Denver, CO 80235, http://www.awwa.org.