Designation: F 2170 – 02

Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using *in situ* Probes[1]

This standard is issued under the fixed designation F 2170; 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 quantitative determination of percent relative humidity in concrete slabs for field or laboratory tests.

1.2 The values given in parentheses are for information only.

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.*

Specific warnings are given in Section 7, 10.3.2, and 10.4.4.

2. Referenced Documents

2.1 *ASTM Standards:*

C 511 Specification for Moist Cabinets, Moist Rooms, and Water Storage Tanks[2]

E 104 Practice for Maintaining Constant Relative Humidity by Means of Aqueous Solutions[3]

F 710 Practice for Preparing Concrete Floors to Receive Resilient Flooring[4]

3. Terminology

3.1 *Definitions:*

3.1.1 *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.

3.1.2 *service temperature and relative humidity*, *n*—average ambient air temperature and relative humidity that typically will be found in a building's occupied spaces during normal use.

4. Summary of Test Method

4.1 This test method comprises two procedures for forming holes in concrete into which a relative humidity probe is placed. Procedure A for hardened concrete involves drilling a cylindrical hole in concrete with a rotary hammerdrill, then placing a hollow sleeve to line the hole. Procedure B is an alternative procedure for fresh concrete, which involves forming a cylindrical hole in concrete by placing a hollow cylindrical tube in the formwork, then placing and consolidating concrete around the tube. The liner or tube permits measurement of RH at a specific, well-defined depth in the concrete.

4.2 Methods of probe calibration and factors affecting equilibration are described in Section 8.

5. Significance and Use

5.1 Moisture permeating from concrete floor slabs affects the performance of flooring systems such as resilient and textile floor coverings and coatings. Manufacturers of such systems generally require moisture testing to be performed before installation on concrete. Internal relative humidity testing is one such method.

5.2 Excessive moisture permeating from floor slabs after installation can cause floor covering system failures such as debonding and deterioration of finish flooring and coatings and microbial growth.

5.3 Moisture test results indicate the moisture condition of the slab only at the time of the test.

6. Apparatus

6.1 *Humidity Probe and Digital Meter*, with relative humidity and temperature sensors in cylindrical probe, with external diameter less than approximately 0.75 in. (20 mm), and accuracy ±2-3 % from 0 to 100 % relative humidity. Obtain probes from a manufacturer with a NIST-traceable calibration certificate stating the range of calibration and the accuracy over that range. Probes shall be calibrated at 95 % relative humidity or higher, in addition to lower relative humidity levels.

NOTE 1—Calibration by end-users using saturated salt solutions in accordance with Practice E 104 is not recommended due to the technical difficulties of maintaining sufficiently accurate reference standards. Checking with salt solutions is an acceptable method of assessing probe performance.

6.2 *Hole Liners*, plastic or non-corroding metal tubes, inside diameter not more than 0.04 in. (1 mm) greater than the probe's external diameter, of sufficient length to seal the hole to the desired depth.

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

Current edition approved July 10, 2002. Published September 2002.

[2] *Annual Book of ASTM Standards*, Vol 04.01.

[3] *Annual Book of ASTM Standards*, Vol 11.03.

[4] *Annual Book of ASTM Standards*, Vol 15.04.

NOTE 2—Liners with projecting circumferential fins at the bottom end are desirable to provide a seal near the bottom of the hole.

6.3 *Rotary Hammerdrill, Carbide Drill Bits, Vacuum Cleaner Equipped with HEPA Filter, and Brush*, for drilling holes in concrete and removing drilled dust from the holes. Drill bit diameter shall not exceed 0.04 in. (1 mm) larger than the external diameter of the hole liner.

7. Hazards

7.1 *Silica and Asbestos Warning*—Do not sand, dry sweep, dry scrape, drill, saw, beadblast, 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 a nonasbestos-containing material, presume that it contain 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.[5]

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 U.S. 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.[6]

7.3 *Wet Concrete Warning*—Contact with wet (unhardened) concrete, mortar, cement, or cement mixtures can cause skin irritation, severe chemical burns, or serious eye damage. Wear waterproof gloves, a long-sleeved shirt, full-length trousers, and proper eye protection when working with these materials. If you have to stand in wet concrete, use waterproof boots that are high enough to keep concrete from flowing into them. Wash wet concrete, mortar, cement, or cement mixtures from your skin immediately after contact. Indirect contact through clothing can be as serious as direct contact, so promptly rinse out wet concrete, mortar, cement, or cement mixtures from clothing. Seek immediate medical attention if you have persistent or severe discomfort.

8. Calibration

8.1 Recalibrate probes at least annually or more frequently if exposed to environmental conditions that affect measurement accuracy.

8.2 Check probe calibration within 30 days before use by either of the two following procedures:

8.2.1 *Calibration Check Procedure 1, Saturated Salt Solutions*—Prepare saturated salt solutions in accordance with Practice E 104. Follow probe manufacturer's recommended procedure for exposing probes. Record the as-found relative humidity and the nominal relative humidity of the salt solutions. If the as-found relative humidity differs from the nominal relative humidity by more than 2 % (below 90 % relative humidity) or by more than 3 % (from 90 to 100 % relative humidity), recalibrate the probe before use.

8.2.2 *Calibration Check Procedure 2, Compressed Dry Air and Moist Room*:

8.2.2.1 *0 % Relative Humidity*—Connect one end of a tube to a compressed gas cylinder containing zero-grade or drier compressed air or an inert gas such as nitrogen. Insert the relative humidity probe into the other end of the tube. Allow the gas to flow at several millilitres per minute until the probe reaches equilibrium (less than 1 % relative humidity drift in 5 min). Record the percent relative humidity.

8.2.2.2 *100 % Relative Humidity*—Place the probe in a moist room or chamber meeting the requirements of Specification C 511 for at least 30 min. Allow the probe to reach equilibrium (less than 1 % relative humidity drift in 5 min). A thin, moisture vapor permeable membrane surrounding the sensing element will inhibit condensation on the sensing element. If condensation occurs, remove the probe from the moist environment and allow to dry before repeating the measurement. Record the percent relative humidity.

8.2.2.3 If checking reveals the probe output differs from 0 by more than 2 % or from 100 % by more than 3 %, recalibrate the probe before use.

9. Conditioning

9.1 Concrete floor slabs shall be at service temperature and the occupied air space above the floor slab shall be at service temperature and service relative humidity for at least 48 h before making relative humidity measurements in the concrete slab.

10. Procedure

10.1 *Number of Tests and Locations*:

10.1.1 Perform three tests for the first 1000 ft^2 (100 m^2) and at least one additional test for each additional 1000 ft^2 (100 m^2).

10.1.2 Select test locations to provide information about moisture distribution across the entire concrete floor slab, especially areas of potential high moisture. For slabs on-grade and below-grade, include a test location within 1 m (3 ft) of each exterior wall.

10.2 Determine the appropriate depth for probe holes from the following table:

Drying Conditions	Drill-to Depth from Top of Slab
Slab drying from top only (Example: slab on ground with vapor retarder below, or slab on metal deck)	40 % (Example: 1.5 in. (40 mm) deep in 4-in. (100-mm) thick slab)
Slab drying from top and bottom (Example: elevated structural slab not in metal deck)	20 % (Example: 0.75 in. (20 mm) deep in 4-in. (100-mm) thick slab)

NOTE 3—Testing at these depths will indicate the potential equilibrium

[5] *Recommended Work Practices for Removal of Resilient Floor Coverings*, Resilient Floor Covering Institute, 401 East Jefferson St., Suite 102, Rockville, MD 20850.

[6] *Lead-Based Paint: Interim Guidelines for Hazard Identification and Abatement in Public and Indian Housing*, U.S. Department of Housing and Urban Development, NTIS Order Number PB91-144311. Available online from www.fedworld.gov.