



Designation: D4787 – 24

Standard Practice for Continuity Verification of Liquid or Sheet Linings Applied to Concrete Substrates¹

This standard is issued under the fixed designation D4787; 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 that may be used for the detection of discontinuities in nonconductive linings or other non-conductive coatings applied to concrete substrates with or without a conductive underlayment.

1.2 Discontinuities may include pinholes, internal voids, holidays, cracks, and conductive inclusions.

1.3 This practice describes detection of discontinuities utilizing a high voltage spark tester using either pulsed or continuous dc voltage.

NOTE 1—For further information on discontinuity testing refer to NACE Standard Practice SP0188, Test Method G62, or Practice D5162.

1.4 The values stated in SI units are to be regarded as 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.* For a specific hazard statement, see Section 7.

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:*²

D149 Test Method for Dielectric Breakdown Voltage and

Dielectric Strength of Solid Electrical Insulating Materials at Commercial Power Frequencies

D5162 Practice for Discontinuity (Holiday) Testing of Non-conductive Protective Coating on Metallic Substrates

D6132 Test Method for Nondestructive Measurement of Dry Film Thickness of Applied Organic Coatings Using an Ultrasonic Coating Thickness Gage

G62 Test Methods for Holiday Detection of Coatings used to Protect Pipelines

2.2 *NACE Standards:*³

SP0188-2024 Discontinuity (Holiday) Testing of New Protective Coatings on Conductive Substrates

3. Terminology

3.1 *Definitions of Terms Specific to This Standard:*

3.1.1 *conductive underlayment, n*—a continuous layer applied to the prepared concrete surface prior to the application of a nonconductive lining layer(s) that will allow high voltage spark testing for discontinuities in the lining, as it will conduct the current present when the spark is generated.

3.1.2 *current sensitivity, n*—control that can be used to prevent low levels of current flow from activating the audible alarm.

3.1.2.1 *Discussion*—Some high voltage testers have an adjustable alarm sensitivity control to set the threshold current at which the audible alarm sounds. If the high voltage can charge the lining, a small amount of current will flow while this charge is established. If the lining contains a pigment that allows a low-level leakage current to flow from the probe while testing the threshold current can be set so that the alarm does not sound until this current is exceeded, that is, when a holiday or flaw is detected. Increasing the current threshold setting makes the instrument less sensitive to this low-level current flow, decreasing the current threshold setting makes the instrument more sensitive to current flow.

3.1.3 *discontinuity, n*—a localized site in the coating or lining that has a dielectric strength less than a determined test voltage.

¹ This practice is under the jurisdiction of ASTM Committee D01 on Paint and Related Coatings, Materials, and Applications and is the direct responsibility of Subcommittee D01.46 on Industrial Protective Coatings.

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² For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at www.astm.org/contact. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

³ Available from NACE International (NACE), 1440 South Creek Dr., Houston, TX 77084-4906, <http://www.nace.org>.

3.1.4 *dielectric strength, n*—the maximum voltage an insulating material can withstand without undergoing electrical breakdown; typically tested in accordance with Test Method **D149**.

3.1.5 *high voltage spark tester, n*—an electrical device (producing a voltage in excess of 4 kV [4000 V]) used to locate discontinuities in a nonconductive protective coating applied to a conductive substrate.

3.1.5.1 *Discussion*—The high voltage is applied to the coating or lining using an exploring electrode and any current resulting from the high voltage passing through a discontinuity in the coating or lining is passed to the device via a signal return cable (also known as a ground or earth wire).

3.1.6 *high voltage voltmeter, n*—a device capable of measuring the voltage between the electrode and the ground connection of a High Voltage Holiday Detector.

3.1.6.1 *Discussion*—When used with a Pulse DC High Voltage Holiday Detector, the High Voltage Voltmeter shall be a peak reading voltmeter.

3.1.7 *holiday, n*—small faults or pinholes that permit current to flow through the conductive substrate, also known as a discontinuity.

3.1.8 *spark-over, n*—the distance a spark, from a high voltage tester, will jump across a space from a grounded surface at a specific electrical voltage.

3.1.9 *telegraphing, n*—current traveling through a moisture path across the surface of the coating to a discontinuity, giving an erroneous indication of a fault.

3.1.10 *test voltage, n*—the electrical voltage established that will allow a discontinuity at the thickest lining location site to be detected, but which will not damage the lining.

4. Summary of Practice

4.1 This practice describes procedures for high voltage electrical detection of discontinuities in new linings applied to concrete substrates through the utilization of a continuous conductive underlayment applied to the prepared concrete surface prior to the application of the nonconductive lining layer(s) or by determining the conductivity of the concrete substrate to be tested. The conductivity of concrete varies, depending on moisture content, type, density, and location of reinforcing mesh or rebar. Test the conductivity of the concrete by attaching the signal return cable to rebar or other metallic ground permanently installed in the concrete. If the concrete is sufficiently grounded a signal return cable may be placed with its electrical contact against the structure and held in place using a wet sandbag. If the test indicates the concrete provides an insufficient signal return the test cannot be conducted. A conductive underlayment will be required if a continuity test is to be conducted and it is not practical to add this conductive layer for the purpose of the test.

5. Significance and Use

5.1 The electrical conductivity of concrete is primarily influenced by the presence of moisture. Other factors that affect the electrical continuity of concrete structures, include the following:

- 5.1.1 Presence of metal rebar,
- 5.1.2 Cement content and type,
- 5.1.3 Aggregate types,
- 5.1.4 Admixtures,
- 5.1.5 Porosity within the concrete,
- 5.1.6 Above or below grade elevation,
- 5.1.7 Indoor or outdoor location,
- 5.1.8 Temperature and humidity, and
- 5.1.9 Age of concrete.

5.2 The electrical conductivity of concrete itself may be successfully used for high-voltage continuity testing of linings applied directly with no specific conductive underlayment installed. However, the voltage required to find a discontinuity may vary greatly from point to point on the structure. This variance may reduce the test reliability.

5.3 Although the most common conductive underlayments are liquid primers applied by trowel, roller, or spray, and which contain carbon or graphite fillers, others may take the form of the following:

- 5.3.1 Sheet-applied graphite veils,
- 5.3.2 Conductive polymers,
- 5.3.3 Conductive graphite fibers,
- 5.3.4 Conductive metallic fibers, and
- 5.3.5 Conductive metallic screening.

5.4 Liquid-applied conductive underlayments may be desirable as they can serve to address imperfections in the concrete surface and provide a better base for which to apply the lining.

5.5 This practice is intended for use only with new linings applied to concrete substrates. Inspecting a lining previously exposed to an immersion condition could result in damaging the lining or produce an erroneous detection of discontinuities 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 is not recommended because of possible spark through which will damage an otherwise sound lining.

5.6 The user may consider this practice when performance requirements of the lining in a specified chemical environment require assurance of a lining free of discontinuities.

5.7 Factors affecting the dielectric properties and test voltage shall be considered. Some factors are the curing time of liquid-applied linings; the possible presence of electrically conductive fillers or solvents, or both; the possible presence of air inclusions or voids; and the compatibility of conductive underlayments with the specified lining.

5.8 A pulsed dc high voltage may cause a lining to break-down at a lower voltage than would be the case for a continuous dc voltage.

6. Apparatus

6.1 *High Voltage Spark Tester*—An electrical detector with a voltage rating in excess of 4000 V. The detector is to consist of an electrical energy source, an exploring electrode, a signal return cable connection, and wire. The detector shall be equipped with a visual or audible indicator.