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: G20 – 10 (Reapproved 2019)

Standard Test Method for Chemical Resistance of Pipeline Coatings[1]

This standard is issued under the fixed designation G20; 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 is intended for evaluating the resistance of pipe coating materials when exposed to various concentrations of reagents or suspected soil contaminants. The test serves as a guide to investigators wishing to compare the relative merits of pipe-coating materials in specific environments. The choice of reagents, concentrations, duration of immersion, temperature of test, and properties to be reported are necessarily arbitrary and should be chosen to reflect conditions known to exist along the pipeline right-of-way.

1.2 The values stated in SI units 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]

D543 Practices for Evaluating the Resistance of Plastics to Chemical Reagents

D883 Terminology Relating to Plastics

G8 Test Methods for Cathodic Disbonding of Pipeline Coatings

G12 Test Method for Nondestructive Measurement of Film Thickness of Pipeline Coatings on Steel (Withdrawn 2013)[3]

G17 Test Method for Penetration Resistance of Pipeline Coatings (Blunt Rod)

3. Summary of Test Method

3.1 This test method consists of an immersion-type test in a closed container where coated pipe specimens are in long-term contact with both the liquid and vapor phase of the test reagent. Specimens exposed in this manner are inspected for visible signs of chemical attack. Subsequent tests for cathodic disbonding in accordance with Test Method G8, or penetration under load in accordance with Test Method G17, may be applied to determine if the specimens have undergone any loss of mechanical or bonding properties.

4. Significance and Use

4.1 The data obtained for short-term tests are of interest only in eliminating the most unsuitable materials or for indicating a probable order of resistance in any particular media.

4.2 Test conditions should take into account the manner and duration of immersion, the reagent, the temperature of the system, the area exposed above and below the liquid level, and other performance factors selected for the particular test.

5. Apparatus

5.1 *Thickness Gage,* capable of measuring the coating thickness in the manner prescribed by Test Method G12.

5.2 *Test Container*—A transparent closed container, sized to completely encase the pipe specimen and large enough to provide adequate exposure to both the liquid and vapor states of reagent.

NOTE 1—For example, a 2-L (2.0-qt) capacity, Mason-type jar with a 70-mm (2.75-in.) diameter neck has been found suitable for use with 2 in. pipe and is illustrated in Fig. 1.

5.2.1 To avoid pressure build-up within the test containers, the threaded cup shall be replaced with a solid-rubber stopper. A positive venting device, such as a water seal, shall be used when testing with volatile solvents at elevated temperatures.

[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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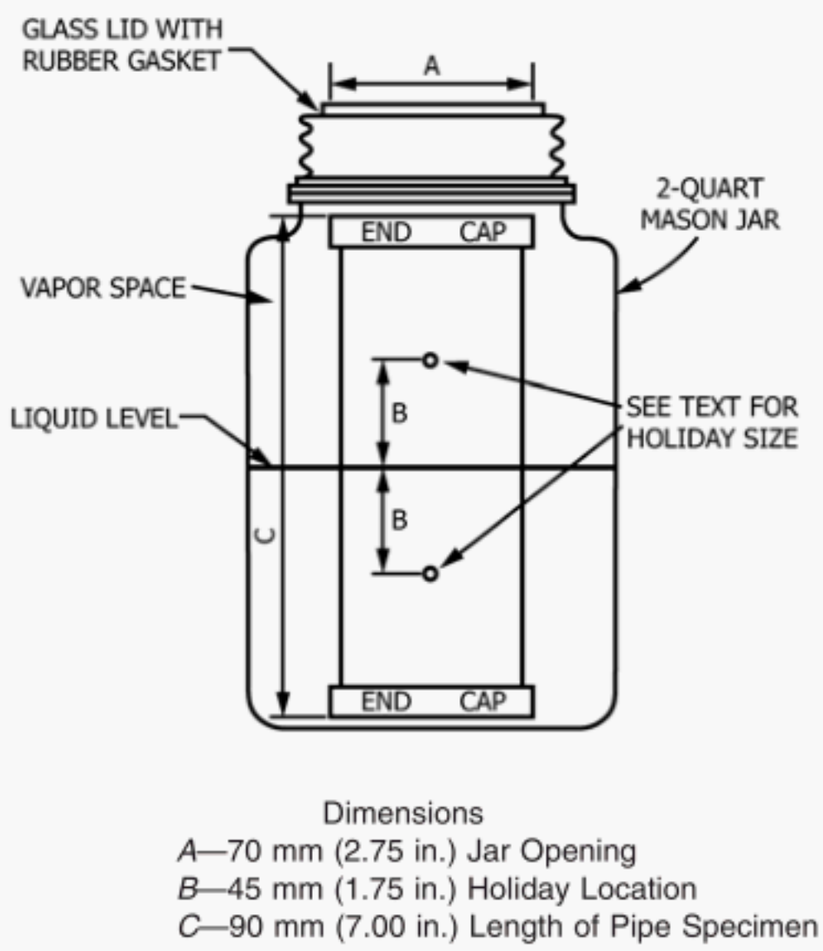

NOTE 1—Dimensions shown for 2 in. IPS pipe.

FIG. 1 Chemical Immersion Test Schematic of Test Cell

5.2.2 A separate container shall be used for each test specimen.

5.3 *Oven or Constant-Temperature Room or Bath*—To ensure uniformity of test results, the test cells and specimen shall be maintained at the test temperature ±5°C (9°F) over the duration of the test period.

5.4 *Auxiliary Testing Devices*—Supplemental equipment used to determine specific mechanical properties of specimens before and after immersion shall conform to the requirements prescribed in the applicable ASTM test method.

6. Reagents

6.1 The reagents selected for coating-resistance tests should be those anticipated to occur in the environment or in the product being carried in the pipeline at the temperatures and in the concentrations expected. The numbers in parentheses refer to the list of standard reagents given in Section 4 of Practices D543.

6.1.1 *Acetic Acid* (5 %) (4.4.2).
6.1.2 *Acetone* (4.4.3).
6.1.3 *Carbon Disulfide.*
6.1.4 *Gasoline.*
6.1.5 *Hydrochloric Acid* (10 %) (4.4.23).
6.1.6 *Kerosine* (4.4.28).
6.1.7 *Lime Water, Saturated.*
6.1.8 *Methyl Alcohol* (4.4.29).
6.1.9 *Methyl Ethyl Ketone.*
6.1.10 *Nitric Acid* (10 %) (4.4.33).
6.1.11 *Sodium Carbonate Solution* (20 %) (4.4.38).
6.1.12 *Sodium Chloride Solution* (10 %) (4.4.40).
6.1.13 *Sodium Hydroxide Solution* (10 %) (4.4.42).
6.1.14 *Sulfuric Acid* (30 %) (4.4.46).
6.1.15 *Toluene* (4.4.48).
6.1.16 *Transformer Oil* (4.4.49).
6.1.17 *Trichlorethylene.*
6.1.18 Other selected environments.

7. Hazards

7.1 Take safety precautions to avoid personal contact, to eliminate toxic vapors, and to guard against explosion hazards in accordance with the hazardous nature of the particular reagents being used.

8. Test Specimen

8.1 The test specimen shall be prepared with its surface preparation and coating procedures equivalent to that of coated pipe. A control specimen shall be retained for comparison.

8.2 In order to utilize the test container specified in 4.2, the pipe specimen, with end caps, shall be restricted to a maximum overall length of 180 mm (7.0 in.) and a diameter of 65 mm (2.5 in.).

8.3 Both ends of the pipe specimens shall be plugged with inert stoppers and coated with an epoxy-base or other suitable coating material.

8.4 *Specimens with Holidays:*

8.4.1 A holiday shall be made in the surface of the coated pipe specimen at a point 25 % of the distance between the end caps. It shall be made by drilling a radial hole through the coating so that the angular cone point of the drill will fully enter the steel where the cylindrical portion of the drill meets the steel surface. The drill diameter shall not be less than three times the coating thickness, but it shall never be smaller than 6 mm (0.25 in.) in diameter. The steel wall of the pipe shall not be perforated.

8.4.2 A second identical holiday shall be drilled into the coating surface at a point 25 % of the distance between the end caps of the specimen (see Fig. 1). Both holidays should lie in the same pipe axis.

8.5 Specimens without intentional holidays shall also be prepared for testing.

NOTE 2—Intentional holidays shall be made in only those specimens for which a comparison of disbonding properties is desired. Other samples used for supplemental mechanical testing shall be run without holidays.

9. Procedure

9.1 Place a single specimen in a vertical position in each test container.

9.2 Fill the container with the selected reagent so that the liquid level covers one half of the coated pipe specimen up to a point midway between the two intentional holidays. Stopper the 704 Container to prevent evaporation of the reagent and against contamination.

9.3 Maintain the reagent level at the original level.

9.4 The basic immersion test for a particular coating material shall consist of twelve specimens, six with holidays and six without, each in an individual test cell. Remove duplicate samples of each from the test at 30, 60, and 90 day intervals. Additional investigations of pre- and post immersion mechanical properties will require additional specimens. It is recommended that in all cases provisions be made for duplicate test specimens.

9.5 Remove the specimen after 30, 60, and 90 days of immersion. Wash with running water all specimens removed from acid, alkali, or other aqueous solutions and wipe them dry with a soft, clean, cotton cloth or paper tissue. Specimens removed from volatile solvents such as acetone, alcohol, etc., need no rinsing before wiping dry.

9.6 Observe and report before, immediately after, and 2 h later the appearance of specimen after exposure to reagent on the basis of visual examination for evidence of loss of gloss, developed texture, decomposition, discoloration, softening, swelling, injury, bubbling, blistering, cracking, solubility, etc. as defined in Terminology D883.

9.7 Mechanically probe each of the intentional holidays in accordance with Section 8.3.3 of Test Method G8 to see if there has been any loss of coating bond during the test period.

9.8 Perform other planned mechanical tests to determine if any degradation of coating properties has occurred through reagent exposure.

10. Report

10.1 The report shall include the following:

10.1.1 Complete identification of the material tested, including type, source, manufacturer's code, and previous history,

10.1.2 Method of preparing test specimen,

10.1.3 Temperature of test,

10.1.4 Description of media, including ASTM designation,

10.1.5 Duration of immersion,

10.1.6 Outside diameter of test specimen,

10.1.7 Initial thickness of coating,

10.1.8 General appearance of specimen after immersion,

10.1.9 Immersion area in square millimetres (square inches),

10.1.10 Vapor phase area in square millimetres (square inches), and

10.1.11 Disbonded area after immersion in square millimetres (square inches).

11. Precision and Bias

11.1 As there are no direct measurements involved with this test method, no precision and bias statement is necessary. Measurements made by procedures for other test methods should refer to the precision and bias statements therein.

12. Keywords

12.1 chemical resistance; pipeline coatings

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