



Designation: G 80 – 88 (Reapproved 1998)

Standard Test Method for Specific Cathodic Disbonding of Pipeline Coatings¹

This standard is issued under the fixed designation G 80; 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 an accelerated procedure for simultaneously determining comparative characteristics of insulating coating systems applied to steel pipe exterior for the purpose of preventing or mitigating corrosion that may occur in underground service where the pipe will be in contact with natural soils and may or may not receive cathodic protection. It is intended for use with samples of coated pipe taken from commercial production and is applicable to such samples when the coating is characterized by function as an electrical barrier.

1.2 This test method is specific with no options. For alternative methods of test see Test Methods G 8.

1.3 The values stated in SI units are to be regarded as the 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 and health practices and determine the applicability of regulatory limitations prior to use.*

2. Referenced Documents

2.1 ASTM Standards:

G 8 Test Methods for Cathodic Disbonding of Pipeline Coatings²

G 12 Test Method for Nondestructive Measurement of Film Thickness of Pipeline Coatings on Steel²

G 16 Practice for Applying Statistics to Analysis of Corrosion Data³

3. Summary of Test Method

3.1 The coating on the test specimen is subjected to electrical stress in a highly conductive, alkaline electrolyte. Electrical stress is obtained by means of a sacrificial magnesium anode. The coating is perforated before starting the test.

3.2 After the test period is concluded, results are determined by physical examination and comparing the loosened or

disbonding coating at the perforations in the immersed area with loosened or disbonded coating at a new test hole in the coating made in an area that was not immersed.

4. Significance and Use

4.1 Breaks or holidays in pipe coatings may expose the pipe to possible corrosion, since after a pipe has been installed underground, the surrounding earth will be more or less moisture-bearing and constitutes an effective electrolyte. Damage to pipe coating is almost unavoidable during transportation and construction. Normal soil potentials as well as applied cathodic protection potentials may cause loosening of the coating, beginning at holiday edges, in some cases increasing the apparent size of the holiday. Holidays may also be caused by such potentials. While apparently loosened coating and cathodic holidays may not result in corrosion, this test provides accelerated conditions for loosening to occur and therefore gives a measure of resistance of coatings to this type of action.

4.2 The effects of the test are evaluated by physical examination assessing the effective contact of the coating with the metal surface in terms of observed differences in the relative adhesive bond. It is usually found that the electrically stressed area propagates from the holiday to a boundary where the loosened coating leaves off for the more effective contact or bond attributed to an original condition throughout the specimen before electrical stressing was applied. Assumptions associated with test results include:

4.2.1 That attempting to loosen or disbond the coating at a new test hole made in the coating in an area that was not immersed represents maximum adhesion or bond as measured by the lifting technique used, and that the same lifting technique can be used at a test hole that was immersed, thereby providing a means of comparing relative resistance to lifting.

4.2.2 That any relatively lesser bonded area at the immersed test holes in the coating was caused by electrical stressing and was not attributable to any anomaly in the application process. Ability to resist disbondment is a desired quality on a comparative basis, but disbondment per se in this test is not necessarily an adverse indication. The virtue of this test is that all dielectric type coatings now in common use will disbond to some degree thus providing a means of comparing one coating with another. Bond strength is more important for proper

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² *Annual Book of ASTM Standards*, Vol 06.02.

³ *Annual Book of ASTM Standards*, Vol 03.02.

functioning of some coatings than others and the same measured disbondment for two different coating systems may not represent equivalent loss of corrosion protection.

4.2.3 That the current density appearing in this test is much greater than that usually required for cathodic protection in natural, inland soil environments.

4.2.4 That there is no impact on test results caused by interaction among multiple test samples in the test vessel. It is suggested that if interference is suspected, clarification may be obtained by testing a single sample in the test vessel.

5. Apparatus

5.1 Apparatus:

5.1.1 *Test Vessel*—A nonconducting material shall be used for the vessel or as a lining in a metallic vessel. Dimensions of the vessel shall permit the following requirements:

5.1.1.1 Test specimens shall be suspended vertically in the vessel with at least 25.4 mm (1-in.) clearance from the bottom.

5.1.1.2 Each test specimen shall be separated from the other specimens, from the anodes and from the walls of the test vessel by at least 38.1 mm (1.500 in.).

5.1.1.3 Depth of electrolyte shall permit the test length of the specimen to be immersed as required in 7.4.

5.1.2 *Magnesium Anode*—The anode shall be made of a magnesium alloy having a solution potential of -1.45 to -1.55 V with respect to a CuCuSO_4 reference electrode in the electrolyte given in 6.1. It shall have a surface area not less than one third that of the total specimen area exposed to electrolyte (outside area exposed only). The anode shall be provided with a factory-sealed, 4107-cmil(14-gage Awg), minimum, insulated copper wire. Anodes without a factory seal may be used if the magnesium extends above the cover.

5.1.3 *Connectors*—Wiring from anode to test specimen shall be 4107-cmil (14-gage Awg), minimum, insulated copper. Attachment to the test specimen shall be by soldering, brazing, or bolting to the nonimmersed end, and the place of attachment shall be coated with an insulating material. A junction in the connecting wire is permitted, provided that it is made by means of a bolted pair of terminal lugs soldered or mechanically crimped to clean wire ends.

5.1.4 *Holiday Tools*—Holidays shall be made with conventional drills of the required diameter. A sharp-pointed knife with a safe handle is required for use in making physical examinations.

5.1.5 *High-Resistance Voltmeter*, for direct current, having an internal resistance of not less than 10 M Ω and having a range from 0.01 to 5 V for measuring potential to the reference electrode.

5.1.6 *Reference Electrode*, saturated CuCuSO_4 of conventional glass or plastic tube with porous plug construction, preferably not over 19.05 mm (0.750 in.) in diameter, having a potential of -0.316 V with respect to the standard hydrogen electrode. A saturated calomel electrode may be used, but measurements made with it shall be converted to the CuCuSO_4 reference for reporting by adding -0.072 V to the observed reading.

5.1.7 *Thickness Gage*, for measuring coating thickness in accordance with Test Method G 12.

5.1.8 *Volt-Ohm-Meter*, for initial testing of apparent coating resistance.

5.1.9 *Metallic Electrode*, used temporarily with the volt-ohm-meter to determine apparent initial holiday status of the test specimen.

5.1.10 *Additional Connecting Wires*, 4107-cmil (14-gage Awg), minimum, insulated copper.

6. Materials

6.1 The electrolyte shall consist of potable tap water with the addition of 1 mass % of each of the following technical-grade salts, calculated on an anhydrous basis: sodium chloride, sodium sulfate, and sodium carbonate. Use freshly prepared solution for each test.

6.2 Materials for sealing the ends of coated pipe specimens may consist of bituminous products, waxy, epoxy, or other materials, including molded elastomer or plastic end caps.

6.3 Plywood or plastic material has been found suitable for the construction of test vessel covers and for the support through apertures of test specimens and electrodes. Wood dowels introduced through holes in the top ends of test specimens have been found suitable for suspending test specimens from the vessel cover.

7. Test Specimen

7.1 The test specimens shall be 60 mm (2.375 in.) O.D. Schedule 40 coated pipes prepared with their surface preparation and coatings procedure equivalent to that of production coated pipe, then cut and drilled as shown in Fig. 1. One end shall be plugged or capped and sealed.

7.2 Three test holes shall be made in the coating in each specimen, drilled 120° apart with one in the center and the other two at locations one-fourth the distance from top and bottom of the immersed test length. Each holiday shall be drilled 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 be not less than three times the coating thickness, but it shall never be smaller than 6.35 mm, (0.250 in.) in diameter. The steel wall of the pipe shall not be perforated. Record initial holiday diameter.

NOTE 1—Before making the holiday, see 7.6.

7.3 The end of the pipe which will protrude above the immersion line shall be provided with suitable supporting means and a separate wire connection for electrical purposes, soldered, brazed, or bolted to the pipe. The protruding end, including hanger and wire connections, shall be protected and sealed with an insulating coating material.

7.4 The specimen test area shall consist of the area between the edge of the bottom end seal and the immersion line for a distance of 490.22 mm \pm 12.7 (19.300 \pm .500 in) representing an area of 92,900 mm² (1 ft²). The bottom end seal area shall not be considered part of the area tested.

7.5 Measure and record the minimum and maximum coating thickness in accordance with Test Method G 12, and the thickness where each holiday is made.

7.6 Verify the continuity of the coating and the effectiveness of the end cap seal before making artificial holidays as follows: