Designation: F 2420 – 05

Standard Test Method for Determining Relative Humidity on the Surface of Concrete Floor Slabs Using Relative Humidity Probe Measurement and Insulated Hood[1]

This standard is issued under the fixed designation F 2420; 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 above the surface of concrete floor 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.* Some specific warnings are given in Section 7.

2. Referenced Documents

2.1 *ASTM Standards:* [2]

E 104 Practices for Maintaining Constant Relative Humidity by Means of Aqueous Solutions

F 2170 Test Method for Determining Relative Humidity in Concrete Floor Slabs Using In-Situ Probes

NOTE 1—For additional references, see A1.2.

2.2 *Other Standards:*

Resilient Floor Covering Institute, Recommended Work Practices for the Removal of Resilient Floor Coverings[3]

U.S. Department of Housing and Urban Development, Lead-Based Paint: Interim Guidelines for Hazard Identification and Abatement in Public and Indian Housing[4]

3. Terminology

3.1 *Definitions:*

3.1.1 *dew point*—dew point temperature is the temperature at which air becomes saturated when cooled with no further addition of moisture or change of pressure. Condensation can occur when moist air is cooled to its dew point and below.

3.1.2 *relative humidity*—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.

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

4. Summary of Test Method

4.1 This test method covers a procedure where a purposely-made thermally insulated hood is placed on and sealed to the surface of a concrete floor slab. An entrapped and impervious air pocket or chamber is formed directly above and in contact with the surface of the bare floor slab. Through a lined access hole in the hood, a humidity probe can be inserted to measure the relative humidity (RH), temperature, and dew point within the air pocket.

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

4.3 The basis of this test is to use a Humidity Probe to determine the relative humidity, temperature and dew point of an air pocket within the air chamber formed under a thermally insulated hood sealed to the floor surface. This air chamber shall be located directly above the bare and clean surface of the concrete floor slab. Sufficient time as outlined under 10.1.6 and 10.1.7 should be allowed for moisture, humidity and temperature equilibrium to become established between the pocket of air and the floor slab before relative humidity readings are taken.

4.4 An example of a suitable hood is illustrated in Figs. 1-3. Calculation of the insulation value of the hood is shown in A1.3.

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[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.

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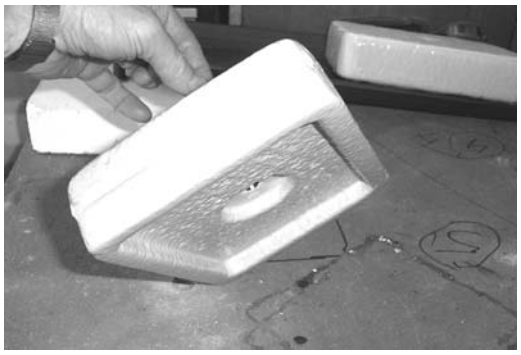
[2] For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

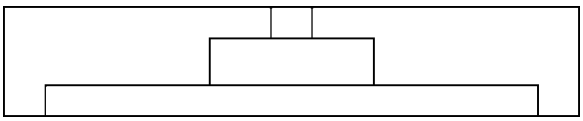
[3] Available from the Resilient Floor Covering Institute, 401 E. Jefferson Street, Suite 102, Rockville, MD 20850, www.rfci.com..

[4] Available from the U.S. Department of Housing and Urban Development, 451 7th Street SW, Washington, DC 20410.



NOTE—Fig. 1 not to scale.
FIG. 1 Typical RH Hood Showing Air Chamber

NOTE—Fig. 2 not to scale.
FIG. 2 Typical RH Hood Showing RH Probe Positioned in Hood



NOTE—Fig. 3 not to scale.
FIG. 3 Diagram of Typical RH Hood

5. Significance and Use

5.1 Moisture permeating from concrete floor slabs affects the performance of flooring systems such as resilient, wood, textile floor coverings and resinous coatings. Manufacturers of such systems generally require humidity/moisture testing be performed before installation over concrete floor slabs. The measurement of relative humidity (RH) directly above the porous surfaces of a floor slab is one such method.

5.2 Excessive moisture in or emitting from 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 The surface RH Hood (relative humidity) test method is intended to quantify the relative humidity condition that exists at the surface of a floor slab to which a floor covering or coating shall be applied. Results indicate moisture content conditions at the time of the test, as moisture movement within the slab is dynamic. See A1.4 for reference to some methods of determining moisture/humidity levels in a concrete slab.

6. Apparatus

6.1 *Humidity Probe and Digital Meter*—Probes shall have relative humidity and temperature sensors, cylindrical in shape and have an external diameter of less than 0.75 in. (20 mm). It is essential that the probe be designed so that it can be sealed within an access hole when positioned in the hood. Relative Humidity Probes should have an accuracy level within ±3 % from 25 to 98 % relative humidity, and be obtained from a manufacturer having a NIST or equivalent traceable calibration procedure. RH Probes should be calibrated at 90 % relative humidity or higher, in addition to lower humidity levels

6.2 An insulated impermeable box or hood shall be manufactured from rigid thermal insulation type material (for example, expanded polystyrene (EPS) or similar). The hood's design shall include a recessed pocket that creates an isolated air chamber directly above the concrete surface. The hood's design must permit it to be sealed to the concrete surface during testing. The hood should have a maximum insulation *U*-value of 1.0 W/(m^2·K). The air chamber should be lined or coated with a suitable vapor barrier material such as PVC so as to isolate the air pocket from the humidity and fluctuations in temperature of the air outside the hood. (See Figs. 1-3 for illustration of an example of a suitable apparatus.) The hood's insulated air chamber shall have a minimum area of between 30 and 40 $in.^2$ (200 and 260 cm^2) with a minimum depth of 0.25 in. (6.3 mm) positioned and directly above and exposed to the surface. This central area of air chamber shall be of sufficient dimensions to allow unrestricted movement of the entrapped air around the sensor end of the RH probe when it is in position within the hood. Provision shall be made so that the RH probe is sealed when positioned in the hood. It is essential that when the hood is sealed to the floor that readings can be taken without breaking the seal and releasing the air in the test chamber. To avoid equipment being left on site unattended, the hood should be designed so that the probe may be removed from the hood, and the access hole plugged while the hood is left sealed to the floor.

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. 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 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.

8. Calibration

8.1 Relative Humidity Probes should be manufactured with NIST or equivalent traceable calibration procedures and have documentation available stating the range of calibration and the accuracy over that range. Probes shall be calibrated at 90 % relative humidity or higher, in addition to lower humidity levels, and have an accuracy level within ±3 % between 25 and 98 % relative humidity.

8.2 Probes should be checked for calibration and if found to be outside tolerance: *(a)* those suitable should be recalibrated, and *(b)* those not suitable for recalibration should be disposed. RH probes should not be used when found to be outside calibration tolerances.

8.3 Probes should be recalibrated on a periodic basis (at least annually). Calibration checking and recalibration may be required on a more frequent basis where probes are exposed to environmental conditions that could affect measurement accuracy.

8.4 *On-Site Performance Calibration Check*:

8.4.1 Check probe calibration within 30 days before use by the following procedure:

8.4.2 *Calibration Check Procedure* (for on-site checking only)—Saturated salt solutions: Use prepared saturated salt solutions in accordance with Practices E 104. Follow probe manufacturer's recommended procedure for exposing probes to this solution. Record the as-found relative humidity and the nominal relative humidity of the salt solutions. If the as-found RH differs from the nominal RH by more than ±3 % the probe should be recalibrated before use.

NOTE 2—Initial Calibration or recalibration by end-users using saturated salt solutions in accordance with Practices E 104 is not recommended due to difficulties of maintaining sufficiently accurate reference standards. Checking with salt solutions is an acceptable method of assessing probes on-site performance.

8.4.3 If calibration checking reveals the probe output differs 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 relative humidity expected under normal use for at least 48 h prior to the hood placements. If this is not possible then the test should be conducted with conditions at 75 ± 10°F (24 ± 5°C) and relative humidity of 50 ± 10 %. All artificial aids used to accelerate drying should be turned off at least 96 h before hoods may be sealed on the concrete surface.

10. Procedure

10.1 *Number of Tests and Locations*:

10.1.1 Perform three tests for the first 1000 ft^2 (93 m^2) and at least one additional test for each additional 1000 ft^2 (93 m^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 test locations in the center of the floor and areas close to exterior walls. Choose areas that are susceptible to high moisture when placing hood.

10.1.2 Prior to placement of the RH hoods the actual test area shall be clean and free of any foreign substances. Only clean bare concrete surfaces shall be exposed to the air chamber underneath the hood.

10.1.3 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 for testing using the RH Hood method. Removal of any existing floor covering or adhesive shall be accomplished using approved OSHA work practices. For removal of any existing flooring or adhesives strictly observe Section 7 and any other appropriate safety and health practices. The cleaned test area should be exposed to conditions specified in 9.1 for a period of at least 24 h prior to starting the test.

10.1.4 Seal the insulated hood firmly to the floor with a suitable preformed butyl/sealant adhesive or similar. The sealant used should be of a type that does not give off any emissions that could affect the relative humidity readings in the hood. Place seal/stopper in probe hole.

10.1.5 Allow a period of at least 72 h to elapse after sealing the hood to the floor so as to achieve moisture equilibrium in the air pocket under the hood before taking readings.[5]

10.1.6 This test method is not suitable for areas that have surface applied vapor barriers or curing compounds that cannot be removed or cleaned off sufficiently to allow vapor flow through the surface of the slab. For very thick floor slab construction, (for example, 8 in. and over), and low porosity slabs or slabs with certain types of power floated low emission surface finishes it may take considerably longer than 72 h to reach moisture equilibrium. Should these conditions exist where a considerable amount of additional time may be required for the satisfactory performance of this test because of the low porosity surface or slow vapor movement in the slab, or both, then Test Method F 2170 (below surface in situ RH) should be considered as a more suitable test method under these circumstances.

10.1.7 Possible edge effect[6] (see A1.6).

10.1.8 Readings are taken by removing stopper from probe access hole in hood, this should be done quickly to ensure that no air escapes from, or enters, the air pocket under the hood.

10.1.9 Insert the humidity probe into hole so that its sensor protrudes into the center air chamber, and is sealed in position during acclimation, and taking of readings.

[5] Equilibrium could be assumed when two consecutive readings taken at 24-h intervals show no change.

[6] To minimize the risk of possible edge effect on thick slabs and porous slabs and screeds, the area 3 by 3 ft (approximately 1 by 1 m) surrounding the hood should be covered with a plastic sheet during the test procedure.

10.1.10 To avoid leaving the humidity probes on site during the equilibration period, the probe may be removed from the hood and hole sealed with a stopper. Continue the determination of relative humidity reading in accordance with 10.2.

10.2 *Measurement*:

10.2.1 Remove the rubber stopper at the top/end of the hole liner sleeve and insert the probe all the way to the bottom/end of the hole liner so that the sensing (filter end) end of the probe is located in the center of the air pocket under the hood. Should the probe be shorter than the liner and its wire protrude from inside the liner this lead wire may need to be sealed in the liner. Connect the probe lead wire to the meter, turn on the meter and allow it to warm up as indicated by the manufacturer's instructions.

10.2.2 Allow the probe to reach temperature equilibrium before measuring relative humidity. The probe must be at the same temperature as the air pocket before taking readings. Even a small difference in temperature could produce a significant error in relative humidity measurement.

10.2.3 Check for drift of readings. Meter readings must not drift more than 1 % relative humidity over approximately 20 min. Equilibration may take up to several hours depending on factors such as the initial temperature difference between probe, air chamber and concrete. The meter may be turned off or disconnected. or both, from the probe while the probe equilibrates with the entrapped air pocket above the concrete. Refer to 10.1.6 and 10.1.7 for reference to the equilibration periods required for the air pocket within the RH hood to reach moisture/humidity equilibrium with the concrete slab below it.

10.2.4 Record the relative humidity to the nearest percent, temperature to the nearest °F/°C. Record the location of the hood on the floor slab.

10.2.5 Use a relative humidity meter to measure the ambient air temperature and relative humidity above the slab in the vicinity of the hood. Record the relative humidity to nearest percentage, and the temperature and dew point temperature to the nearest °F/°C.

10.2.6 If a surface thermometer is used, record this temperature. See A1.5 for notes on use of infrared thermometer to determine the average temperature to the nearest °F/°C of the concrete slab surface adjacent to the hood locations.

10.2.7 When testing is complete, remove the insulated hood and clean off any adhesive or sealer that may be adhered to the surface of the concrete. After removal of the hood allow sufficient time (at least 24 h) for the area where it was positioned to reach moisture equilibrium with the surrounding area of the floor. This should be completed before proceeding further or applying a covering.

10.2.8 Once RH values have been determined refer to whatever standard criteria that has been established. Test values that do not meet the agreed upon established criteria generally require more time for the slab to dry before further testing is performed. The equipment and hood should be removed while the floor slab is allowed to continue drying before carrying out further tests in accordance with 10.1 and 10.2.

11. Report (see Sample Report Sheet in Annex A1)

11.1 Report the following information:

11.1.1 Name and address of the structure,

11.1.2 Date and time measurements were made,

11.1.3 Name, title, and affiliation of persons performing the measurements,

11.1.4 Locations of hoods on the structure,

11.1.5 Relative humidity in each hood to the nearest % RH,

11.1.6 Temperature in each hood to the nearest °F/°C,

11.1.7 Ambient air temperature, to the nearest °F/°C. relative humidity (to the nearest % RH) and dew point adjacent to each hood,

11.1.8 Make, model, and last calibration date of the equipment which is being used to make the measurements, and

11.1.9 Report any observations that might affect the interpretation of individual measurements such as: age and thickness of slab, standing water on the slab, wet coring operations, evidence of flooding or water damage, area water table, weather, ventilating system operations, vapor check, or artificial drying processes, or combination thereof.

12. Precision and Bias

12.1 Precision of this test method has not yet been determined.

12.2 Bias is affected by accuracy of probe calibration and can be strongly affected by equilibration of probes in the hood, and equilibrium of air in the chamber above the concrete. Measurements made too soon after placing a hood on the concrete or a probe in the hood, or both, without allowing sufficient time for equilibrium to be established may result in significantly lower or higher measurements than those made under equilibrium conditions.

13. Keywords

13.1 concrete; dew point; entrapped air chamber; equilibrium; flooring; floor slabs; insulated hood; moisture; relative humidity; temperature; thermal insulation

ANNEX

(Mandatory Information)

A1. EXAMPLE REPORT FORM

A1.1 Example Report Form

REPORT OF RELATIVE HUMIDITY ON THE SURFACE OF CONCRETE FLOOR SLAB (BY RH HOOD METHOD)						
Name and Address of Structure				Identify Floor		
Test Location (use bldg grid if known)	% Relative Humidity Under Hood	Temp Under Hood °F/°C	Dew Point Temperature °F/°C	Air Temp °F/°C	Air Relative Humidity, %	Floor Slab Temp °F/°C Adjacent to Hood
Instrument Used						
Make, Model, Serial Number				Last Calibration Date		
Tests Performed by						
Name				Date		
Company Name, Address						

A1.2 Additional Relative References

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

E 1907 Practices for Determining Moisture-Related Acceptability of Concrete Floors to Receive Moisture-Sensitive Finishes[2]

F 710 Practice for Preparing Concrete Floors to Receive Resilient Floor Coverings[2]

British Standard BS 8203:2001 Code of Practice for Installation of Resilient Floor Coverings[7]

British Standard BS 5325:2001 Code of Practice for Installation of Textile Floor Coverings[7]

A1.3 Calculation of U-Value for RH Probe Hood

K value for 25 kg/m^3 EPS = 0.036
K value for coating material = 0.17
Thickness of EPS = 40.0 mm
Thickness of coating A = 0.8 mm
Thickness of coating B = 0.5 mm
R Value for EPS = 0.04/0.036 = 1.11
R Value for coating A = 0.0008/0.17 = 0.005
R Value for coating B = 0.0005/0.17 = 0.003
R Total = 1.11 + 0.005 + 0.003 = 1.118 m^2·K/W
U Value Total = 1/1.118 = 0.89 W/(m^2·K)

[7] Available from the British Standards Institute (BSI), 389 Chiswick High Rd., London, W4 4AL, UK, www.bsi-global.com.

A1.4 Measurement Methods of Determining Moisture Levels in a Concrete Slab

A1.4.1 Moisture Content tests indicate the amount of moisture in a concrete expressed as a percentage of its dry weight.

A1.4.2 Relative Humidity In-situ test method indicates the % internal relative humidity in the floor slab at the time of the test.

A1.4.3 The surface RH Hood relative humidity test method is intended to simulate the relative humidity condition that exists at the surface level of a floor slab, which shall have a covering, applied to it.

A1.4.4 The results from any of above indicate the conditions at the time of the test.

A1.5 Infrared Thermometers

A1.5.1 Hand-held, range at least 15 to 122°F (−10 to 50°C) with a resolution of 1°F/°C and accuracy of ±2 % of the reading. When using Infrared thermometers manufacturers instructions should be followed especially those relating to safety and safe use when laser beam is turned on.

A1.6 Edge Effect

A1.6.1 When testing floor slabs such as thick slabs, porous slabs, lightweight screeds and underlayment screeds, covering the area 3 by 3 ft (approx 1 by 1 m) surrounding the hood with plastic sheeting for the duration of the test procedure should help to minimize the risk of possible edge effect.