Designation: D 5162 – 00

Standard Practice for Discontinuity (Holiday) Testing of Nonconductive Protective Coating on Metallic Substrates[1]

This standard is issued under the fixed designation D 5162; 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 practice covers procedures for determining discontinuities using two types of test equipment:

1.1.1 *Test Method A*—Low Voltage Wet Sponge, and

1.1.2 *Test Method B*—High Voltage Spark Testers.

1.2 This practice addresses metallic substrates. For concrete surfaces, refer to Practice D 4787.[2]

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 and health practices and determine the applicability of regulatory limitations prior to use.*

2. Referenced Documents

2.1 *ASTM Standards:*

D 4787 Practice for Continuity Verification of Liquid or Sheet Linings Applied to Concrete Substrates[2]

3. Terminology

3.1 *Definitions of Terms Specific to This Standard:*

3.1.1 *discontinuity, as used in this standard*— a void, crack, thin spot, foreign inclusion, or contamination in the coating film that significantly lowers the dielectric strength of the coating film. May also be identified as a holiday or pinhole.

3.1.2 *holiday, as used in this standard*—a term that identifies a discontinuity.

3.1.3 *holiday detector, as used in this standard*— a device that locates discontinuities in a nonconductive coating film applied to a conductive surface.

3.1.4 *pinhole, as used in this standard*—a film defect characterized by small porelike flaws in the coating which, when extended entirely through the film, will appear as a discontinuity. A pinhole in the finish coat may not appear as a discontinuity.

4. Significance and Use

4.1 A coating is applied to a metallic substrate to prevent corrosion, reduce abrasion or reduce product contamination, or both. The degree of coating continuity required is dictated by service conditions. Discontinuities in a coating are frequently very minute and not readily visible. This practice provides a procedure for electrical detection of minute discontinuities in nonconductive coating systems.

4.2 Electrical testing to determine the presence and number of discontinuities in a coating film is performed on a nonconductive coating applied to a conductive surface. The allowable number of discontinuities should be determined prior to conducting this test since the acceptable quantity of discontinuities will vary depending on coating film thickness, design, and service conditions.

4.3 The low voltage wet sponge test equipment is generally used for determining the existence of discontinuities in coating films having a total thickness of 20 mils (0.5 mm) or less. High voltage spark test equipment is generally used for determining the existences of discontinuities in coating films having a total thickness of greater than 20 mils (0.5 mm).

4.4 Coatings that are applied at a thickness of less than 20 mils (0.5 mm) may be susceptible to damage if tested with high voltage spark testing equipment. Consult the coating manufacturer for proper test equipment and inspection voltages.

4.5 To prevent damage to a coating film when using high voltage test instrumentation, total film thickness and dielectric strength in a coating system shall be considered in selecting the appropriate voltage for detection of discontinuities. Atmospheric conditions shall also be considered since the voltage required for the spark to gap a given distance in air varies with the conductivity of the air at the time the test is conducted. Suggested starting voltages are provided in Table 1.

4.6 The coating manufacturer shall be consulted to obtain the following information, which would affect the accuracy of this test to determine discontinuities:

4.6.1 Establish the length of time required to adequately dry or cure the applied coating film prior to testing. Solvents retained in an uncured coating film may form an electrically conductive path through the film to the substrate.

4.6.2 Determine whether the coating contains electrically conductive fillers or pigments that may affect the normal dielectric properties.

4.7 This practice is intended for use with new linings applied to metal substrates. Its use on a lining previously exposed to an immersion condition could result in damaging the lining or producing erroneous detection of discontinuities

[1] This practice is under the jurisdiction of ASTM Committee D-33 on Protective Coating and Lining Work for Power Generation Facilities and is the direct responsibility of Subcommittee D33.04 on Inspection.

Current edition approved May 10, 2000. Published July 2000. Originally published as D 5162–91. Last previous edition D 5162–91.

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

TABLE 1 Suggested Voltages for High Voltage Spark Testing

Total Dry Film Thickness		Suggested Inspection, V
mils	mm	
8–12	0.20–0.31	1 500
13–18	0.32–0.46	2 000
19–30	0.47–0.77	2 500
31–40	0.78–1.03	4 000
41–60	1.04–1.54	5 000
61–80	1.55–2.04	7 500
81–100	2.05–2.55	10 000
101–125	2.56–3.19	12 000
126–160	3.20–4.07	15 000
161–200	4.08–5.09	20 000
201–250	5.10–6.35	25 000

due to permeation or moisture absorption of the lining. Deposits may also be present on the surface causing telegraphing. The use of a high voltage tester on a previously exposed lining has to be carefully considered because of possible spark through which could damage an othewise sound lining. A low voltage tester can be used without damaging the lining but may also produce erroneous results.

5. Test Methods

TEST METHOD A—LOW VOLTAGE WET SPONGE TESTING

5.1 **Apparatus**

5.1.1 *Low Voltage Holiday Detector*—an electronic device powered by a self-contained battery with voltages ranging from 5 to 90 V dc, depending on the equipment manufacturer's circuit design. It is used to locate discontinuities in a nonconductive coating applied to a conductive substrate. Operation includes the use of an open-cell sponge electrode wetted with a solution for exploring the coating surface, a ground connection, and an audible or visual indicator, or both, for signaling a point of coating discontinuity.

5.1.2 *Low Voltage Wet Sponge Tester*— a sensitivity device with the operating voltage being of little importance other than being part of the particular electronic circuit design.

5.1.3 *Wet Sponge Type Instruments*—a number of commercially available, industry-accepted, instruments are available. The following electronic principle describes two types of devices generally used; others may be available but are not described in this practice.

5.1.3.1 *Lightweight, Self-Contained, Portable Devices*—based on the electrical principle of an electromagnetic sensitive relay or a solid-state electronic relay circuit that energizes an audible or visual indicator when a coating discontinuity is detected. Generally this equipment is capable of being recalibrated in the field by the user.

5.1.3.2 *Lightweight, Self-Contained, Portable Devices*—also based on the principle of an electronic relaxation oscillator circuit that reacts significantly to the abrupt drop in electrical resistance between the high dielectric value of the coating film and the conductive substrate at the point of coating film discontinuity. This results in a rise in oscillator frequency as well as in the audible signal from the device. Generally, this equipment is incapable of being recalibrated in the field by the user.

5.2 **Procedure**

5.2.1 Sufficient drying or curing of the coating shall be allowed prior to conducting a test. The length of time required shall be obtained from the coating manufacturer. Solvents retained in the coating film could produce erroneous indicators.

5.2.2 The surface shall be clean, dry, and free of oil, dirt and other contaminates. Measure the film thickness of the coating with a nondestructive dry film thickness gage. If the coating film exceeds 20 mils (0.5 mm), use the procedures for high voltage spark testing described in Test Method B, High Voltage Spark Testing.

5.2.3 Test the instrument for sensitivity in accordance with 5.3.

5.2.4 Attach the ground wire from the instrument ground output terminal to the metallic substrate and ensure positive electrical contact.

5.2.5 Attach the exploring sponge lead to the other output terminal.

5.2.6 Wet the sponge with a solution consisting of tap water and a low sudsing wetting agent, combined at a ratio of not more than ½ fluid oz of wetting agent to 1 gal water. An example of a low sudsing wetting agent is one used in photographic development. The sponge shall be wetted sufficiently to barely avoid dripping of the solution while the sponge is moved over the coating. The wetting agent residue must be removed prior to executing repairs.

5.2.7 Sodium chloride (salt) shall not be added to the wetting solution because of the potential erroneous indications of discontinuities. The salt, after drying on the coated surface, may form a continuous path of conductivity. It will also interfere with intercoat adhesion of additional coats.

5.2.8 Contact a bare spot on the conductive substrate with the wetted sponge to verify that the instrument is properly grounded. This procedure shall be repeated periodically during the test.

5.2.9 Move the sponge over the surface of the coating at a moderate rate approximately 1 ft/s (0.3 m/s), using a double pass over each area. Apply sufficient pressure to maintain a wet surface. If a discontinuity is detected, turn the sponge on end to determine the exact location of the discontinuity.

5.2.10 Discontinuities that require repair shall be identified with a marker that is compatible with the repair coating or one that is easily removed.

5.2.11 To prevent telegraphing (current traveling through a moisture path to a discontinuity, giving an erroneous indication), take care to ensure that the solution is wiped dry from a previously detected discontinuity before continuing the test.

5.2.12 The wetting agent must be completely removed by rinsing the holiday area prior to repair.

5.2.13 Wet sponge holiday detection is not recommended between coats of a multicoat system. However, when a test is conducted between coats of a multicoat system, a wetting agent shall not be used and all residue left by the test water must be completely removed prior to applying additional coats.

5.3 **Verifying Operation of Equipment**

5.3.1 The instrument shall be tested for sensitivity prior to initial use and periodically thereafter, in accordance with the equipment manufacturer's instructions.