Designation: F 1869 – 03

Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride[1]

This standard is issued under the fixed designation F 1869; 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 the rate of moisture vapor emitted from below-grade, on-grade, and above-grade (suspended) concrete floors.

1.2 This quantity of moisture shall be expressed as the rate of moisture vapor emission, measured in pounds of moisture over a 1000 ft^2 area during a 24-h period.

1.3 The values stated in inch-pound units are to be regarded as the standard. The values given in parentheses are for information only.

1.4 *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:* [2]

C 670 Practice for Preparing Precision and Bias Statements for Test Methods for Constsruction Materials

F 141 Terminology Relating to Resilient Floor Coverings

2.2 *Resilient Floor Covering Institute Standard:*

Recommended Work Practices[3]

2.3 *Military Standard:*

Mil Spec B-131H Type 1, Class III[4]

3. Terminology

3.1 *Definitions:* See Terminology F 141 for definitions of the terms, above-grade (suspended), below-grade, concrete, on-grade, and resilient flooring.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *moisture vapor emission rate (MVER)*—amount of water vapor in pounds emitted from a 1000 ft^2 area of concrete flooring during a 24-h period (multiply by 56.51 to convert to $\mu g/s\ m^2$).

4. Significance and Use

4.1 Use this test method to obtain a quantitative value indicating the rate of moisture vapor emission from a concrete floor and whether or not that floor is acceptable to receive resilient floor covering. The moisture vapor emission rate only reflects the condition of the concrete floor at the time of the test. All concrete subfloors emit some amount of moisture in vapor form. Concrete moisture emission is a natural process driven by environmental conditions. All floor coverings are susceptible to failure from excessive moisture vapor emissions. The moisture vapor emitted from a concrete slab is measured in pounds. This measurement is the equivalent weight of water evaporating from 1000 ft^2 of concrete surface in a 24–h period. The calcium chloride moisture test has been the industry standard for making this determination and is a practical, well-established and accepted test of dynamic moisture. It will produce quantified results directly applicable to flooring manufacturer's specifications. The results obtained reflect only the condition of the concrete floor at that time.

5. Apparatus

5.1 *Test Unit Contents*:

5.1.1 *Cylindrical Plastic Dish Containing Anhydrous Calcium Chloride*, tape sealed against moisture, or heat sealed in a heat sealable bag meeting Mil Spec B-131H Type 1, Class III, or both, to protect from moisture intrusion.

5.1.1.1 The weight of the container, the anhydrous calcium chloride and the tape seal shall be 1.06 oz (30 g) ± 10 %.

5.1.2 *Pressure Sensitive Label*, to be used to identify the container of calcium chloride and to record the date, time, and container weight when the test is started and completed.

5.1.3 *Transparent Cover*, with 0.5 in. (12 mm) flanges around the perimeter, approximately 0.5 ft^2 (460 ± 46 cm^2), as measured between the inside of the flanges, is required to seal the test area of the floor. The plastic cover shall have a 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.

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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 Resilient Floor Covering Institute, 966 Hungerford Drive, Suite 12-B, Rockville, MD 20850.

[4] Available from Standardization Documents Order Desk, Bldg. 4 Section D, 700 Robbins Ave., Philadelphia, PA 19111-5094, Attn: NPODS.

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greater than the height of the container of anhydrous calcium chloride. The height of the container shall be 1½ in. ± 0.125 (38 ± 3.2 mm).

5.1.4 *Strip of Sealant*, to secure the plastic cover to the floor in an airtight fashion.

5.1.5 *Brightly Colored Warning Label*, to be placed on the plastic cover as a protective warning while the test is being conducted.

5.1.6 *Mailing Bag*, for the return of the return of the sample to the party responsible for calculating the test results.

5.2 *Gram Scale*, capable of measuring 0.1 g. This scale will be used to weigh the calcium chloride container at the start and end of the test. On-site measurement is preferred to mailing the container back to the supplier for results.

5.3 *Thermometer*, capable of measuring room temperature.

5.4 *Hygrometer*, capable of measuring the relative humidity of the test site.

6. Conditioning

6.1 The test site should be at the same temperature and humidity expected during normal use. If this is not possible, then the test conditions should be 75 ± 10°F (23.9 ± 5.5°C) and 50 ± 10 % relative humidity. Maintain these conditions 48 h prior to, and during testing.

6.2 Prior to placement of the anhydrous calcium chloride tests, the actual test area shall be clean and free of all foreign substances. All residual adhesives, curing compounds, sealers, paints, floor coverings, etc. shall be removed. Removal shall be accomplished using approved OSHA work practices. For removal of existing resilient floorings or residual adhesive, strictly observe the Warning that follows and Notes 1 and 2. (**Warning**—Do not sand, dry sweep, dry scrape, drill, saw, beadblast, or mechanically chip or pulverize existing resilient flooring, backing, lining felt, or asphaltic cut-back adhesives. These products may contain either 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 contains non-asbestos material, presume it contains asbestos. Regulations may require that the material be tested to determine asbestos content. RFCI's recommended work practices are a defined set of instructions addressed to the task of removing all resilient floor covering structures whether or not they contain asbestos. When RFCI's recommended work practices are followed, resilient floor covering structures that contain (or are presumed to contain) asbestos can be removed in a manner that will comply with the current occupational exposure to asbestos standard's permissible exposure limits (PEL) issued by the Occupational Safety and Health Administrations (OSHA).

NOTE 1—Various federal, state, and local government agencies have regulations covering the removal of asbestos-containing material. If considering the removal of resilient floor covering or asphaltic cut-back adhesive that contains or is presumed to contain asbestos, review and comply with the applicable regulations.

NOTE 2—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 "Lead-based Paint: Interim Guidelines for Hazard Identification and Abatement in Public and Indian Housing"[5] regarding: (*1*) appropriate methods for identifying lead-based paint and removing of such paint, and (*2*) any licensing, certification, and training requirements for persons performing lead abatement work. (Use only qualified of certified lead abatement contractors to remove lead-based paint.)

7. Procedure

7.1 Expose a minimum area of 20 by 20 in. (50.8 by 50.8 cm) to conditions specified in 6.1 and 6.2 for a minimum period of 24 h prior to starting each test. Weigh the container of anhydrous calcium chloride, including the tape used to seal the container, the container lid, and the label which should be affixed to the lid. Record the weight to the nearest 0.1 g on the container label along with the starting time to the nearest ± ¼ h.

7.1.1 If not provided by the $CaCl_2$ test kit manufacturer, obtain the actual area of the test site. Measure the length and width of the plastic cover between the inside of the flanges, and multiply to obtain the area. Measure the bottom of the dish containing the $CaCl_2$ to obtain the radius. To calculate the area of the dish, use the following equation:

$$A = \pi r^2 \quad (1)$$

where:

π = 3.14

Deduct the area of the dish from the area of the plastic covering. Record this as the actual test area. This will be used to make the final calculation at the end of the test.

7.2 Apply the sealant to the flanges of the plastic cover in a continuous bead. If the sealant has been preinstalled by the kit manufacturer, expose by peeling off the protective covering. The purpose of the sealant is to form an airtight seal around the perimeter of the plastic cover.

7.3 Carefully remove the sealing tape from the calcium chloride dish and attach it to the side of the plastic container. This tape will be used again to reseal the same container. Remove the container lid and invert it under the dish. Set the dish (and lid) onto the concrete surface. (**Warning**—Do not spill any of the calcium chloride from the container. If spillage occurs that test kit is to be discarded requiring test to be performed with a new test kit.

Immediately place the plastic cover over the calcium chloride dish. Firmly press down on the cover's flanges compressing the sealant providing an airtight seal around the cover.

7.4 After test has been in place for 60-72 h, remove the plastic cover. It may be best to cut the top open with a razor blade so the dish can be easily retrieved. Replace the lid on the container and immediately reseal using the original sealing tape. Immediately reweigh the sealed container. Record the new weight, the date, and time the test was stopped. Record if performed at the test site.

NOTE 3—If test container is to be return-mailed for results, immediately place in mailing bag ensuring bag is properly sealed. Follow mailing instructions provided with kit.

[5] Available from U.S. Department of Housing and Urban Development, Washington, DC. Use September 1990 or subsequent editions.

7.5 The formula for computing moisture vapor emission rate (MVER) is as follows:

$$\text{MVER} = \frac{24\ 000 \cdot \Delta M}{453.612 \cdot A \cdot T} = \frac{52.91 \cdot \Delta M}{A \cdot T} \quad (2)$$

where:

MVER = moisture vapor emission rate, lb/1000 ft^2/24 h,
ΔM = change in mass (weight gain) of anhydrous $CaCl_2$ in g,
A = contact area of the flanged cover on concrete in ft^2 deducting the area of the $CaCl_2$ dish, and
T = exposure time in hours.

7.6 To convert test results to SI, multiply by 56.51 to obtain results in μg/(s m^2).

7.7 Use the following guidelines to determine the number of test locations to be utilized simultaneously.

7.7.1 Three test locations for areas up to 1000 ft^2(100 m^2).

7.7.2 Add one additional test for each 1000 ft^2(100 m^2) or fraction thereof.

NOTE 4—When conducting moisture emission tests, the test units should not be concentrated but shall be located in various parts of the floor area. One unit shall be placed near the center with others being placed around perimeter. Selection of test sites shall include areas of potential moisture, that is, joints and perimeter of building.

8. Precision and Bias

8.1 The single-operator, within-laboratory precision of Test Method F 1869 was determined using at least 30 commercially-available test kits that conform to F 1869. The data used to develop this precision statement were obtained using the inch-pound version of this test method. The figures given in the second column are the standard deviations that have been found to be appropriate for the materials and conditions of test described in the first column. The figures in the third column are the limits that should not be exceeded by the difference between the results of two properly conducted tests.

Normal weight concrete MVER, lb/1000 ft^2/24 h	Standard Deviation[A]	Acceptable Range of Two Results[A]
7.9	1.0	2.8
3.3	0.3	0.8
Lightweight concrete MVER, lb/1000 ft^2/24 h	**Standard Deviation[A]**	**Acceptable Range of Two Results[A]**
10.2	0.9	2.5
4.1	0.3	0.8

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

8.2 No information can be presented on the bias of the procedure in Test Method F 1869 for measuring moisture vapor emission rates from concrete because no material having an accepted reference value is available.

9. Keywords

9.1 anhydrous calcium chloride; moisture vapor emission rate; quantitative calcium chloride; resilient flooring; RMA referee test

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