



Designation: ~~G8–96 (Reapproved 2019)~~ G8 – 24

## Standard Test Methods for ~~Cathodic Disbonding of Pipeline Coatings~~ Coated Steel<sup>1</sup>

This standard is issued under the fixed designation G8; 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 ( $\epsilon$ ) indicates an editorial change since the last revision or reapproval.

### 1. Scope

1.1 ~~These test methods cover accelerated~~ apply to procedures 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 determining the degree of disbondment of a coating from a steel substrate when placed in contact with inland soils and may or may not receive cathodic protection. They are intended for use with samples of coated pipe taken from commercial production and are applicable to such samples when the coating is characterized by function as an electrical barrier-an electrolyte and a potential is applied to the steel. Specimens may include coated steel pipe or coated flat or curved steel plate. The coating applied to the steel substrate shall be non-metallic and shall not show flow characteristics at the test temperature.

1.2 ~~This test method is intended for testing coatings submerged or immersed in the test solution at room temperature. When it is impractical to submerge or immerse the test specimen, Test Method~~ These test methods apply to specimens that are immersed in an electrolyte bath or specimens with an attached electrolyte ~~G95 may be considered where the test cell is cemented to the surface of the coated pipe specimen. cell at ambient room temperature, 21 °C to 25 °C (70 °F to 77 °F), conditions. If higher temperatures are required, see~~ Test Method ~~G42. If a specific test method is required with no options, see Test Method~~ G80.

1.3 ~~These test methods apply to methods of polarization including sacrificial anodes or impressed current applied to the steel by a rectifier.~~

1.4 ~~The values stated in SI units to 3 significant decimals~~ are to be regarded as the standard. The values given in parentheses are for information only.

1.5 *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.*

1.6 *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:*<sup>2</sup>

[A36 Specification for Carbon Structural Steel](#)

<sup>1</sup> These test methods are under the jurisdiction of ASTM Committee D01 on Paint and Related Coatings, Materials, and Applications and are the direct responsibility of Subcommittee D01.48 on Durability of Pipeline Coating and Linings.

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<sup>2</sup> 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.

[D1141 Practice for Preparation of Substitute Ocean Water](#)

[D5162 Practice for Discontinuity \(Holiday\) Testing of Nonconductive Protective Coating on Metallic Substrates](#)

[G12D7091 Test Method Practice for Nondestructive Measurement of Dry Film Thickness of Pipeline Coatings on Steel Non-magnetic Coatings Applied to Ferrous Metals and Nonmagnetic, Nonconductive Coatings Applied to Non-Ferrous Metals \(Withdrawn 2013\)](#)

[G42 Test Method for Cathodic Disbonding of Pipeline Coatings Subjected to Elevated Temperatures](#)

[G80 Test Method for Specific Cathodic Disbonding of Pipeline Coatings \(Withdrawn 2013\)<sup>3</sup>](#)

[G95 Test Method for Cathodic Disbondment Test of Pipeline Coatings \(Attached Cell Method\)](#)

### 3. Summary of Test Method

3.1 Three test methods are described in this standard. In each method, an artificial holiday or defect is applied to the specimen's coating film through to the steel substrate. The specimen is immersed in a defined electrolyte with the steel polarized to a defined voltage.

3.1.1 *Method A*—The specimens are immersed in an electrolyte immersion bath. A specified metallic anode is used to polarize the specimen with no electrical monitoring during the test period.

3.1.2 *Method B*—The specimens are immersed in an electrolyte immersion bath. Polarization of the specimen is conducted using an impressed current potentiostat at a specified DC voltage with electrical monitoring during the test period.

3.1.3 *Method C*—The specimens shall have a cell containing the electrolyte attached to the surface of the specimen. Polarization of the specimen is conducted using an impressed current potentiostat at a specified DC voltage with electrical monitoring during the test period.

3.2 Both of the two test methods described subject the coating on the test specimen to electrical stress in a highly conductive, alkaline electrolyte. Electrical stress is obtained either by means of a sacrificial magnesium anode or from an impressed current system. The coating is perforated before starting the test. Upon completion of immersion exposure, a physical examination is conducted by comparing the extent of loosened or disbonded coating at the holiday in the immersed area with extent of loosened or disbonded coating at a new holiday in the coating made in an area that was not immersed. Test specimens are also examined for any other visible defect.

3.1.1 In Method A, a magnesium anode is used with no electrical monitoring during the test period. The results are determined by physical examination after the test period is concluded.

3.1.2 In Method B, either a magnesium anode or an impressed current system may be used. Electrical instrumentation is provided for measuring the current in the cell circuit. The electrical potential is also measured, and upon conclusion of the test period, the test specimen is physically examined.

3.1.3 In both test methods physical examination is conducted by comparing the extent of loosened or disbonded coating at the perforations in the immersed area with extent of 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 it 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.

4.1 The effects of the test may be evaluated by either physical examination or monitoring the current drawn by the test specimen and both of these two. Usually there is no correlation between the two methods of evaluation but both methods are significant. Physical examination consists of 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 the following: Breaks or holidays in a coating applied over steel exposes the substrate to a potential corrosion cell. When the steel is subjected to cathodic protection by the polarization of the steel via sacrificial anodes or impressed current, the exposed steel at the holiday becomes the cathode in the corrosion cell. When the electrolyte is neutral or slightly alkaline, hydroxyl ions form from the reduction of oxygen and, when paired with a suitable cation from the electrolyte, form an alkaline solution. Depending on the strength of this alkaline solution and the concentration of the alkaline compound, this alkalinity may disrupt the adhesion between the coating and the steel, disbonding the coating from the steel.~~

~~4.2.1 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 Any relatively lesser bonded area at the immersed test holes in the coating was caused by electrical stressing and was not attributable to an 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 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 The amount of current in the test cell is a relative indicator of the extent of areas requiring protection against corrosion; however, the current density appearing in this test is much greater than that usually required for cathodic protection in natural, inland soil environments.~~

~~4.2 Current density of the cathodic cell also can affect the degree of cathodic disbondment. The greater the current density generated by the concentration of electrons at the anode, the greater the number of hydroxyl ions formed, thus increasing the alkalinity available for disrupting the adhesion between the coating and the steel substrate. Likewise, the concentration of oxygen in the electrolyte will affect the concentration of hydroxyl ions formed at the cathode.~~

~~4.3 For these reasons it is often useful to measure pH, oxygen, and current density when conducting a cathodic disbondment test.~~

## 5. Apparatus

### 5.1 Apparatus for ~~Both Methods: All Three Methods—Method A, Method B, and Method C:~~

~~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.~~

~~5.1.1.4 If electrical monitoring is to be performed as required in Method B, the reference electrode may be placed anywhere in the vessel, provided it is separated from the specimen and from the anode by not less than 38.1 mm (1.500 in.).~~

~~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  $\text{CuCuSO}_4$  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.~~

~~5.1.1 Connectors—Wiring from anode to test specimen shall be 4107-cmil (14-gage Awg); 4107 cmil (14 gauge AWG), minimum, insulated copper. Attachment to the test specimen shall be by soldering, brazing, or bolting to the nonimmersed/non-immersed 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.~~

5.1.2 *Holiday Tools*—Holidays shall be made with conventional drills of the required diameter. For use in preparing small-diameter pipe specimens such as 19.05 mm (0.750 in.) nominal diameter pipe, specimens, the use of a drill modified by substantially grinding away the sharp cone point flat end mill has been found effective in preventing perforation of the metal wall of the pipe. A sharp-pointed knife with a safe handle is required for use in making physical examinations.

5.1.3 *High-Resistance Voltmeter, Disbondment Evaluation Tools*—for direct current, having an internal resistance of not less than 10 MΩ and having a range from 0.01 to 5 V for measuring potential to the reference electrode. A sharp-pointed thin blade knife with a safe handle is required for use in removing disbonded coating from the specimen.

5.1.4 *Reference Electrode, Electrode*—saturated CuCuSO<sub>4</sub> reference, of conventional glass or plastic tube with porous plug construction, preferably notelectrode Ag/AgCl in saturated KCl with double junction, or a saturated Cu/CuSO<sub>4</sub> over 19.05 mm (0.750 in.) in diameter, having a potential of -0.316 V with respect to the standard hydrogen electrode. A calomel electrode may be used, but measurements made with it shall be converted to the CuCuSO<sub>4</sub> reference electrode shall be used. The accuracy of the Ag/AgCl reference electrode shall be checked before starting the test. The Ag/AgCl reference electrode can be checked against another Ag/AgCl reference electrode which is only used reference for reporting by adding -0.072 V to the observed reading for accuracy checkup only without routine usage. The two Ag/AgCl reference electrodes can be inserted into the same electrolyte solution (for example, 3 % NaCl solution). The voltage differential shall be within 5 mV. If over 5 mV, the subject Ag/AgCl reference electrode shall be discarded.

5.1.5 *Thickness Gage, Gauge*, for measuring coating thickness in accordance with Test Method Practice G42D7091.

5.1.6 *Holiday Detector*, for locating holidays in the coating of the test specimen in accordance with Practice D5162, Test Method A – Low Voltage Wet Sponge Testing.

5.1.7 *Thermometer*, for measuring electrolyte temperature, general lab type, 1° subdivisions, 76.2 mm (3 in.) immersion.

5.1.8 *High-Resistance Voltmeter*, for direct current, having an internal resistance of not less than 10 MΩ and capable of measuring as low as 10 μV potential drop across a shunt in the test cell circuit.

5.2 *Additional Apparatus for Methods, Method A and Method B:*

5.2.1 *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:

5.2.1.1 Test specimens shall be suspended vertically in the vessel with at least 25.4 mm (1.0 in.) clearance from the bottom.

5.2.1.2 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 (1.5 in.).

5.2.1.3 The depth of electrolyte shall permit the test length of the specimen to be immersed such that a minimum of 23 227 mm<sup>2</sup> (36 in.<sup>2</sup>) shall be immersed in the electrolyte.

5.2.1.4 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.

5.3 *Additional Apparatus for Method A:*

5.3.1 *Sacrificial Anodes*—Anodes shall be made as specified in Table 1. It shall have a surface area not less than one third that of the total specimen area exposed to electrolyte (for flat panels, the area containing the artificial holiday only and for pipe outside

TABLE 1

Metal Alloy	Potential (Ag/AgCl reference electrode)	Potential (Cu/CuSO <sub>4</sub> reference electrode)
Magnesium	-1.33 to -1.43 V	-1.45 to -1.55 V
Zinc	-0.88 to -0.98 V	-1.00 to -1.10 V
User specified alloy	User specified	User specified

area exposed only). The anode shall be provided with a factory-sealed, 4107 cmil (14 gauge AWG), minimum, insulated copper wire for connecting to the test specimen. Anodes without a factory seal may be used if the alloy extends above the cover or if the connection of the wire to the anode is coated with an insulating material. Anodes, alternatively, may be directly bolted to the test specimen ensuring that there is positive electrical contact between the anode and the test specimen. If pre-used anodes are to be used, the anodes shall be cleaned by wire brushing or by immersion in dilute acid to remove corrosion products to ensure they are active.

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5.4 Additional Apparatus for Method B:

5.2.1 ~~High-Resistance Voltmeter~~, for direct current, having an internal resistance of not less than 10 MΩ and capable of measuring as low as 10 μV potential drop across a shunt in the test cell circuit.

5.4.1 ~~Precision Wire-Wound Resistor, 1-Ω 1 Ω ± 1 %, 1-W (minimum), to 1 W (minimum)~~, shall be used in the test cell circuit as a shunt for current.

5.2.3 ~~Volt-Ohm-Meter~~, for initial testing of apparent coating resistance.

5.4.2 ~~Metallic Electrode~~, used temporarily with the ~~volt-ohm-meter~~ high-resistance voltmeter to determine apparent initial holiday status of the test specimen.

5.4.3 ~~Additional Connecting Wires, 4107-cmil (14-gage Awg)~~, Additional connecting wires shall be 4107 cmil (14 gauge AWG), minimum, insulated copper.

5.4.4 ~~Brass Studs~~, used at a terminal board, together with alligator clips or knife switches, for making and breaking ~~circuits~~. Alligator clips shall not be used to connect to electrodes or specimens at the top location of test cells.

5.2.7 ~~Zero-Resistance Ammeter~~, capable of measuring direct current as low as 10 μA may be used in the alternative method given in 9.1.3 and substituted for the apparatus described in ~~5.2.1 and 5.2.2~~.

5.4.5 ~~Direct-Current Rectifier, Rectifier or Power Supply~~, capable of supplying constant voltage at a voltage of ~~1.50 ± 0.01 V, up to 5.0 V ± 0.05 V~~, as measured between the test specimen and reference electrode.

5.4.6 ~~Impressed Current Anode, Impressed-Current Anode Assembly (Fig. 1)~~: shall be of the nonconsumable type provided with a factory sealed, insulated copper wire.<sup>4</sup>

5.4.6.1 ~~Filter Tube~~—Anode assembly shall be inserted into a glass tube. Length of the tube shall be a minimum of 180 mm (7 in.) and 6 mm (0.25 in.) in diameter. A removable glass or plastic (for example, polyester) wool plug shall be fitted at the bottom of the tube. The plug shall be removed after testing and disposed.

5.4.6.2 ~~Impressed-Current Anode~~—The anode shall be of corrosion-resistant metal wire 0.51 mm (0.020 in. – 24 gauge AWG) diameter. A titanium wire coated with mixed metal oxide IrO<sub>2</sub>/Ta<sub>2</sub>O<sub>5</sub> or a platinum coated wire has been used with good results.

5.4.7 ~~Voltage Divider, 100-Ω, 25-W~~ 100 Ω, 25 W rheostat, to be used if more than one specimen is to be tested as shown in ~~Fig. 1~~ Fig. 6.

5.5 Additional Apparatus for Method C:

5.5.1 ~~Test Vessel~~—The test vessel shall be a transparent plastic or glass tube that is centered over the intentional holiday and sealed to the test sample surface with a waterproof sealing material. The cylinder shall be 101.6 mm (4.0 in.) nominal diameter and of sufficient height to contain 127.0 mm (5.0 in.) of electrolyte. Size of vessel shall remain unchanged. Sealing procedure must be altered to accommodate specimen having a diameter less than 101.60 mm (4 in.).

5.5.2 ~~Impressed-Current Anode Assembly (Fig. 1)~~:

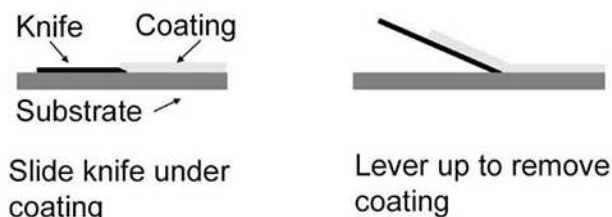
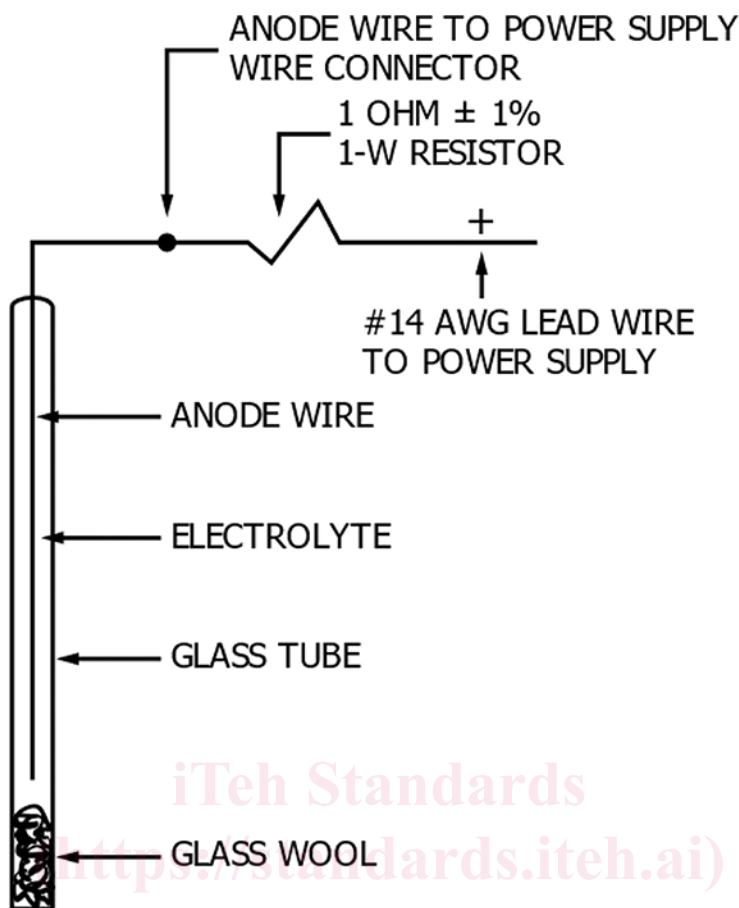


FIG. 4 Removal of Disbonded Coating





NOTE 1—Test hole made in non-immersed area after testing not shown (see Fig. 2).

FIG. 1 Anode Assembly for Methods B and C

ASTM G8-24

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5.5.2.1 Filter Tube—Anode assembly shall be constructed utilizing an immersion tube. Length of the tube shall be a minimum of 180 mm (7 in.) and 6 mm (0.25 in.) in diameter. A removable glass or plastic (for example, polyester) wool plug shall be fitted at the bottom of the tube. The plug shall be removed after testing and disposed.

5.5.2.2 Impressed-Current Anode—The anode shall be of corrosion-resistant metal wire 0.51 mm (0.020 in. – 24 gauge AWG) diameter. A titanium wire coated with mixed metal oxide  $\text{IrO}_2/\text{Ta}_2\text{O}_5$  or a platinum coated wire has been used with good results.

5.5.3 High-Impedance Multimeter—For making direct-current and voltage measurements, the multimeter must have an internal resistance of not less than 10 M  $\Omega$  and be capable of measuring current as low as 1 mA, and voltage up to 10 V.

5.5.4 Direct-Current Rectifier or Power Supply, capable of supplying constant voltage at a voltage of up to 3.00 V  $\pm$  0.05 V, as measured between the test specimen and reference electrode.

5.5.5 Precision Wire-Wound Resistor, 1  $\Omega$   $\pm$  1 %, 1 W (minimum), shall be used in the test cell circuit as a shunt for current (Fig. 1).

## 6. Reagent and Materials

6.1 The electrolyte shall consist of potable tap water with the addition of 1 mass % of employed shall be one of those found in Table 2 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:

**TABLE 2**

Electrolyte Designation	Ionic Composition	Preparation
I	Aqueous solution of 1 % sodium chloride, 1 % sodium sulfate, 1 % sodium carbonate	Using technical grade salts, add to distilled or deionized water, and mix until dissolved.
II	Aqueous solution of 3% sodium chloride	Using technical grade sodium chloride, add to distilled or deionized water, and mix until dissolved.
III	Synthetic seawater	Practice <b>D1141</b> (without heavy metals)
IV	Specified by the user	Specified by the user

6.1.1 Use freshly prepared solution for each test.

6.2 Materials for sealing edges of coated panels or the ends of coated pipe specimens may consist of bituminous products, wax, epoxy, or other materials, including molded elastomeric or plastic end caps, shall consist of non-conducting protective materials.

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 specimen shall be a representative piece of production-coated pipe. One end shall be plugged or capped, and sealed. Test specimens shall be of the following types, unless otherwise specified by the end user:

7.1.1 *Applicable for Methods A, B, and C*—Coated flat panels or coupons shall have minimum dimensions of 150 mm × 300 mm (6 in. × 12 in.) with a minimum thickness 3.2 mm (1/8 in.). Unless otherwise specified, the grade of steel shall be Specification **A36** or equivalent. Uncoated edges shall have a protective edging applied to the panels when used with Method A and Method B.

7.1.2 *Applicable for Methods A and B*—Coated pipe shall have an outside diameter of 50.8 mm (2 in.) with a wall thickness of 6.4 mm (0.25 in.) and a minimum length of 300 mm (12 in.). The end of the pipe to be immersed shall be plugged or capped, and sealed.

7.1.3 *Applicable for Method C*—Coated pipe or curved plate of a diameter that the test vessel can be fitted and sealed to the surface. The recommended wall thickness of the test specimen shall be 6.4 mm (0.25 in.) or greater.

7.2 One or three holidays shall be made in each specimen. Three holidays are recommended. Recommended dimensions are given in Fig. 2. A specimen with one holiday shall have it drilled in the middle of the immersed length. If three holidays are used, they shall be 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. With small-diameter pipes, where there is danger of perforating the pipe, the holiday shall be started with a standard 60° cone point and finished with a drill that has had a substantial portion of the cone point ground away.

Note 1—Before making the holiday, see 8.1.

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. The bottom end seal area shall not be considered part of the area tested. Any suitable diameter and specimen length of pipe may be used, but the immersed area shall be not less than 23–227 mm<sup>2</sup> (36 in.<sup>2</sup>). An area of 92–900 mm<sup>2</sup> (1 ft<sup>2</sup>) has been found preferable when convenient.

## 8. Test Specimen Preparation

8.1 Three single holiday specimens or one, three holiday pipe specimen shall be tested for each coating/test condition unless otherwise specified.



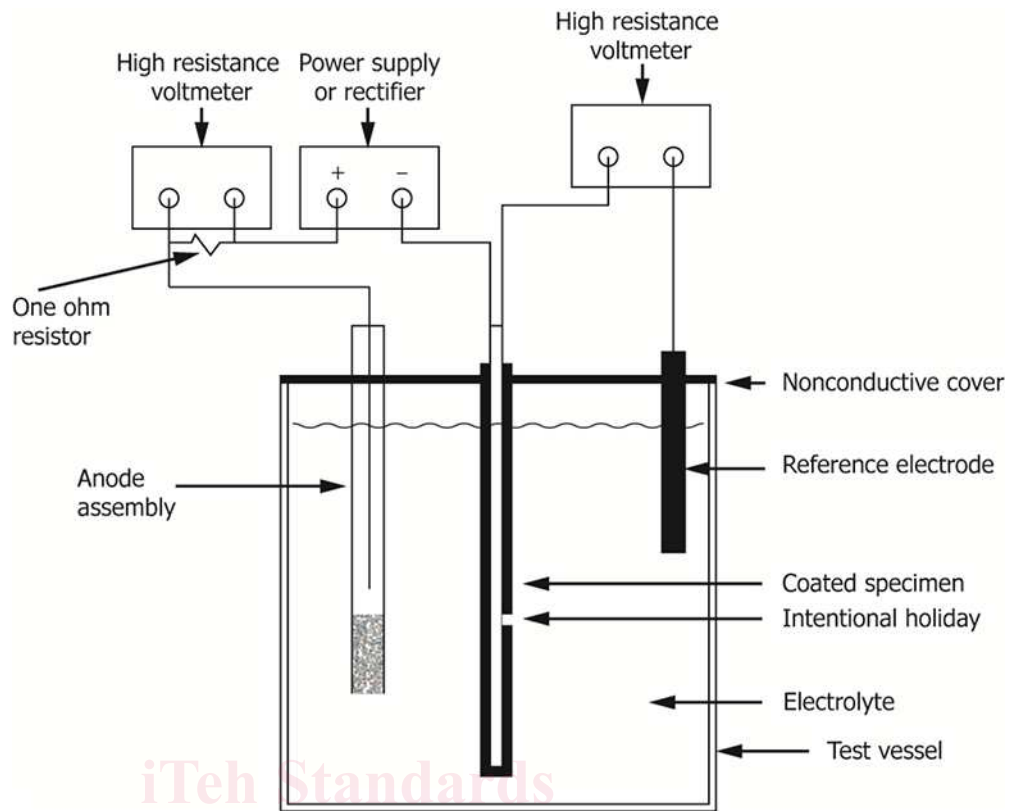


FIG. 5 Test Assembly for Method B Using an Impressed Current with One Specimen

8.2 Before making artificial holidays, verify the continuity of the coating and the effectiveness of the end-cap seal as follows: Preparation of Artificial Holiday:

8.2.1 Prior to making the artificial holiday, the continuity of the coating shall be verified by using a low-voltage wet-sponge holiday detector (Practice D5162) with sufficient water on the sponge to ensure electrical connection in case a holiday is encountered. Specimens with holidays shall be removed and not tested and replaced with holiday free specimens.

8.2.2 Immerse the test specimen and a metallic electrode in the electrolyte. Connect one terminal of the multimeter to the test specimen and the other terminal to the metallic electrode. Measure the apparent resistance in ohms, making two determinations: one with the specimen connected to the positive terminal of the multimeter; and one with the specimen connected to the negative terminal. For flat panels, curved panels, and large diameter pipe specimens, one intentional holiday shall be made in each specimen to be tested at the center of the immersion area. The 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 specimen shall not be perforated by the drill. The drill shall be for Methods A and B, 6.4 mm (0.25 in.) in diameter and for Method C, 3.2 mm (0.125 in.) in diameter, unless otherwise specified.

8.1.2 Disconnect the specimen from the multimeter but leave it immersed for 15 min. Then, measure the resistance again as in 8.1.1.

8.2.3 A significant decrease in either resistance reading after 15 min will indicate a flaw in the coating or end-cap seal. Reject the specimen if the flaw is identified in the coating. If the flaw is in the end-cap seal, it may be repaired and the resistance remeasured as in 8.1.1. For 50.8 mm (2.0 in.) pipe specimens, three holidays with diameters of 6.4 mm (0.25 in.) shall be drilled with a flat end mill or a regular drill bit and the angular cone point of the drill will fully enter the steel where the cylindrical portion of the drill meets the steel surface. One holiday shall be drilled in the center of the immersion area of the pipe. One holiday shall be drilled halfway above the center holiday to the upper immersion level on the pipe, offset 120° to the right the center holiday. One holiday shall be drilled halfway below the center holiday to the 8.1.1 and bottom on 8.1.2; the pipe, offset 120° to the left the center holiday.

8.1.4 The lowest resistance after 15 min of immersion shall be not less than 1000 MΩ but a stable reading below 1000 MΩ may not indicate a flaw and the specimen may be used for test. All resistance measurements shall be reported in the results.

8.2 Record initial holiday diameter(s).

8.3 Measure and record the ~~minimum and maximum coating thickness~~ dry film thickness of the coating in accordance with Test Method Practice ~~G12D7091~~, and the ~~thickness dry film thickness immediately adjacent to where each holiday is made~~.

8.4 For Methods A and B, the end of the specimen 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 specimen. The protruding end, including hanger and wire connections, shall be protected and sealed with an insulating coating material. The specimen test area shall consist of the area between the edge of the bottom end of the specimen and the immersion line and shall be not less than 23 227 mm<sup>2</sup> (36 in.<sup>2</sup>).

### 9. Procedure for Method A

9.1 Immerse the test specimen in the electrolyte and connect it to the anode as shown in Fig. 32. Position the middle or single holiday so that it faces away from the anode. Space the anode with respect to test specimens as described in 5.1-15.2. Mark the correct immersion level of the test specimen with a grease pencil or other suitable marker and maintain by daily additions of ~~potable distilled or deionized~~ water as required. Perform the test at electrolyte temperature of 21 to 25°C (70 to 77°F). ~~21 °C to 25 °C (70 °F to 77 °F)~~ and aerate the electrolyte solution throughout the length of the immersion period unless otherwise specified. An aquarium air pump with a hose and air stone has been shown to be adequate for aerating the electrolyte. Check the temperature daily and adjust as necessary.

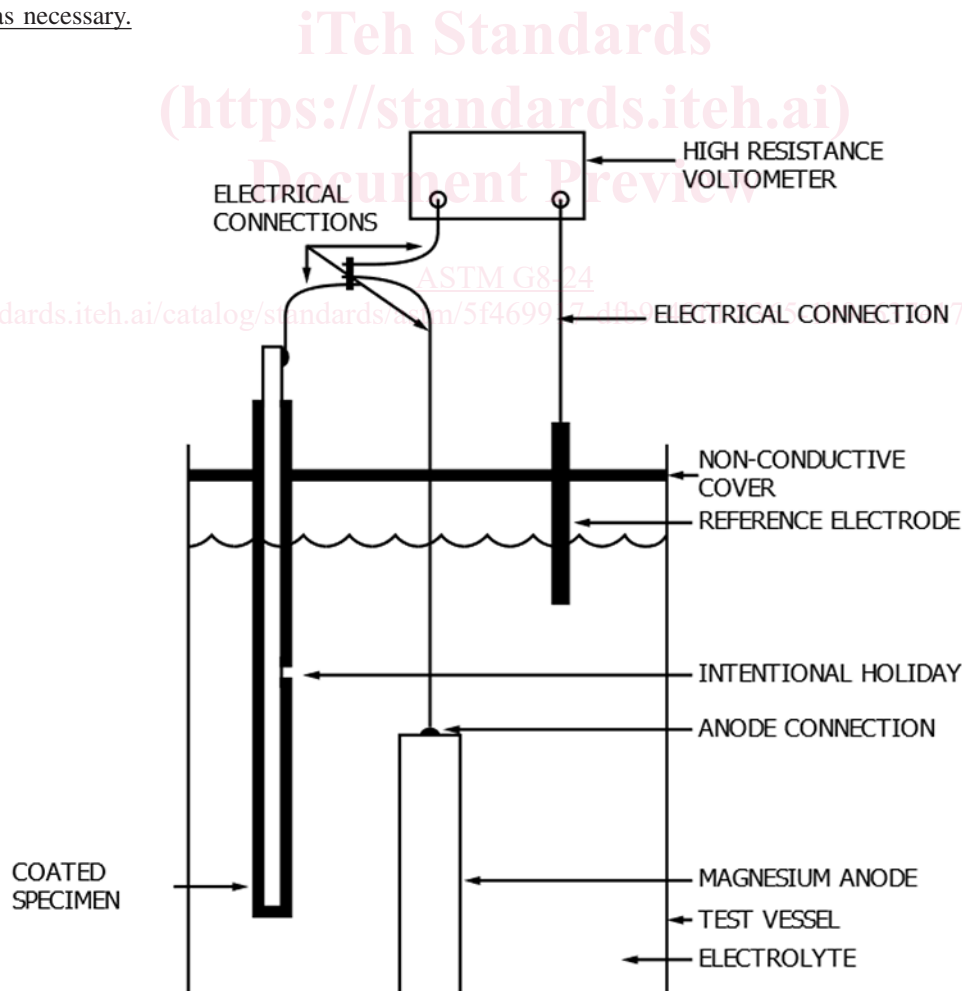


FIG. 32 Test Assembly for Method A Using a Magnesium Anode