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Standard Practice for Moisture Surveying of Roofing and Waterproofing Systems Using Non-Destructive Electrical Impedance Scanners[1]

This standard is issued under the fixed designation D7954/D7954M; 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 applies to techniques that use non-destructive electrical impedance (EI) scanners to locate moisture and evaluate the comparitive moisture content within insulated low-slope roofing and waterproofing systems.

1.2 This practice is applicable to roofing and waterproofing systems wherein insulation is placed above the deck and positioned underneath and in contact with electrically nonconductive single-ply or built-up roofing and waterproofing membranes and systems such as coal tar, asphalt, modified bitumen, thermoplastics, spray polyurethane foam, and similar electrically non-conductive membrane materials. This practice is also applicable to roofing and waterproofing systems without insulation placed above moisture absorbing decks such as wood, concrete, or gypsum, that are in contact with single-ply or built-up roofing and waterproofing membranes as described above.

1.3 This practice is applicable to roofing and waterproofing systems incorporating electrically nonconductive rigid board insulation made from materials such as organic fibers, perlite, cork, fiberglass, wood-fiber, polyisocyanurate, polystyrene, phenolic foam, composite boards, gypsum substrate boards, and other electrically nonconductive roofing and waterproofing systems such as spray-applied polyurethane foam.

1.4 This practice is not appropriate for all combinations of materials used in roofing and waterproofing systems.

1.4.1 Metal and other electrically conductive surface coverings and near-surface embedded metallic components are not suitable for surveying with impedance scanners because of the electrical conductivity of these materials.

1.4.2 This practice is not appropriate for use with black EPDM, any membranes containing black EPDM, or black EPDM coatings because black EPDM gives false positive readings.

1.4.3 Aluminum foil on top-faced insulation, roofing, or waterproofing membranes gives a false positive reading and is not suitable for surveying with impedance scanners; however, liquid-applied aluminum pigmented emulsified asphalt-based coatings shall not normally affect impedance scanner readings.

1.4.4 See A1.4 for some cautionary notes on roofing anomalies and limitations that affect the impedance test practice.

1.5 Moisture scanners using impedance based technology are classified as EI scanners.

NOTE 1—The term capacitance is sometimes used when describing impedance scanners. Capacitance scanners are purely capacitive as they do not have a resistive component. Impedance scanners combine both capacitance and resistance for testing; thus, they are well suited to the measurement of different types of materials and constructions found in roofing and waterproofing systems as the combination of both components allows for a more versatile testing, calibration, and measurement arrangement.

1.6 This practice also addresses necessary verification of impedance data involving invasive test procedures using core samples.

1.7 This practice addresses two generally accepted scanning techniques for conducting moisture surveys using electrical impedance scanners:

1.7.1 *Technique A*—Continuous systematic scanning and recording (see 8.2), and

1.7.2 *Technique B*—Grid format scanning and recording (see 8.3).

1.8 This practice addresses some meteorological conditions and limitations for performing impedance inspections.

1.9 This practice addresses the effect of the roofing or waterproofing construction, material differences, and exterior surface conditions on the moisture inspections.

1.10 This practice addresses operating procedures, operator qualifications, operating methods, scanning, surveying, and recording techniques.

1.11 *Units*—The values stated in either SI units or inch-pound units are to be regarded separately as standard. The values stated in each system may not be exact equivalents; therefore, each system shall be used independently of the other. Combining values from the two systems may result in nonconformance with the standard.

[1] This practice is under the jurisdiction of ASTM Committee D08 on Roofing and Waterproofing and is the direct responsibility of Subcommittee D08.20 on Roofing Membrane Systems.

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1.12 *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. Caution should be taken when accessing, walking, or using scanning equipment on the roofing or waterproofing surfaces, or elevated locations, when using ladders, and when raising and lowering equipment to elevated locations.*

2. Referenced Documents

2.1 *ASTM Standards:*[2]

C1616 Test Method for Determining the Moisture Content of Organic and Inorganic Insulation Materials by Weight

D1079 Terminology Relating to Roofing and Waterproofing

D7438 Practice for Field Calibration and Application of Hand-Held Moisture Meters

E2586 Practice for Calculating and Using Basic Statistics

F2659 Guide for Preliminary Evaluation of Comparative Moisture Condition of Concrete, Gypsum Cement and Other Floor Slabs and Screeds Using a Non-Destructive Electronic Moisture Meter

NOTE 2—See A1.3 for other referenced documents.

3. Terminology

3.1 For definitions of terms used in this practice, refer to Terminology D1079.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *comparative moisture, content, n*—qualitative characterization of moisture content in relative terms (that is, low, medium, and high levels of moisture).

3.2.2 *core sample, n*—small specimen of insulation and membrane having a minimum of 2-in. [50-mm] diameter obtained by cutting through these components down to the deck and removing them from the roofing section under test.

3.2.2.1 *Discussion*—Core samples are used to verify the membrane and insulation composition and ascertain information on their condition.

3.2.3 *detect or detection, v or n*—for the purpose of impedance scanning, the condition at which there is a consistent indication that an elevated level of impedance reading is present within the roofing or waterproofing system.

3.2.4 *false-positive, adj*—reading that indicates that elevated moisture is present when it is not.

3.2.4.1 *Discussion*—For example, a false positive in roofing for impedance scanning may be returned when some other electrically conductive material is present in the roofing system.

3.2.5 *gravimetric analysis, n*—determination of moisture content by weight of a material by comparing wet weight to over dry weight expressed as a percentage.

3.2.6 *moisture content, MC, n*—mass of moisture per unit mass of dry material.

3.2.6.1 *Discussion*—The moisture content is usually expressed as a percentage by weight and determined gravimetrically.

3.2.7 *roof assembly, n*—assembly of interacting roof components including the roof deck, air or vapor retarder, insulation and membrane, or primary roof covering designed to weatherproof a structure.

3.2.8 *roof section, n*—portion of a roof that is separated from adjacent portions by walls or expansion joints with no changes in the components throughout the section.

4. Summary of Practice

4.1 This practice covers a procedure in which a specifically developed non-destructive electronic impedance (EI) based moisture scanner is used in conjunction with interpretive data and invasive verification practices to detect and evaluate the moisture conditions within low-sloped roofing and waterproofing systems by non-destructively measuring the electrical alternating current (ac) impedance.

4.2 This practice is intended to be used in conjunction with the impedance scanner manufacturer's operation instructions and guides.

5. Significance and Use

5.1 Excess moisture trapped in roofing or waterproofing systems can adversely affect performance and lead to premature failure of roofing or waterproofing systems and its components. It also reduces thermal resistance, resulting in reduced energy efficiency and inflated energy costs. Impedance scans can be effective in identifying concealed and entrapped moisture within roofing or waterproofing systems.

5.2 This practice is intended to be used at various stages of the roofing and waterproofing system's life such as: during or at completion of installation of roofing or waterproofing system to determine if there was moisture intrusion into the roofing or waterproofing system or underlying materials, at regular intervals as part of a preventative maintenance program, and to aid in condition assessment, or before replacement or repair work, or combinations thereof, to assist in determining the extent of work and replacement materials.

5.3 This practice alone does not determine the cause of moisture infiltration into roofing or waterproofing systems; however, it can be used to help tracing excess moisture to the point of ingress.

6. Apparatus

6.1 *EI Scanner*—This apparatus shall be specifically developed to detect and evaluate non-destructively comparative moisture conditions within roofing and waterproofing systems.

6.1.1 *Principles of Operation*—The EI of a material varies in proportion with the material's moisture content. The EI of materials such as those listed in 1.2 and 1.3 in the roofing or waterproofing system directly under the footprint of the scanner is measured by creating an alternating electric field that penetrates the materials under test. The small alternating

[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.

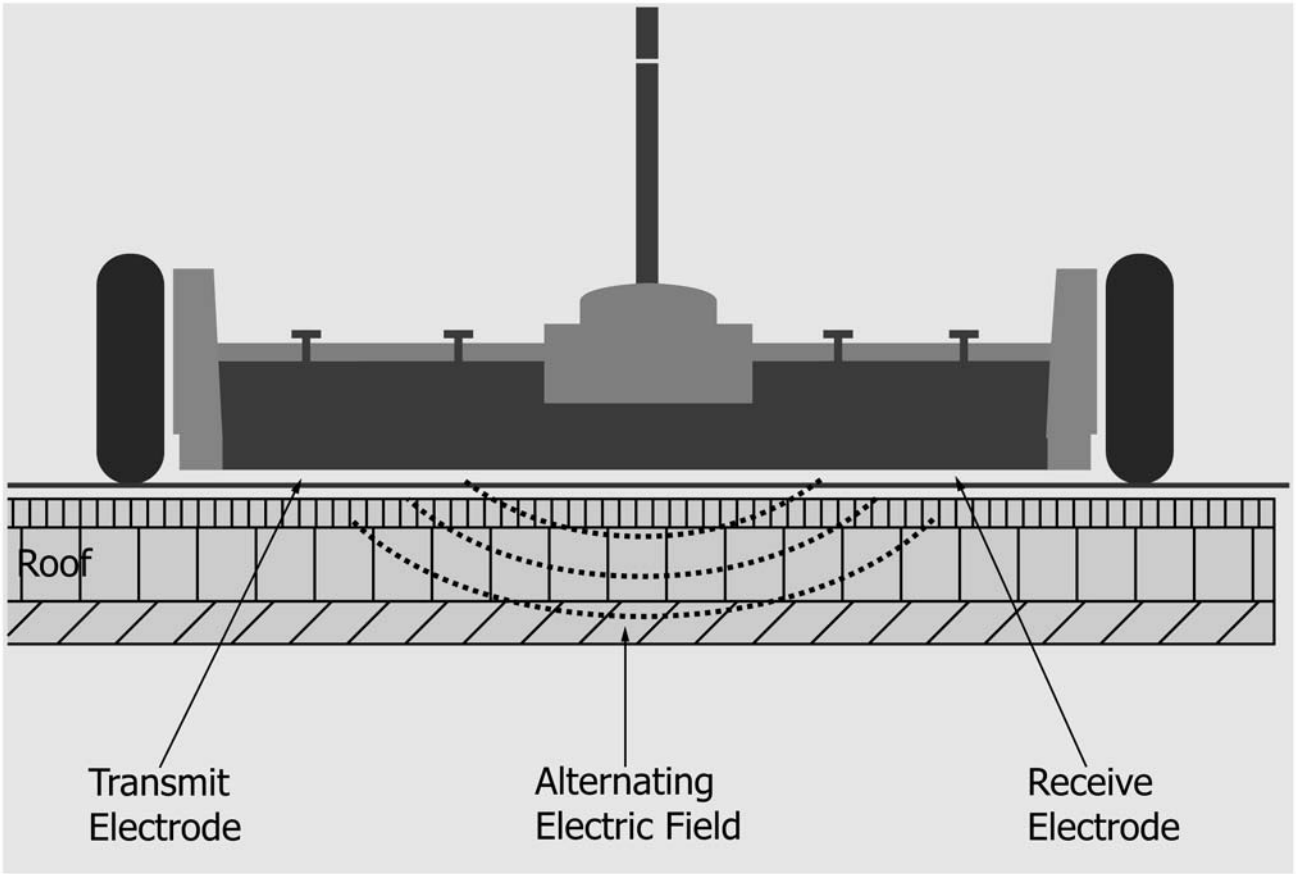

FIG. 1 Typical Non-Destructive Moisture Scanner

current (ac) flowing through this field is inversely proportional with the impedance of these moisture-absorbing materials. The instrument determines the current's amplitude and converts this value to a comparative moisture value.

6.1.1.1 The depth of the signal penetration varies depending on the sensitivity and signal strength settings of the scanner as well as the composition of materials, thickness, and moisture content of the roofing or waterproofing system under test.

6.1.2 *Apparatus Requirements:*

6.1.2.1 The moisture scanner shall be capable of sending signals non-destructively into the materials below the surfacing and the scanner.

6.1.2.2 The moisture scanner shall have integrated adjustable calibration ability for the differing composition, thickness, density of materials, and moisture conditions that can be encountered in roofing or waterproofing assemblies.

6.1.2.3 The moisture scanner shall have a display giving comparative readings of moisture conditions of materials found in roofing and waterproofing systems.

6.2 *Scanner Types*—Two types of impedance scanners are commercially available:

6.2.1 Handheld scanner designed to be used for point readings on a grid system, and

6.2.2 Mobile-wheeled scanner, which can be rolled across the roofing or waterproofing to obtain continuous readings as the scanner moves over the surface.

NOTE 3—See A1.1 and A1.2 for examples of typical handheld and mobile-wheeled types of impedance scanners.

7. Operator Qualifications and Referenced Materials

7.1 The operator shall:

7.1.1 Be familiar with the use of the impedance scanner;

7.1.2 Have knowledge of and available for reference at the roof site a copy of the manufacturer's operating and calibration instructions for the impedance scanner used;

7.1.3 Have knowledge of how and under what circumstances the impedance scanning system can be used, as well as its limitations;

7.1.4 Have a thorough understanding of the construction and components used in the roofing or waterproofing system assembly under test, such as types of membranes, roofing insulations, decking, and attachment;

7.1.5 Confirm the composition of the roofing or waterproofing assembly and endeavor to obtain historical data regarding the construction, age, and performance of the roofing or waterproofing assembly; and

7.1.6 Have a thorough understanding and knowledge of roofing and waterproofing technology including types of roofing or waterproofing membranes and materials, decks, insulation materials, system assemblies and construction procedures, equilibrium moisture content, moisture migration in buildings,

as well as health and safety requirements when carrying out roofing or waterproofing moisture surveying.

7.2 *Data Interpreter*—Individuals interpreting the field data shall have knowledge of: impedance scanner principles of operation, moisture migration transport mechanisms, environmental effects, oven dry and equilibrium moisture contents (EMC), thermal resistance ratios (TRR), verification methods, and roofing and waterproofing construction as it applies to moisture analysis and gravimetric analysis to diagnose and interpret the readings from the roofing or waterproofing system surveyed.

NOTE 4—See A1.4 for additional information on technique and anomalies.

8. Impedance Scanning Techniques

8.1 Two techniques, (A) and (B), for conducting moisture surveys using impedance scanners are:

8.2 *Technique A—Continuous Systematic Scanning and Recording*—This practice involves moving (rolling) the impedance scanner in a systematic and continuous row-by-row manner when traversing the roof surface.

8.2.1 As the scanner is rolled along each run or row in a systematic fashion, continuous impedance readings shall be displayed on the scanner's meter. These readings shall be visually observed by the operator.

8.2.2 All areas where elevated moisture content levels are indicated by increased impedance readings displayed on the scanner's meter shall be referenced, recorded, and marked on the roof surface or the appropriate position on the roof drawing or both by the operator.

8.2.3 This technique is applicable to the mobile-wheeled unit as it gives a continuous reading while traversing the roof surface (see 6.2.2).

8.3 *Technique B—Grid Format Scanning and Recording*—This practice involves the scanning the roof using a grid format where the scanner is moved within the grid pattern.

8.3.1 Scanning is done with a grid pattern layout system in which the scanner is moved in a uniform fashion within the grid pattern. Readings are taken and recorded at each grid intersection point or at regular similar spaced intervals on or between grid lines; additional readings are taken and recorded in areas where elevated moisture levels are indicated by increased impedance readings.

8.3.2 See 9.3 for information on grid system layout.

8.3.3 This technique is considered applicable to both handheld and the mobile-wheeled impedance scanners as referenced in 6.2.1 and 6.2.2.

8.4 When impedance or comparative moisture level readings or other markings are recorded on the roof surface, obtain permission from the building owners or their agent before marking the roof surface with paint or similar marking material. Ensure that materials used for marking are compatible with the roofing or waterproofing systems so damage does not occur.

9. Preparation

9.1 *Preparation as Applying to Both Technique A and B*—Before commencement of non-destructive impedance testing, the operator shall:

9.1.1 Confirm the composition of the roofing or waterproofing assembly and obtain any available historical data regarding the construction, age, and performance of the roofing or waterproofing assembly;

9.1.2 Obtain a roofing and waterproofing plan drawing, if available; and

9.1.3 Prepare drawings (if not available) and survey report sheets for each roofing or waterproofing section being surveyed on to which scanner readings and other relevant data shall be recorded.

9.2 *Calibration as Applying to Both Technique A and B:*

9.2.1 Before carrying out a roofing or waterproofing moisture survey with either a handheld or mobile-wheeled impedance scanner, it is necessary to calibrate the equipment on an area of roofing or waterproofing where the surface and subsurface insulation and components are dry.

9.2.2 Typically, core samples taken for calibration purposes shall consist of specimens of the roofing or waterproofing system at least 2 in. [50 mm] in diameter to include roofing or waterproofing membrane and all materials from the top surface down to the deck.

9.2.3 Core samples shall be taken by cutting through the system down to the deck and shall be evaluated by appropriate methods to determine composition, condition, and moisture content. If decking material is capable of moisture absorption, its moisture condition shall be also be evaluated by appropriate means (see Note 5). Typically, core samples taken from dry reference locations shall be retained for gravimetric analysis in accordance with Test Method C1616 at the verification stage (see Section 11).

NOTE 5—Readings obtained by a resistance-pin-type moisture meter to evaluate moisture conditions of core samples are relative and, typically, need to be correlated with moisture content value at the verification stage (see Note 9). Typically, for evaluation of the moisture condition for a wood deck, use a practice such as Practice D7438. For concrete and gypsum decks, use a guide such as Guide F2659.

9.2.4 All roofing or waterproofing areas where core samples were taken shall be repaired ensuring the affected area is weathertight and these repairs shall be carried out in accordance with the roofing or waterproofing system manufacturer's recommendations or the National Roofing Contractors Association *Repair Manual for Low-Slope Roof Systems*.[3]

9.3 *Additional Preparation Applying to Technique B:*

9.3.1 *Grid System*—Establish an *x-y* square coordinate grid system on the entire area to be surveyed. This grid system shall be set up in even increments. This indicates test points or passes (in the case of the mobile unit) on or between grid lines. This grid system provides location reference for scanner readings.

[3] Available from the National Roofing Contractors Association, 10255 W. Higgins Rd., Suite 600, Rosemont, IL 60018-5607.

9.3.2 The recommended grid spacing is 5 ft [1.5 m] and the maximum spacing shall not exceed 10 ft [3.0 m]. Closer grid spacing to increase the survey resolution is permitted.

9.3.3 In addition to readings taken at regular intervals, additional readings shall be taken at edges, near penetrations, equipment curbs, flashings, and other roof areas commonly identified as locations of possible moisture ingress into roofing and waterproofing systems.

9.3.4 Coordinate markings shall be made on the roofing or waterproofing surface and around perimeter wall flashings of the section being inspected for reference during and after the survey (see 8.4).

10. Procedure

10.1 *Scanning Procedure*—For both handheld and mobile-wheeled scanners, use Techniques A or B.

10.1.1 At the time of the moisture evaluation survey, the roofing or waterproofing surface of the area being surveyed shall be free of debris and dry. Ponded water, snow, ice, rain, debris, and other materials not part of the roofing or waterproofing system shall be removed before testing. The report shall indicate the cleared areas that were surveyed.

NOTE 6—The presence of surface moisture can be determined by use of moisture detection paper (MDP).

10.1.2 Having established the reference location, power the scanner on, place it within the dry reference location, and calibrate it in accordance with the impedance scanner manufacturer's instructions. Choose the sensitivity range to be used in accordance with the manufacturer's instructions and zero the impedance scanner's meter reading.

10.1.3 With the scanner powered on and calibrated, sensitivity ranges selected, and meter reading zeroed, position the scanner on the surface of the section of roofing to be surveyed with the scanner's sensing pads in direct contact with the roofing or waterproofing system surface.

10.1.4 When carrying out moisture evaluation testing, the impedance scanner shall be placed in direct contact with the surface being tested in accordance with the manufacturer's recommendations. Direct contact between the instrument's electrodes (sensing pads) and roof surface is required so that there is minimal signal loss as the detection signal passes through the thickness of coverings or coating materials.

10.1.5 As the scanner is moved within the preplanned scanning pattern, readings are taken and recorded as follows: the continuous scanning and record technique (A) is used as detailed in 8.2 and the grid format scanning technique (B) is used as detailed in 8.3.

10.1.6 Take additional readings in areas adjacent to points where elevated readings are indicated.

10.1.7 When conducting impedance surveys in environments prone to temperature fluctuation during the survey, it is recommended to check the scanner's dry reference location setting every hour and adjust if necessary.

10.1.8 When impedance readings or other markings are recorded on the roof surface, ensure that permission for the use of such markings has been obtained from the building owners or their agent and that materials used for marking are compatible with the roofing or waterproofing systems.

10.1.9 When the handheld scanner is used, readings shall be taken and recorded at the coordinate intersections.

10.1.10 When the mobile-wheeled scanner is used, readings are displayed on a continuous basis as the scanner is rolled along its scanning runs or passes. Typically, readings are taken and recorded at grid points or closer within each pass.

10.1.11 Additional readings are taken and recorded in areas adjacent to points where elevated moisture content was indicated.

10.1.12 Typically, all readings shall be taken and recorded to meet the requirements of Section 13.

10.1.13 If the survey is being conducted on an aggregate surfaced roof, the aggregate shall be dry and of uniform thickness. Areas with varying thicknesses of aggregate or moisture or dirt present shall be noted and treated separately. Affected areas shall be dry and additional core cuts shall be taken to determine "dry" reference values for the affected areas.

10.1.14 Areas where the roofing or waterproofing system has non-uniform composition or thickness, such as areas with tapered insulation, or recover roofing has been installed, shall be tested, verified, and noted separately as these variations may provide different results from the main area of roofing or waterproofing. The presence of additional depth of insulation (such as tapered insulation or an overlaid system) shall be established, and, if moisture is present, typically the location and depth of moisture shall be confirmed with a resistance/conductivity moisture meter fitted with long insulated probes. Such areas with varying composition shall be noted and treated separately to areas of uniform composition.

10.1.15 While performing an impedance moisture evaluation survey, visually inspect and note any visible defects and anomalies such as fish mouths and blistering. Mark anomalies with an indelible marker and record their locations on roof, report sheet, or roof plan.

NOTE 7—See A1.4 for some cautionary notes on roofing anomalies and limitations that affect the impedance test method.

10.1.16 Selected suspect wet areas shall be confirmed by core sampling and verification as outlined in Section 11.

11. Verification

11.1 All field data from a non-destructive impedance scan is qualitative or comparative. Subsequent to the non-destructive impedance scanning described above, when quantitative results are required, the data shall be quantified by using core samples and performing further testing.

11.2 The core samples taken for verification purposes shall consist of specimens of the roofing or waterproofing system at least 2 in. [50 mm] in diameter to include roofing or waterproofing membrane and all materials from the top surface. The core samples shall be taken by cutting through the system down to the deck and shall be evaluated by various appropriate methods to determine the composition, condition, and moisture content and shall be quantified by gravimetric analysis in accordance with Test Method C1616.

11.2.1 All roofing or waterproofing areas where core samples were taken shall be repaired as per 9.2.4.

11.3 Minimum verification for each roofing or waterproofing section tested shall meet the following requirements:

11.3.1 *For "Dry" Reference Location*—Quantify the moisture content of the core samples taken from the "dry" referenced location used for calibration of the scanner by gravimetric analysis in accordance with Test Method C1616.

NOTE 8—Refer to the *Repair Manual for Low-Slope Roof Systems*,[3] Table 5.2 p. 81.

11.3.2 *For Areas Indicated "Wet" (Elevated Impedance Readings)*—Three or more core samples shall be selected from suspect wet areas in each roofing or waterproofing section under test for the purpose of moisture determination by gravimetric analysis. The cores selected shall represent (*1*) low (but not the lowest), (*2*) medium, and (*3*) high level (but not the highest) reading from each section inspected.

11.3.3 These selected suspect wet areas chosen shall be references on drawings or report sheets or both.

11.3.4 The components of each core sample shall be analyzed for moisture content by weight in accordance with Test Method C1616. Separate the different components of each core sample taken into different layers (that is, insulation, membrane, vapor retarder, and so forth). Place each component into separate moisture and airtight containers at the time of sampling.

11.3.5 Each component of each core sample for analysis shall be immediately sealed in their containers; clearly labelled to identify date, location, roof section, *x-y* coordinate and operator; and any other information required by the person preparing the report.

11.3.6 Core samples shall be sent to a testing laboratory for gravimetric analysis to determine the percentage moisture content in accordance with Test Method C1616.

NOTE 9—When oven drying gypsum-based products, it is important that the oven temperature does not exceed 110 ± 5°F [45 ± 3°C] so as to avoid driving off chemically bound water in the gypsum.

11.3.7 Other moisture-testing equipment such as nuclear meters, infrared equipment, handheld non-destructive impedance meters, or pin-type resistance meters are useful to complement impedance readings, but they shall not replace core sampling for quantitative verification of results.

NOTE 10—It is permitted to check the insulation material of each core specimen immediately after extraction from the roofing system to provide a quick indication of its moisture condition with a pin-type resistance moisture meter. The pin-type resistance meter readings should be recorded so as they can be correlated with moisture content measurements obtained by gravimetric analysis at the verification stage of the procedure.

11.3.8 Samples for analysis shall be recorded on the report sheets using the identification from that sample.

12. Analysis of Data

12.1 The moisture content of the core samples elements taken and tested by gravimetric analysis are expressed as percentage moisture content (%MC) in accordance with Test Method C1616.

12.2 Results from gravimetric analysis of the core samples obtained in accordance with 9.2.3 shall be plotted against the relative moisture content readings taken during the moisture survey.

12.3 Once moisture content levels have been determined for "low," "medium," and "high" readings, a straight graph shall be generated relating the field (impedance) readings to the actual moisture content levels. This graph shall be used to convert field readings to percentage moisture by weight values.

12.4 Typically, a histogram shall then be prepared to make the data more compact and in a manageable form. This histogram groups data points by defining intervals and combining all data points that fall within that interval. Once the count rate is defined, a graph of the roofing or waterproofing plan can be drawn to summarize the moisture survey and a graphic moisture map shall be prepared depicting the different moisture levels.

NOTE 11—See Practice E2586.

13. Report

13.1 Prepare a report for the survey performed. The report shall include, as a minimum, the following information:

13.1.1 Building identification and use;

13.1.2 Name, address, and telephone number of the organization providing the survey;

13.1.3 Make, model, and serial number of equipment used;

13.1.4 Names of operator and data analyst;

13.1.5 The survey technique used (handheld or mobile continuous methods);

13.1.6 Condition of the surface at the time of survey;

13.1.7 Date and time of the survey;

13.1.8 The composition and condition of the roofing or waterproofing system as determined from the core sampling;

13.1.9 Description of the roofing or waterproofing assembly;

13.1.10 Verification results, including the actual moisture content found in the core samples;

13.1.11 Scale drawing of the roofing or waterproofing area that shows the location and size of the areas with readings recorded above the EMC depicted by color coding, or contouring, for the moisture survey conducted;

13.1.12 Ambient relative humidity, temperature, and dew point temperature readings before, midway, and at the end of the survey; and

13.1.13 List, describe, and identify location of all features such as repairs, patched areas, embedded flashings, extra thickness of materials, or surfacing that are known to result in inconsistent readings.

14. Keywords

14.1 core sample; detection; impedance; moisture content; moisture detection; moisture scanner; nonconductive; nondestructive; roofing system; scanner; waterproofing

ANNEX

(Mandatory Information)

A1. IMPEDANCE TEST METHOD

A1.1 See Fig. A1.1 for typical handheld impedance scanner.

A1.2 See Fig. A1.2 for typical continuous impedance scanner.

A1.3 Additional Referenced Documents

A1.3.1 C1153 Practice for Location of Wet Insulation in Roofing Systems Using Infrared Imaging

A1.3.2 D1864 Test Method for Moisture in Mineral Aggregate Used on Built-Up Roofs

A1.3.3 D2829 Practice for Sampling and Analysis of Existing Built-Up Roofing Systems

A1.3.4 D5957 Guide for Flood Testing Horizontal Waterproofing Installations

A1.3.5 D6630 Guide for Low Slope Insulated Roof Membrane Assembly Performance

A1.3.6 Griffin, C. W., and Fricklas, R. L., *Manual of Low Slope Roof Systems*, 4th ed., The McGraw-Hill Company Inc., New York.

A1.3.7 ANSI/SPRI/RCI NT-1 Detection and Location of Latent Moisture in Building Roofing Systems by Nuclear Radioscopic Thermalization[4]

A1.4 Some Cautionary Notes on Roofing Anomalies and Limitations that Affect the Impedance Test Method

A1.4.1 Metal and other electrically conductive surface coverings are not suitable for surveying with impedance methods because of the electrical conductivity of these materials.

[4] Available from American National Standards Institute (ANSI), 25 W. 43rd St., 4th Floor, New York, NY 10036, http://www.ansi.org.

FIG. A1.1 Typical Handheld Impedance Scanner

A1.4.2 Aluminum foil-top-faced roof insulations, waterproofing membranes, embedded metal flashings, and so forth will also produce false positives when using impedance techniques; however, liquid-applied aluminum coatings will not typically affect impedance readings.

A1.4.3 Wet-applied insulations such as lightweight insulating concrete and wet-applied decks such as gypsum may retain significant quantities of construction water that may skew impedance survey results; it may be possible to correct for construction water content as part of an instrument's calibration.

A1.4.4 When testing spray foamed roofs where moisture tends to collect in pockets, the continuous impedance scanning method may give more comprehensive results because of more extensive coverage. In some cases, when surveying ballasted single-ply membranes using the grid technique, it may be necessary to remove the ballast if it contains moisture or dirt.

A1.4.5 With aggregate-ballasted and aggregate-surfaced membranes, variable aggregate size and weight may reduce instrument sensitivity, and thus, it may be necessary to recalibrate the scanner.

A1.4.6 Impedance scanners are more sensitive to interply moisture and moisture closer to the instrument's electrodes. Such anomalies may be differentiated from insulation moisture by using core sampling or a probe-type conductivity/resistance moisture meter fitted with insulated pins.

A1.4.7 Anomalies, such as roof patches that are dissimilar to the roof system under test, may give erroneous readings. It may be necessary to recalibrate the instrument in these areas to factor out their effect; such areas should be noted separately.

A1.4.8 The rates of moisture absorption and retention by roofing or waterproofing insulations vary according to the type of insulation and environmental exposure.

A1.4.9 Impedance scanners may assist in tracing moisture to source; however, they cannot be relied on to identify the point of ingress.

A1.4.10 When extruded polystyrene insulation is placed under ballast and above protected waterproofing membranes, impedance scanners may not be able to detect moisture in the insulation below the roof membrane without removing the extruded polystyrene and ballast.

A1.4.11 The presence of dew, rain, snow, and ice significantly affects impedance readings. If these conditions are encountered, the roof surface shall be allowed time to dry before the surveying. As non-destructive impedance readings are qualitative, they shall be correlated with the moisture content of test samples extracted before producing the moisture profile section analysis.

A1.4.12 Accurate interpretation of impedance moisture meter data requires verification by other means because of the

FIG. A1.2 Typical Continuous Impedance Scanner

combination of different materials in roofing or waterproofing systems. Roof impedance scanners detect variable impedance not actual moisture content.