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.

Designation: G10 – 10 (Reapproved 2019)

Standard Test Method for Specific Bendability of Pipeline Coatings[1]

This standard is issued under the fixed designation G10; 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 test method covers the specific determination of the effect of short-radius bends on coatings applied to 33.4-mm (1-in. nominal) diameter pipe.

1.2 The values stated in SI units to three significant decimals are to be regarded as the standard. The values given in parentheses are for information only.

1.3 *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.*

1.4 *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]

G6 Test Method for Abrasion Resistance of Pipeline Coatings

G12 Test Method for Nondestructive Measurement of Film Thickness of Pipeline Coatings on Steel (Withdrawn 2013)[3]

3. Summary of Method

3.1 The method consists of bending a 33.4-mm (1-in. nominal) diameter specimen of coated pipe around a mandrel to produce a range of short-radius bends. Coating failure in the form of cracking or loss of adhesion is detected through visual and electrical inspection of the bent specimen.

4. Significance and Use

4.1 This test will provide information on the ability of coatings applied to pipe to resist cracking, disbonding, or other mechanical damage as a result of bending. Because the test is applied to coated pipe from commercial production, the results can be directly used in the selection of similar materials for service. The test also has application as a quality control method when variations in coating application or material formulation will affect bending performance.

5. Apparatus

5.1 The bending apparatus shall be essentially as shown in Figs. 1-3 and shall include the following:

5.1.1 *Variable-Radius Mandrel,* constructed from four 19-mm (0.75-in.) thick pieces of plywood, bolted together and conforming to the geometric shape shown in Fig. 1. The geometric construction is accomplished by laying out along the outer edge of the mandrel a series of seven consecutive arcs at decreasing radii of 610, 530, 460, 380, 300, and 230 mm (24, 21, 18, 15, 12, and 9 in.). The first five arcs shall be carried through a 45-deg angle to the next point of tangency. A 45-deg V-notch shall be cut into the edge of the mandrel for seating the pipe specimen. Holes shall be drilled at appropriate locations in the mandrel face for positioning the lever arm and fastening pipe clamps.

5.1.2 *Lever Arm-Roller Assembly*—A 1.83-m (72-in.) lever arm with nylon roller supplies the mechanical advantage necessary to bend the pipe specimen. The lever arm shall contain a series of holes which are used to maintain proper clearance between the roller and pipe sample during the bending operation.

5.2 *Thickness Gage*—Measurements of coating thickness will be required for this test. This shall be done in accordance with Test Method G12.

5.3 *Holiday Detector*—A low-voltage d-c holiday detector of the wet-sponge type, specified in Test Method G6, shall be used to locate breaks in the coating film.

6. Test Specimens

6.1 The test specimen should be 2.5 m (100 in.) in length. It should be representative of production-coated pipe and be free

[1] This test method is under the jurisdiction of ASTM Committee D01 on Paint and Related Coatings, Materials, and Applications and is the direct responsibility of Subcommittee D01.48 on Durability of Pipeline Coating and Linings.

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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] The last approved version of this historical standard is referenced on www.astm.org.

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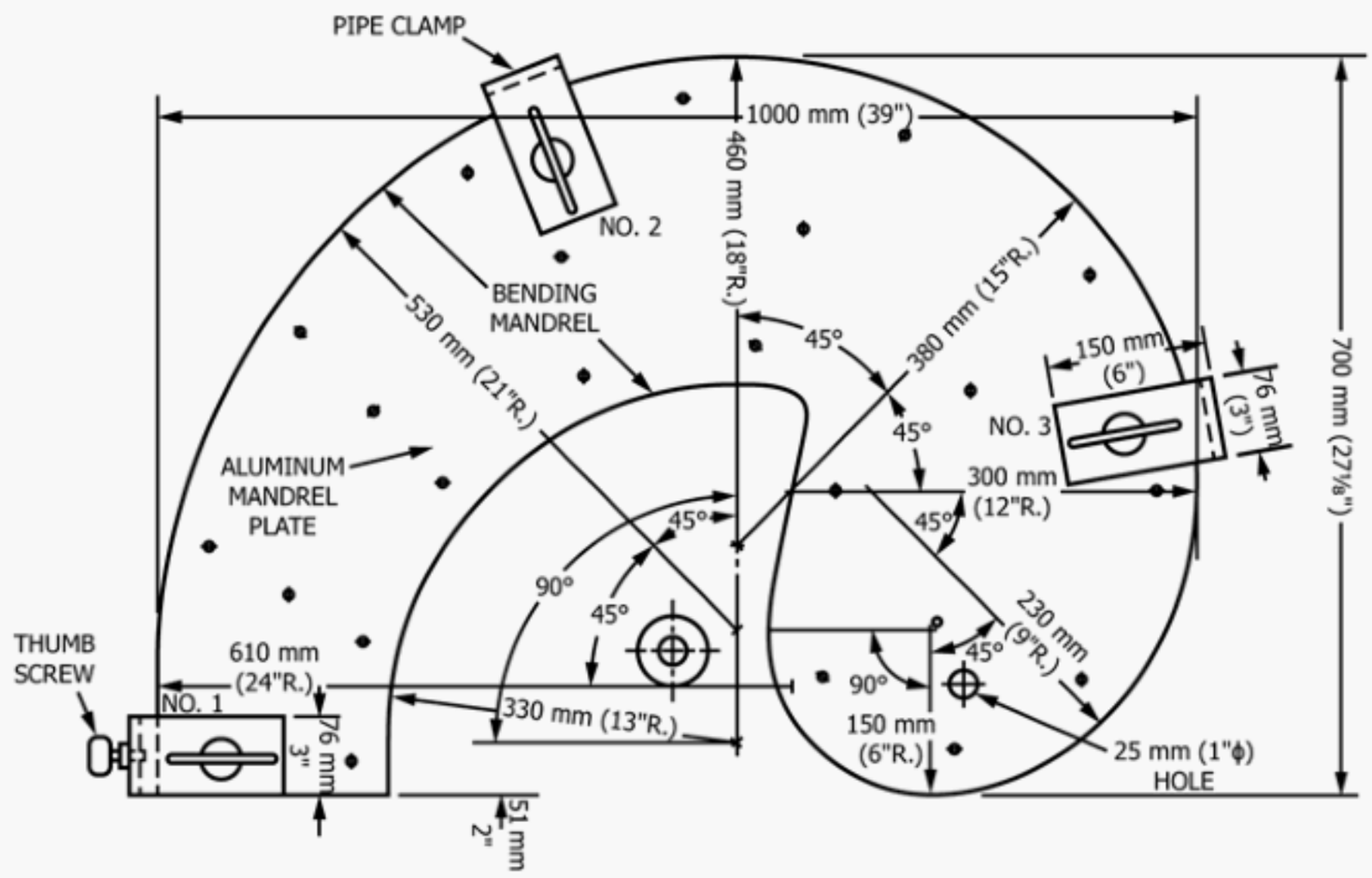

FIG. 1 Variable-Radius Mandrel

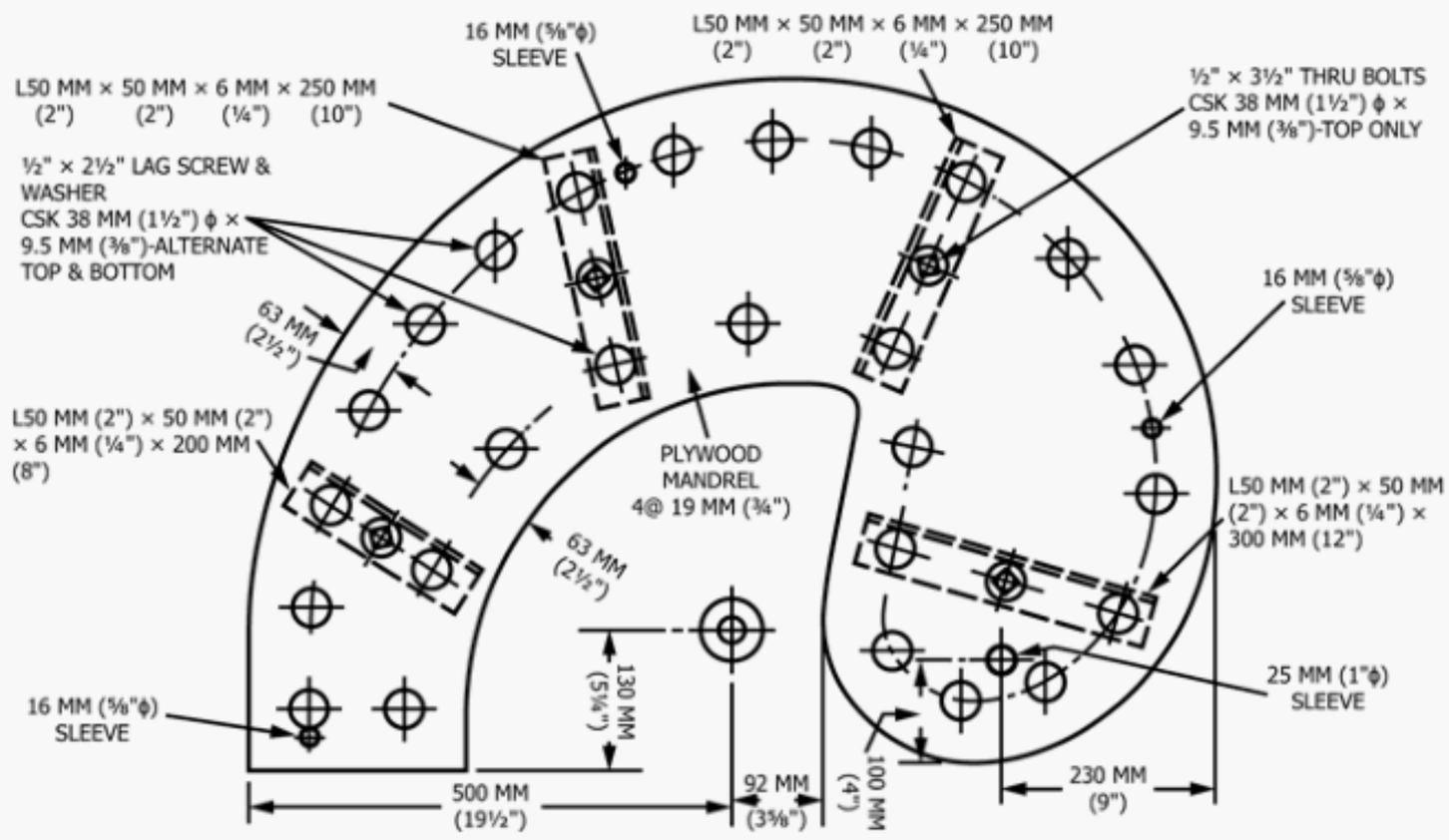

FIG. 2 Details of Mandrel Assembly and Support Brackets

of obvious coating flaws or defects. Coating specimens shall be applied to 33.4-mm (1-in. nominal) diameter pipe.

7. Conditioning

7.1 The specimen shall be exposed to room temperature for a sufficient time to ensure thermal equilibrium in the pipe and coating. A temperature in the range from 20 to 30°C (68 to 85°F) shall be considered room temperature.

8. Procedure

8.1 Perform the test at a room temperature of 21 to 25°C (70 to 77°F).

8.2 Measure the applied coating thickness of each specimen in accordance with Test Method G12.

8.3 The time to execute the test at a uniform velocity should be agreed upon by the producer and the user.

8.4 Place the conditioned test specimen into the V-notch. Secure the pipe in place with clamp No. 1 and tighten the thumb screw. Remove the threaded handle from clamp No. 1 to allow for clearance of the lever arm. With the steel pivot pin at hole A of the lever arm (see Fig. 3), insert the pin into the socket on the bed of the bending jig. Place the nylon roller at position C on the lever arm. Apply the roller to the pipe specimen, and with a constant, even force with the lever handle, bend the pipe around the mandrel until the 460-mm (18-in.) radius bend has been made. Insert and secure pipe clamp No. 2. Continue bending the pipe until the 300-mm (12-in.) radius has been reached. Insert and secure pipe clamp No. 3. Reposition the lever arm by moving the pivot pin to the 25-mm (1-in.) diameter hole in the mandrel surface. Move the nylon roller to position B on the lever arm. Apply the roller to the pipe and complete the bending operation by forming the specimen through the 230-mm (9-in.) radius.

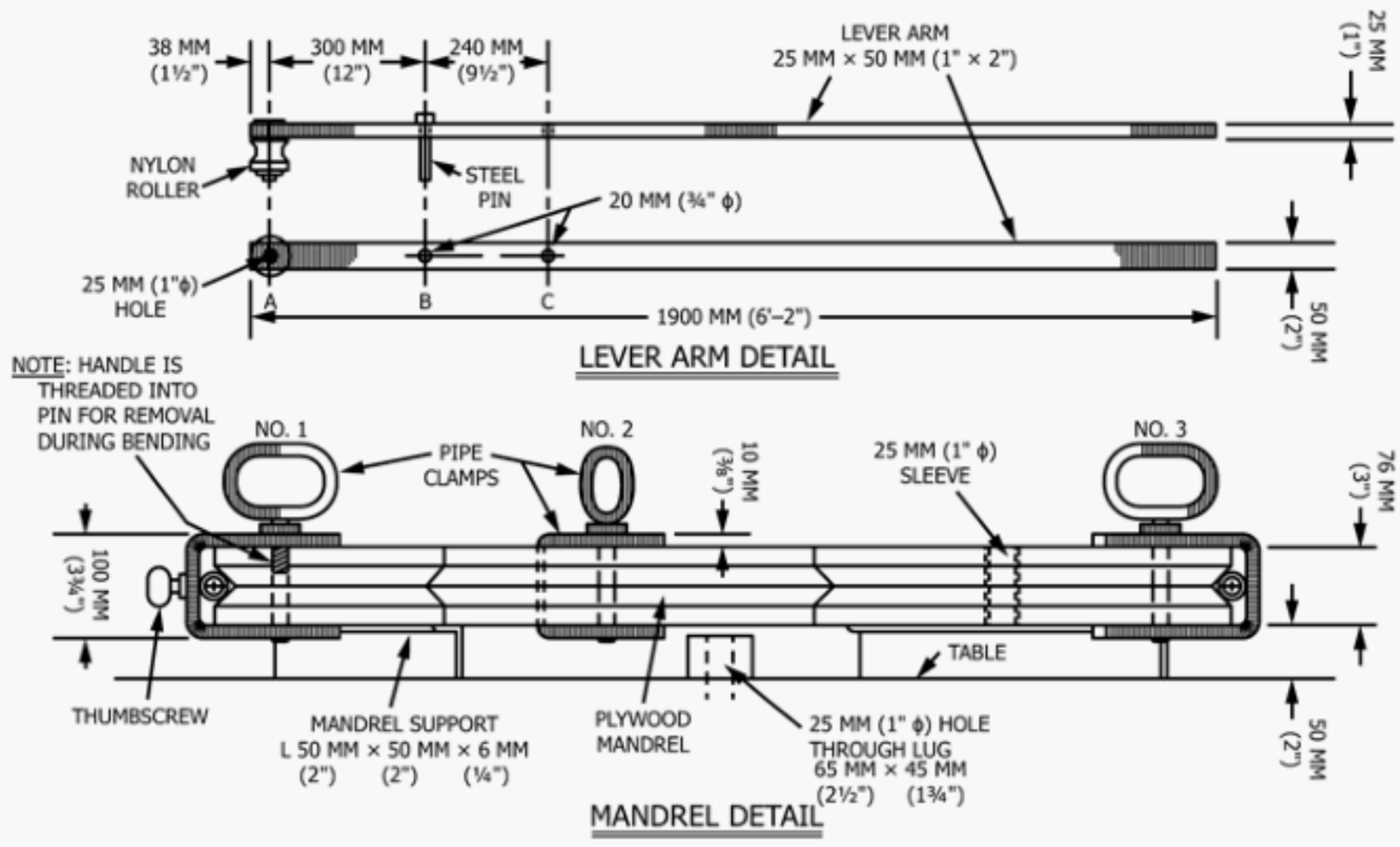

FIG. 3 Details of Lever Arm and Pipe Clamps

8.5 Examine the bent specimen with a wet-sponge holiday detector to determine at what point, if any, cracking of the coating film occurred. Note the number, size, location, and type of cracks present. Examine the pipe specimen for any loss of coating bond caused by the bending operation.

NOTE 1—The possibility of some coatings developing stress-induced cracks in the period following the bending operation should not be overlooked. If this is a consideration, the bent specimen should be retained for a 24-h post-bent inspection.

9. Report

9.1 The initial test report shall include the following:

9.1.1 Complete identification of the coated pipe tested, including: name and type of coating, average coating thickness, minimum coating thickness, maximum coating thickness, manufacturer's lot number, and date of manufacture.

9.1.2 Temperature of the pipe specimen as tested,

9.1.3 Radius at which cracking first occurred,

9.1.4 Description of the type of cracking,

9.1.5 Location and extent of any loss in pipe-to-coating bond,

9.1.6 Number of specimens tested,

9.1.7 Any peculiar characteristics of the specimen noted during the test or after immediate removal from the test apparatus, and

9.1.8 Post-bend retention time.

10. Precision and Bias

10.1 As this test method serves as a coating performance guide to investigators wishing to compare the relative merits of pipe-coating materials, no precision and bias statement is required.

11. Keywords

11.1 bendability; flexability; pipeline coatings

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