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AMERICAN SOCIETY FOR TESTING AND MATERIALS
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# Standard Test Method for Electrical Resistivity of Membrane-Pavement Systems[1]

This standard is issued under the fixed designation D 3633; 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 the measurement of the electrical resistivity of water-barrier membrane-pavement systems when applied to concrete bridge decks.

1.2 Measurements shall be performed on the bituminous pavement surface covering the water-barrier membrane.

1.3 This test method utilizes a measure of electrical resistance between the saturated top surface of the water-barrier membrane and the reinforcing steel embedded in the concrete bridge deck.

1.4 The values measured represent the electrical resistance obtained with the equipment and procedures stated herein and do not necessarily agree or correlate with those using other equipment or procedures.

1.5 The values stated in SI units are to be regarded as the standard.

1.6 *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:*

C 670 Practice for Preparing Precision and Bias Statements for Test Methods for Construction Materials[2]

D 3743 Terminology Relating to Bridge Deck and Substructure Protection[3]

D 4071 Practice for Use of Portland Cement Concrete Bridge Deck Waterproof Barrier Membrane Systems[3]

E 105 Practice for Probability of Sampling Materials[4]

## 3. Terminology

3.1 For definitions of terms used in this specification, refer to Terminology D 3743.

## 4. Significance and Use

4.1 This test method for measuring the electrical resistivity of water-barrier membrane-pavement systems may be interpreted to indicate the effectiveness of such systems.

4.2 This test method is predicated on the fact that an electrical connection between the surface of the pavement and the reinforcing steel in the concrete pavement cannot be made through an impermeable water-barrier membrane.

4.3 This test method may be used for acceptance when the accepting agency specifies the minimum resistance value desired.

## 5. Apparatus

5.1 *Ohmmeter*, dc, 20 000 Ω/V rating connected to a double-pole, double-throw switch box or ac ohmmeter (switch box not required).

NOTE 1—When this test method is used for acceptance, the accepting agency should specify the type of ohmmeter to be used.

5.2 *Insulated Wire*, No. 18, Belden test probewire or equivalent. Two spools, minimum 38 m (125 ft).

5.3 *Copper Plate*, 305 by 305 by 3.0 mm (12 by 12 by ⅛in.), with the means for connecting the ohmmeter lead and a wooden handle approximately 1 m (39 in.) in length.

5.4 *Polyurethane Sponge*, 305 by 305 by 13 mm (12 by 12 by ½ in.), to be attached to the copper plate with rubber bands or other suitable means. When assembled this apparatus is called the probe.

5.5 *Pressure Spray Can*, 12-L (3-gal) capacity, with a hose and spray nozzle.

## 6. Reagent

6.1 A wetting agent which, when added to the water, will break the surface tension and promote the penetration of the water through the bituminous pavement.

NOTE 2—An example of a wetting agent is a super-saturated solution of cupric sulfate crystals in warm water to which is added 19 mL/gal of Dioctyl Sodium Sulfo-succinate (Tradename "Aerosol" OT Clear, 10 %). When ambient test site temperature is below 50°F (10°C), add 15 % by volume of either isopropyl or denatured alcohol to prevent clouding of the wetting agent. Clouding of the wetting agent may inhibit penetration.

## 7. Sampling

7.1 Determine locations on the bridge deck to be tested by using either a grid pattern similar to that illustrated in Fig. 1 or by a random location system, based upon Practice E 105 or a similar method, that will ensure that the bridge deck area to be tested will be adequately represented.

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[1] This test method is under the jurisdiction of ASTM Committee D-4 on Road and Paving Materials, and is the direct responsibility of Subcommittee D04.36 on Bridge Deck Protective Systems.

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[2] *Annual Book of ASTM Standards*, Vol 04.02.

[3] *Annual Book of ASTM Standards*, Vol 04.03.

[4] *Annual Book of ASTM Standards*, Vol 14.02.

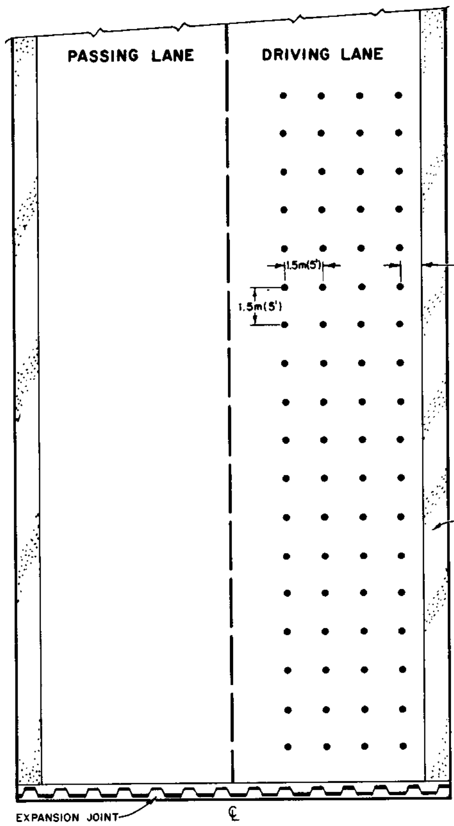


**FIG. 1 Layout for Test Grid**

## 8. Procedure

8.1 Prepare the surface to be tested by removing all foreign material by sweeping or scraping, or both. Do not use water to clean. The surface must be dry and clean before testing.

8.1.1 Locate the reinforcing steel with a pachometer. Drill with a rotary impact hammer at selected locations to expose the reinforcing steel to allow attachment of ohmmeter leads. Alternately, drill until the drill bit contacts the steel firmly to allow ohmmeter lead attachment.

8.2 Uncoil an ample length of wire to reach all areas to be tested, attach the minus (−) jack of the ohmmeter to the reinforcing steel and the plus ( + ) jack to the 305 by 305 by 3.0-mm (12 by 12 by ⅛-in.) copper plate of the probe. Then saturate the sponge with water containing the wetting agent.

NOTE 3—A direct connection from the ohmmeter to the top layer of reinforcing steel in the deck is desirable. However, if it is not practical to do this, the bridge railing, expansion joints, light standards, drainage scuppers, or other exposed steel, which is known to have contact with the top mat of reinforcing steel, may be used to provide this connection.

8.2.1 Check the ohmmeter battery for satisfactory charge, then zero the ohmmeter dial indicator. Connect the two wire leads to the ohmmeter and check for circuit continuity.

8.2.2 Check for overall equipment operation and satisfactory circuit by placing the probe on exposed concrete deck curbing and observing the resistance reading on the ohmmeter. This reading will normally range from 1000 to 3000 Ω for various bridge decks. Place the probe at several locations along the curb and observe the readings, which must remain relatively constant as an indication of a complete electrical circuit and especially to ensure a good contact with the reinforcing steel.

NOTE 4—Excessive moisture in the pavement would cause invalid resistance readings. To give a measure of assurance against this, the resistance between any two test sites may be checked prior to the testing sequence described in 8.3 through 8.4. This is accomplished by attaching the ohmmeter to two probes, rather than a single probe, and the reinforcing steel. Immediate low readings (10 000 ± Ω) will indicate excessive moisture in the pavement and on top of the membrane and further testing of the entire deck, or at least such identified portions of it, should be postponed.

8.3 By means of the pressure spray can containing water mixed with 8 mL/L (1 oz/gal) of wetting agent, wet a spot at each test location as determined in 7.1. Each spot should be large enough to accommodate the probe. Repeat the wetting of each test site three to five times in series. Take care that the wetted areas do not interconnect, either on the surface or at the pavement water-barrier membrane interface.

8.3.1 In order to be sure that the applied water has penetrated the pavement and is in contact with the water-barrier membrane, select a representative, well-compacted, test location as a check point. After allowing ample time for moisture penetration at all test sites, place the probe on the check point and determine the resistance with the test apparatus assembled as described in 8.2. Repeat the wetting of all test sites followed by a determination of the resistance at the check point. Do this until the check point resistance reading has stabilized. The time required for the wetting process will vary, depending on the thickness and permeability of the pavement layer (30 min is normally sufficient).

NOTE 5—The reasoning behind the above requirement is that when the dense, very well-compacted pavement at the check point, which has been wetted equally along with all other test locations, achieves a stabilized resistance, then logically all other test sites should have stabilized also. It has been found expedient in some cases (due to high ambient temperatures) to place prewetted sponges at each test site after wetting in order to maintain saturation.

8.4 Proceed to test the bridge deck for electrical resistance. Place the probe at each test location and allow the ohmmeter reading to settle; note it. For a d-c ohmmeter, reverse the leads by tripping the double-pole switch. When the reading has settled again, note it and record the average of two such readings as the resistance for each point. (See Fig. 2 for an example of the recording procedure.)

NOTE 6—Reversal of the dc meter leads by means of the switch box and averaging the readings reduces the error induced by galvanic coupling of the probe and the reinforcing steel. This is not necessary when using an ac ohmmeter. If readings are taken using scales other than the highest range provided by the ohmmeter, note the scale used.

8.5 If it is desired to further define areas of low-resistance readings, establish a grid pattern with intersections at intermediate points not previously tested. These points should only be tested after allowing sufficient time for the moisture in the pavement to dissipate. Time for this will depend on the density and thickness of the pavement, as well as the ambient and pavement temperatures (usually a minimum of 24 h should be allowed).

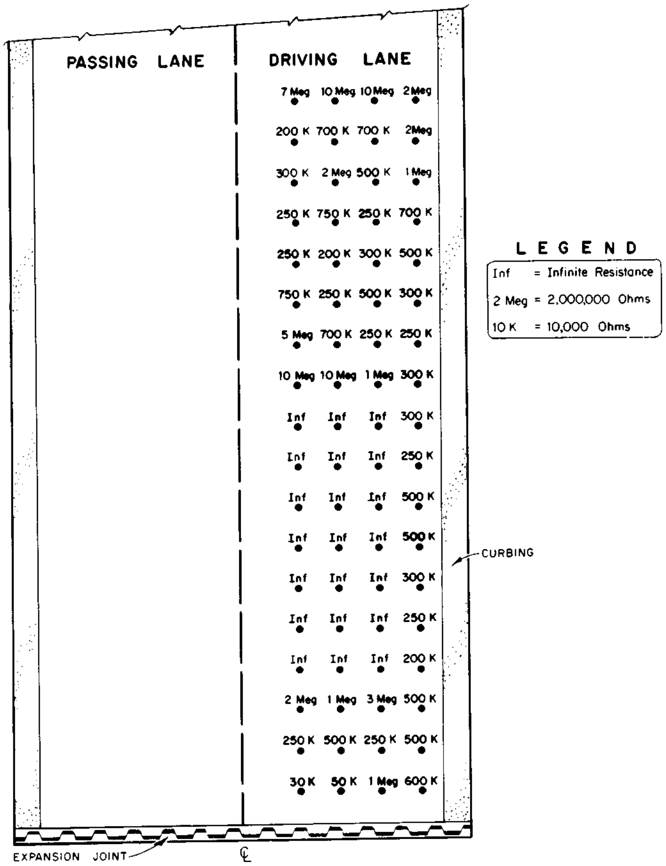


**FIG. 2 Typical Resistance Values**

## 9. Report

9.1 The resistance values shall be reported in a manner similar to that shown in Fig. 2. Areas that fail to meet any minimum requirements may be outlined on the grid sheet. If desired, these same areas may be outlined on the bridge deck. Any repairs or corrections that need to be made shall be noted on the report sheet.

## 10. Precision and Bias

10.1 Data were developed for precision statement from a water-barrier membrane-pavement system that had been in service for some time. The precision statements may not be applicable when testing new installations since an effective membrane should produce readings of infinite resistance.

10.2 The single operator coefficient of variation of a single test result has been found to be 79 %.[5] Therefore, results of two properly conducted tests by the same operator on the same day should not differ by more than 2.23 times the average of the two results.

10.3 The multi-operator coefficient of variation of a single test result has been found to be 79 %.[4] Therefore, results of two properly conducted tests by different operators on the same day should not differ by more than 2.23[4] times the average of the two results.

10.4 *Bias*—Since there is no accepted reference material available at this time for determining bias for this test method, no statement on bias is being made.

## 11. Keywords

11.1 membrane-pavement systems; reinforcing steel; water barrier resistivity

[5] These numbers represent, respectively, the (1s %) and (d2s %) limits as described in Practice C 670.