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Designation: D6676 – 01$^{\varepsilon 1}$

Standard Test Method for Cathodic Disbonding of Exterior Pipeline Coatings at Elevated Temperatures Using Interior Heating[1]

This standard is issued under the fixed designation D6676; 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.

ε[1] NOTE—Editorial changes were made throughout in October 2001.

1. Scope

1.1 This test method describes an accelerated procedure for determining comparative characteristics of coating systems applied to the exterior of steel pipe for the purpose of preventing or mitigating corrosion that may occur in underground or immersion where the pipe is carrying heated media and is under cathodic protection. This test method is intended for use with samples of coated pipe, or with a specimen cut from the section of coated pipe or flat plates, and is applicable to such samples when the coating is characterized by function as an electrical barrier.

1.2 This test method is intended to simulate conditions when external coatings are exposed to high temperature inside the pipe and to an ambient temperature outside, and thus are subjected to temperature gradient. If elevated temperatures are not required, see Test Method G8. If a specific test method is required with no options, see Test Method G80. If elevated temperatures are required but without temperature gradient, see Test Method G42.

1.3 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.

1.4 *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:*[2]

G8 Test Methods for Cathodic Disbonding of Pipeline Coatings

G12 Test Method for Nondestructive Measurement of Film Thickness of Pipeline Coatings on Steel

G42 Test Method for Cathodic Disbonding of Pipeline Coatings Subjected to Elevated Temperatures

G62 Test Methods for Holiday Detection in Pipeline Coatings

G80 Test Method for Specific Cathodic Disbonding of Pipeline Coatings

G95 Test Method for Cathodic Disbondment Test of Pipeline Coatings (Attached Cell Method)

3. Summary of Test Method

3.1 The test method described, subjects the coating on the test specimen to electrical stress in a highly conductive alkaline electrolyte. Electrical stress is obtained from an impressed direct- current system. An intentional holiday is to be made in the coating prior to starting of test.

3.1.1 Electrical instrumentation is provided for measuring the current and the potential throughout the test cycle. At the conclusion of the test period, the test specimen is physically examined.

3.1.2 Physical examination is conducted by comparing the extent of loosened or disbonded coating at the intentional holiday in the immersed area with extent of loosened or disbonded coating at a reference holiday made in the coating in an area that was not immersed.

3.1.3 The cathodic stress is applied under conditions of a constant temperature gradient, simulating a heated pipeline with an exterior coating.

3.1.4 Specimens that can be used are: (*a*) piece of pipe (Fig. 1) or (*b*) samples cut from pipe or flat plate (Fig. 2 and Fig. 3).

3.1.4.1 Some coatings rely on application tension (such as tape) for maximum cathodic disbondment resistance. Cut coupons or flat plates must not be used.

4. Significance and Use

4.1 Damage to a pipe coating is almost unavoidable during transportation and construction. 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 moisture-bearing and will constitute an effective

[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.

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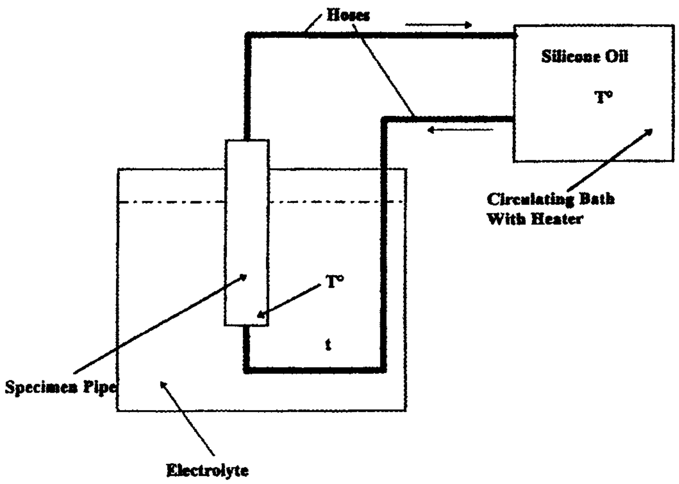

FIG. 1 Pipe Specimen Heated Inside

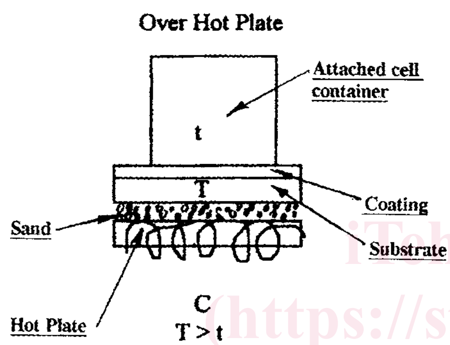

FIG. 2 Flat Specimen Heated Over Hot Plate

electrolyte. Applied cathodic protection potentials may cause loosening of the coating, beginning at holiday edges. Spontaneous holidays may also be caused by such potentials. Usually exterior pipeline coatings applied over pipes carrying hot media (oil, gas) are exposed to high temperature inside the pipe and low temperature outside and subjected to temperature gradient. Heat flux is directed from metal (substrate) to the coating. This test method provides accelerated conditions for cathodic disbondment to occur under simulated heating and provides a measure of resistance of coatings to this type of action.

4.2 The effects of the test are to be evaluated by physical examinations and monitoring the current drawn by the test specimens. 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 cathodically disbonded area propagates from an area where adhesion is zero to an area where adhesion reaches the original level. An intermediate zone of decreased adhesion may also be present.

4.3 Assumptions associated with test results include:

4.3.1 Maximum adhesion, or bond, is found in the coating that was not immersed in the test liquid, and

4.3.2 Decreased adhesion in the immersed test area is the result of cathodic disbondment.

4.4 Ability to resist disbondment is a desired quality on a comparative basis, but disbondment in this test method is not necessarily an adverse indication of coating performance. The virtue of this test method is that all dielectric-type coatings now in common use will disbond to some degree, thus providing a means of comparing one coating to another.

4.5 The amount of current flowing 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.

4.6 Test voltages higher than those recommended may result in the formation of chlorine gas. The subsequent chemical effects on the coating could cast doubt on the interpretation of the test results. Filter tube with fritted disk (see Test Method G95) or layer of sand (40 mesh) put on the coated surface may reduce this effect.

5. Apparatus

5.1 *Test Vessel for Pipe Specimen (Fig. 4)*—A suitable nonreactive vessel shall be used, capable of withstanding internal heating at test temperature and suitable to accommodate a test specimen, an anode. Heating the test sample can be provided by internally heating. The pipe sample may be filled with a suitable heat transfer material (oil, steel, shot, sand, copper chips, etc.) A thermocouple or thermometer and heater can be immersed in the heat transfer medium to effectively control the temperature of the sample. Dimensions of the vessel shall permit the following requirements:

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5.1.1 Test specimen shall be suspended vertically in the vessel with at least 25 mm (1 in.) clearance from the bottom.

5.1.2 Test specimen shall be separated by not less than 38 mm (1½ in.), and a vertically suspended anode can be placed at an equal distance from each specimen not less than the separation distance.

5.1.3 Test specimen shall be separated from any wall of the vessel by not less than 13 mm (½ in.).

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

5.1.5 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 mm (1½ in.).

5.2 *Test Vessel for Flat or Cut From Pipe Specimens (Fig. 3)*—A transparent plastic of glass tube that is centered over the intentional holiday and sealed to the test sample surface with a waterproof sealing material. The cylinder is to be 101.6 mm (4.0 in. nominal diameter) and of sufficient height to contain 127.0 mm (5.0 in.) of electrolyte.

5.3 *Impressed-Current Anode*—Anode shall be of the platinum wire type, 0.51 mm (0.020 in.)–24 gage diameter. It shall be of sufficient length to extend outside the confines of the test cell and shall be connected to the wire from the power source with a bolted or compressed fitting.

5.4 *Anode Assembly*—Anode shall be suspended inside the test vessel so that the tip of the anode assembly closest to the holiday is 25.4 mm (1 in.) above, and the edge of the anode assembly is 12.7 mm (½ in.) above, and the edge of the anode assembly is 12.7 mm (½ in.) offset from the holiday.