Designation: F3183 – 21

Standard Practice for Guided Side Bend Evaluation of Polyethylene Pipe Butt Fusion Joint[1]

This standard is issued under the fixed designation F3183; 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 provides information on apparatus, specimen preparation and procedure for conducting a guided three point side bend evaluation of a transverse specimen cut from a coupon removed from a butt fusion joint in polyethylene pipe having a wall thickness of approximately 1 in. (25 mm) and thicker. See Fig. 1. This practice provides a means to assess ductility of a butt fusion joint by applying a lateral (side) bending strain across a specimen taken from the full butt fusion cross-section, from outside diameter to inside diameter.

NOTE 1— For wall thicknesses less than 1 in. the user is referred to Practice F2620, Appendix X4.1 for bend back testing.

1.2 No test values are provided by this practice. The result is a non-numerical report. Criteria for test result evaluation are provided in standards or codes that specify the use of this practice by comparison to benchmark laboratory results as described in 5.3 or by comparison to example results presented in Appendix X1 to this practice.

1.3 *Units*—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.

1.4 *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.*

NOTE 2—Laboratory methods that are commonly used for testing polyethylene butt fusion joints include Test Method D638, Test Method D790 and Test Method F2634.

NOTE 3—This practice has been developed for use on butt fusion joints in polyethylene pipe with a wall thickness of 1.00 in. or greater. The practice may be used on butt fusion joints in polyethylene pipe with thinner wall thicknesses. However, the applicability of the practice should be determined by the user of the practice.

1.5 *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]

D638 Test Method for Tensile Properties of Plastics

D790 Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials

D1600 Terminology for Abbreviated Terms Relating to Plastics

D2122 Test Method for Determining Dimensions of Thermoplastic Pipe and Fittings

F412 Terminology Relating to Plastic Piping Systems

F2620 Practice for Heat Fusion Joining of Polyethylene Pipe and Fittings

F2634 Test Method for Laboratory Testing of Polyethylene (PE) Butt Fusion Joints using Tensile-Impact Method

3. Terminology

3.1 *Definitions*—Unless otherwise specified, definitions and abbreviations are in accordance with Terminologies D1600 and F412.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *bend angle, n*—The included angle between the surfaces of the side bend specimen on each side of the loading nose that is formed by the deflection of the side bend specimen when the loading nose extends the side bend test specimen through the test fixture rotatable supports.

3.2.2 *bend test coupon, n*—A transverse section of butt fused polyethylene pipe extending from the pipe outside wall to the pipe inside wall and having approximately equal lengths

[1] This test method is under the jurisdiction of ASTM Committee F17 on Plastic Piping Systems and is the direct responsibility of Subcommittee F17.40 on Test Methods.

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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.

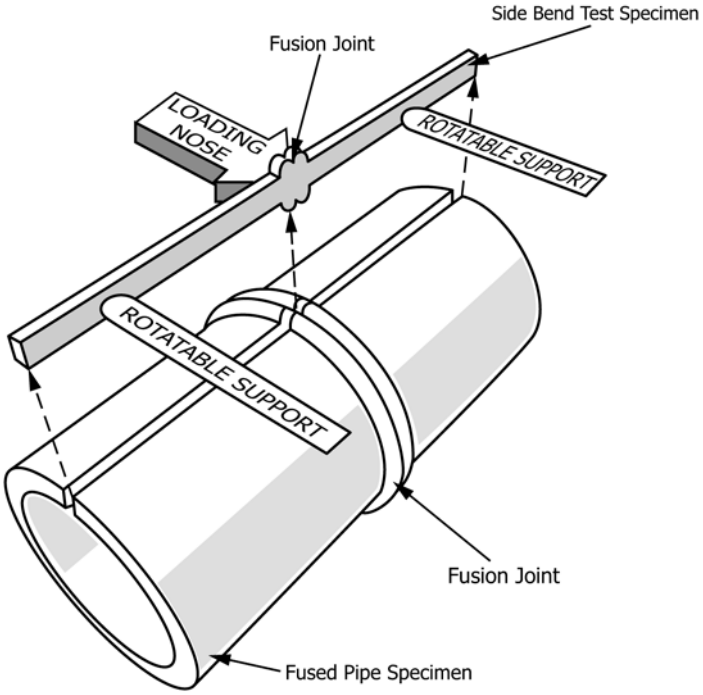

FIG. 1 Guided Side Bend Conceptual Schematic

of pipe on each side of a centrally located butt fusion joint. The side bend test specimen is produced from the bend test coupon. See Fig. 1.

3.2.3 *combined fusion bead zone, n*—A transverse through-wall section of the side bend specimen that is bounded by imaginary planes that extend across the pipe wall from the inner and outer fusion bead surfaces of Pipe A and Pipe B fusion beads. See Fig. 2. Butt fusion joints typically produce beads that extend (roll) over the pipe ends both inside and outside of the joint.

3.2.4 *ductility, n*—The ability of a material to deform plastically before fracturing.

3.2.5 *loading nose, n*—A bar located equidistant between and opposite to rotatable supports and having a cylindrical forward surface. The loading nose is extended at a uniform rate of displacement between the rotatable supports to bend the side bend test specimen. See Fig. 3.

3.2.6 *R/t, n*—A dimensionless number representing the ratio of the loading nose radius, *R*, in inches (or mm) to the measured thickness, *t*, in inches (or mm) of the side bend test specimen.

3.2.7 *rotatable supports, n*—Two cylindrical bars spaced equidistant from and parallel to the loading nose that turn freely on their central longitudinal axis and support the side bend test specimen.

3.2.8 *side bend test specimen, n*—A transverse section of the wall of butt fusion joined pipe that is machined (planed) from a bend test coupon.

4. Summary of Practice

4.1 This practice provides a means to assess the relative ductility of sections of polyethylene butt fusion joints from pipe having a wall thickness of approximately 1 in. (25 mm) or greater using a three point bend testing procedure. This practice

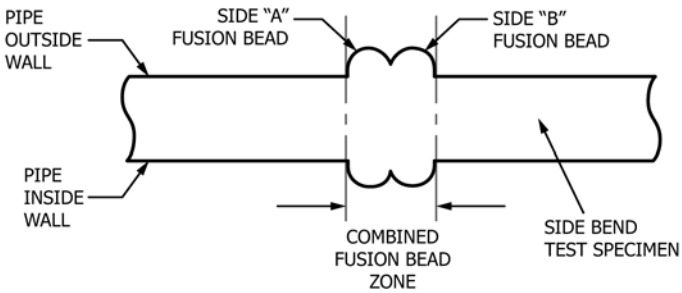

FIG. 2 Combined Fusion Bead Zone

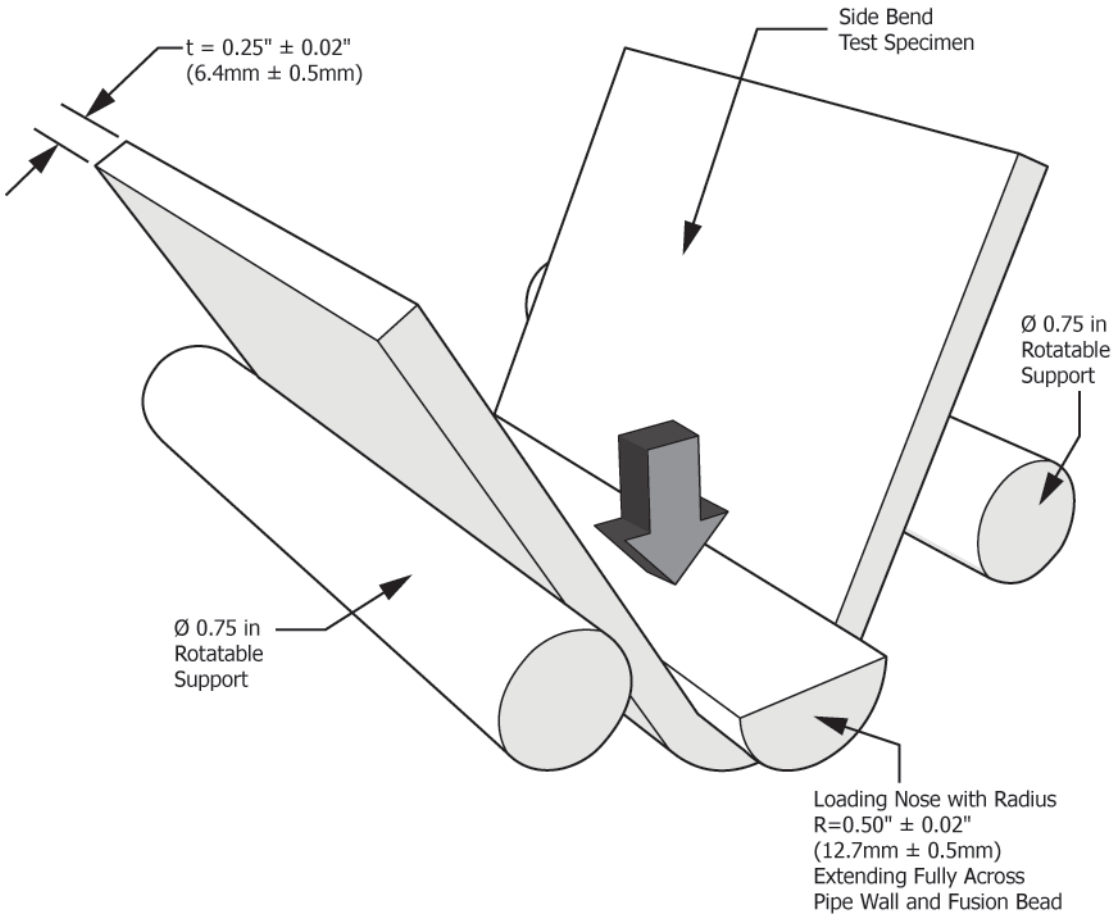

FIG. 3 Schematic of Guided Side Bend Apparatus

applies a bending strain to the transverse side of a through-wall side bend test specimen prepared from a bend test coupon taken from a butt fusion joint.

NOTE 4—When applied to the testing of welds in metals, this type of three-point bending is commonly called side bend.

4.2 Typically, bend test coupon pairs are cut from a position around the pipe and the position directly opposite on the other half of the butt fusion joined pipe sample. Optionally, segmenting larger diameter butt fusion joined pipes into four or more equal sections (quadrants, sixths, eighths, etc.) provides additional bend test coupon pairs.

5. Significance and Use

5.1 This standard practice is a procedure to evaluate the ductility of side bend test specimens that are a transverse section of the pipe wall and butt fusion. Side bend test specimens are prepared from bend test coupons from sample polyethylene pipe butt fusion joints that are made using polyethylene pipe having a wall thickness of approximately 1 in. (25 mm) and greater. A three-point bend is applied to the side bend test specimen by pressing the side bend test specimen into a gap between two rotatable supports with a loading nose. The bending load is applied such that the bending strain is transverse to the plane of the fusion joint.

5.2 Equipment for cutting bend test coupons, preparing side bend test specimens and conducting this practice is available for laboratory and for field use.

5.3 Benchmark criteria for evaluating field testing results are developed by testing a statistically valid number of sample butt fusions in a controlled environment, preferably using equipment for field use. Guided side bend test results from field tests are then evaluated by comparison to benchmark test results from the controlled environment.

6. Apparatus

6.1 *The Side Bend Fixture*—An apparatus to securely hold all of the essential parts and the side bend test specimen in a stable configuration while the practice is conducted. The testing fixture shall provide for accurate visual alignment of the side bend test specimen relative to the centerline of the loading nose, and shall provide visual determination of side bend test specimen bend angle. The testing fixture shall be constructed such that full and continuous contact of the side bend test specimen with the loading nose is maintained as the test is performed. The essential parts are as follows:

6.1.1 *Rotatable supports*—Two cylindrical bars each having a diameter of 0.75 in. ± 0.01 in. (17.6 mm ± 0.3 mm) that are mounted in the testing fixture such that they can rotate freely