Designation: F2659 – 10

StandardGuide for Preliminary Evaluation of Comparative Moisture Condition of Concrete, Gypsum Cement and Other Floor Slabs and Screeds Using a Non-Destructive Electronic Moisture Meter[1]

This standard is issued under the fixed designation F2659; 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 guide focuses on obtaining the comparative moisture condition within the upper 1.0 in. (25.4 mm) stratum in concrete, gypsum, anhydrite floor slabs and screeds for field tests. Due to the wide variation of material mixtures and additives used in floor slabs and screeds, this methodology may not be appropriate for all applications. See 1.2 through 1.8 and Section 11. Where appropriate or when specified use further testing as outlined in Test Methods F1869, F2170 or F2420 before installing a resilient floor covering.

1.2 This guide is intended for use to determine if there are moisture-related conditions existing on, or in, the floor slabs that could adversely impact the successful application and performance of resilient flooring products.

1.3 This guide may be used to aid in the diagnosis of failures of installed resilient flooring.

1.4 This guide is intended to be used in conjunction with meter manufacturer's operation instructions and interpretive data where available.

1.5 Where possible, or when results need to be quantified use this standard guide to determine where additional testing such as Test Methods F1869, F2170, or F2420 as specified to characterize the floor slab and the test area environment for moisture, humidity and temperature conditions.

1.6 This guide may not be suitable for areas that have surface applied moisture migration systems, curing compounds or coatings that cannot be removed or cleaned off sufficiently to allow the moisture to move upwards through the slab. For a floor slab of 6 in. (150 mm) plus thickness, low porosity slabs, slabs with no vapor retarder installed, and slabs where the above surface environmental conditions can have a greater than normal influence on the moisture reduction gradient of the floor slab or screed, consider Test Method F2170 (below surface in situ rh method) as a more suitable test method under these circumstances.

1.7 This guide is not intended to provide quantitative results as a basis for acceptance of a floor for installation of moisture sensitive flooring finishes systems. Test Methods F1869, F2170, or F2420 provide quantitative information for determining if moisture levels are within specific limits. Results from this guide do not provide vital information when evaluating thick slabs, slabs without effective vapor retarders directly under the slab, lightweight aggregate concrete floors, and slabs with curing compound or sealers on the surface.

1.8 The values stated in inch-pound units are to be regarded as standard. The values given in parentheses are mathematical conversions to SI units that are provided for information only and are not considered standard.

1.9 *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.* Specific warnings are given in Section 7.

2. Referenced Documents

2.1 *ASTM Standards:*[2]

D4259 Practice for Abrading Concrete

F1869 Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride

F2170 Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in situ Probes

F2420 Test Method for Determining Relative Humidity on the Surface of Concrete Floor Slabs Using Relative Humidity Probe Measurement and Insulated Hood (Withdrawn 0)[3]

NOTE 1—Also see Related Documents section at the end of this standard.

[1] This guide is under the jurisdiction of ASTM Committee F06 on Resilient Floor Coverings and is the direct responsibility of Subcommittee F06.40 on Practices.

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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.

[3] The last approved version of this historical standard is referenced on www.astm.org.

3. Terminology

3.1 *Definitions:*

3.1.1 *dew point, n*—dew point temperature is the temperature at which condensation begins. It is the temperature at which air must be cooled in order to reach saturation (assuming air pressure and moisture content are constant).

3.1.2 *moisture content (MC), n*—moisture content tests indicate the moisture content in the slab at the time of the test. This can be defined as the mass of moisture per unit mass of dry material, for example:

$$\frac{\text{Wet weight} - \text{Dry weight}}{\text{Dry weight}} \times 100$$

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3.1.3 *relative humidity, n*—ratio of the amount of water vapor actually in the air compared to the amount of water vapor required for saturation at that particular temperature and pressure, expressed as a percentage.

3.1.4 *service temperature and relative humidity, n*—the average ambient air temperature and relative humidity that typically will be found in the buildings occupied spaces during normal use.

3.1.5 *vapor emission, n*—moisture vapor emission is used to define the amount of water vapor emitting from the concrete floor slab when using the Anhydrous Calcium Chloride test. This is usually expressed in lb/1000 ft^2 during a 24-h period.

4. Summary of Guide

4.1 *Procedure:*

4.1.1 This guide covers a procedure in which a purpose-made and calibrated electronic moisture meter is used in conjunction with interpretive methods provided by meter or the meter manufacturer, or both, to determine the comparative moisture content in the upper 1 in. (25.4 mm) stratum of concrete and other floor slabs and screeds by non-destructively measuring the electrical ac impedance.

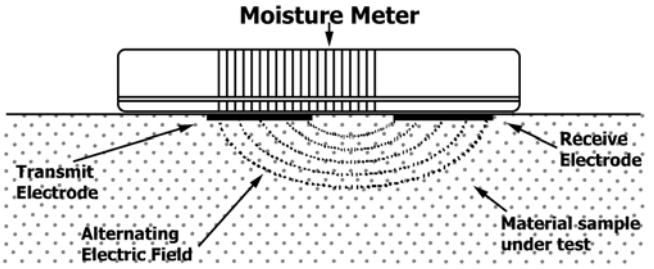
4.2 *Principles of Operation:*

4.2.1 The electrical impedance of a material varies in proportion to its comparative moisture condition. The electrical impedance of the floor slab directly under the footprint of the instrument is measured by creating an alternating electric field that penetrates the material under test. The small alternating current flowing through the field is inversely proportional to the impedance of the material. The instrument determines the current's amplitude and thus derives the moisture value. (See Fig. 1). Classifications of meters using this technology are impedance, capacitance based and electrical field change detecting devices.

4.2.2 The depth of the signal penetration will vary depending on the material and moisture content of the material being tested. It generally varies from 0.5 to 1.0 in. (12.7 to 25.4 mm).

5. Significance and Use

5.1 Moisture in concrete floor slabs affects the performance of flooring systems such as resilient, wood, and textile floor coverings and coatings. Manufacturers of such systems generally require moisture testing be performed before installation of coverings on floor slabs and screeds. The measurement of sub-surface comparative moisture condition in the upper 1.0 in. (25.4 mm) stratum of a concrete slab with a non-destructive moisture meter is one such method.



NOTE 1—Not to scale.

FIG. 1 Typical Non-destructive Electronic Moisture Meter for Concrete

5.2 Excessive moisture in floor slabs after installation can cause floor covering system failures such as delamination, bonding failure, deterioration of finish flooring and coatings, and microbial growth.

5.3 5.3 Comparative moisture content tests indicate the moisture in the slab, which is usually referenced to the percentage of dry weight. That is:

$$\frac{\text{Wet weight} - \text{Dry weight}}{\text{Dry weight}} \times 100$$

Results indicate conditions at the time of the test.

5.4 Methods of meter calibration and factors affecting equilibration are described in Section 8.

6. Apparatus for Non-Destructive Moisture Meter Testing Procedure

6.1 An electrical impedance moisture meter specifically developed and calibrated for the non-destructive measurement of the comparative moisture condition in concrete flooring slabs.

6.2 The moisture meter should have a clear display giving readings of the moisture condition for concrete and other floor slabs in meaningful and interpretable units of measurement.

6.3 The moisture meter should be placed in direct contact with the surface of the bare clean concrete in accordance with the meter manufacturer's recommendations. Direct contact between the instrument and the concrete itself is required so that there is no loss of signal sensitivity, which could occur as the sensing signals pass through the thickness of covering or coating materials on the material (floor slab) being tested.

6.4 The moisture meter should be capable of sending non-destructive signals through the surface into the concrete slab without damage. Examples of suitable meters are illustrated in Appendix Appendix X2.

7. Hazards

7.1 *Silica and Asbestos Warning*—Do not sand, dry sweep, drill, saw, bead blast, or mechanically chip or pulverize existing resilient flooring, backing, lining felt, paint, asphaltic cutback adhesives, or other adhesives. These products may contain asbestos fibers or crystalline silica. Avoid creating dust.

Inhalation of such dust is a cancer and respiratory tract hazard. Smoking by individuals exposed to asbestos fibers greatly increases the risk of serious bodily harm. Unless positively certain that the product is non-asbestos-containing material, presume that it contains asbestos. Regulations may require that the material be tested to determine asbestos content. The Resilient Floor Covering Institute's (RFCI) recommended work practices for removal of existing resilient floor coverings should be consulted for a defined set of instructions addressed to the task of removing all resilient floor covering structures.

7.1.1 Various federal, state, and local government laws have regulations covering the removal of asbestos-containing materials. If considering the removal of resilient flooring or asphaltic cut–back adhesive that contains or presumes to contain asbestos, review and comply with the applicable regulations.

7.2 *Lead Warning*—Certain paints may contain lead. Exposure to excessive amounts of lead dust presents a health hazard. Refer to applicable federal, state, and local laws and guidelines for hazard identification and abatement of lead-based paint published by the US Department of Housing and Urban Development regarding appropriate methods for identifying lead-based paint and removing such paint, and any licensing, certification, and training requirements for persons performing lead abatement work.

8. Calibration

8.1 Moisture Measurement meters should be manufactured with traceable calibration procedures and have manufacturer's certification, or documentation, available stating the range of calibration and the accuracy of the meter. Moisture Meters should be initially calibrated at a minimum of two points.

8.2 The Moisture Meter should be of a design that the user can check the calibration.

8.3 Check calibration within 30 days before use by using guidelines or equipment, or both, supplied or recommended by the manufacturer of the moisture meter. If the as-found readings differ from the nominal readings by more than the tolerances as laid down by the manufacturer, then the meter manufacturer or its approved recalibration service provider should recalibrate the meter before it is used.

9. Pre-test Conditioning and Preparation

9.1 The floor slab shall be at service temperature and the occupied air space above the floor slab shall be at service temperature and relative humidity expected under normal use for at least 48 h prior to moisture content testing. If this is not possible then the test should be conducted with conditions at 75 ± 10 ºF (24 ± 5ºC) and relative humidity of 50 ± 10 %.

9.1.1 All artificial aids used to accelerate drying should be turned off at least 96 h before commencement of the moisture testing otherwise results may not accurately reflect the amount of moisture present in the slab during normal operating conditions.

9.2 No visible water in liquid form should be present on the concrete at the time this testing procedure is being carried out.

9.3 Avoid testing locations in direct sunlight or subject to direct sources of heat.

9.4 Prior to moisture testing the concrete, the surface of the test area shall be clean and free of any covering, coatings, adhesive residue, finishes, dirt, curing compounds, or other substances. Non-chemical methods for removal, such as abrasive cleaning or bead blasting, including methods described in Practice D4259 may be used on existing slabs with deleterious residues to achieve an appropriate state for testing. Surface preparation shall take place as follows:

9.5 Concrete slabs covered by existing resilient floor coverings must have such coverings and all three-dimensional adhesive removed, and the test area should be exposed to conditions specified in 9.1 for a minimum of 24 h prior to cleaning and testing.

9.6 Remaining adhesive or other deleterious residues, or both, or concrete slabs that have never hosted resilient floor coverings must be cleaned of all substances as noted in 9.4. Such cleaning may take place immediately prior to testing. Removal of any floor covering or adhesive shall be carried out in accordance with RFCI recommended work practices for the removal of resilient floor coverings.

9.7 Moisture meters for concrete normally have their initial calibration based on clean and bare concrete.

9.8 Removal of any existing floor covering or adhesive shall be accomplished using approved OSHA work practices. For removable of any existing flooring or adhesives strictly observe Section 7 and any other appropriate safety and health practices.

10. Procedure

10.1 Follow the instrument manufacturer's instructions. Typically, power up the moisture meter, place the meter on the bare and clean concrete slab with its sensors firmly pressed down giving direct contact with the surface of the floor slab. Concrete moisture meters that have spring-loaded contacts incorporated in the electrodes or sensor should be pressed down onto the surface of the area being tested so that these contacts are fully compressed when taking measurements.

10.2 With the meter switched on, an electric field penetrates the slab. The current flowing through this field is determined and converted to a comparative or percentage moisture content reading, which is instantly displayed on the instrument dial.

10.3 Where covered floor slabs are being tested, all covering materials, adhesive residue, curing compound, sealers, paints etc., shall be removed to expose an area of clean bare concrete so that the electrodes, when positioned for testing, are in direct contact with the clean surface of the floor slab. See 9.4 and 9.5.

10.4 Readings typically indicate comparative moisture condition that is based on the moisture conditions for concrete and for other screed or slabs. Readings are instantly shown on the meter's analog or digital display.

10.5 Measurements should be made by taking readings at a number of locations in close proximity to one another such as 3 to 5 readings within an area of 1 ft^2 (929 cm^2) at each location, Always report maximum readings at that location.

10.6 *Number of Tests and Locations*—Perform at least eight tests for the first 1000 ft^2 (100 m^2) and at least five additional