Designation: F2199 – 09 (Reapproved 2014)

Standard Test Method for Determining Dimensional Stability of Resilient Floor Tile after Exposure to Heat[1]

This standard is issued under the fixed designation F2199; 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 determination of the change in linear dimensions of resilient floor tile after exposure to heat.

1.2 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.

1.3 *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.*

2. Referenced Documents

2.1 *ASTM Standards:*[2]

E177 Practice for Use of the Terms Precision and Bias in ASTM Test Methods

E691 Practice for Conducting an Interlaboratory Study to Determine the Precision of a Test Method

F141 Terminology Relating to Resilient Floor Coverings

F2055 Test Method for Size and Squareness of Resilient Floor Tile by Dial Gage Method

3. Terminology

3.1 Definitions are in accordance with Terminology F141 unless otherwise indicated.

4. Significance and Use

4.1 The final appearance of an installed tile floor depends upon several factors. These include but are not limited to size and squareness of the tile, the quality of joint cut, the quality and preparation of the subfloor and the skill of the installer. Long term appearance of the installed floor is also dependent on but not limited to the ability of the tile to resist shrinkage due to internal stress relief. This test method is used to measure the ability of floor tile to retain its original dimensions following exposure to heat simulating a long service life at reasonable and expected temperatures.

5. Apparatus

5.1 *Mechanical Convection-Type Oven, or equivalent,* capable of maintaining a temperature of 180 ± 3.6°F (82 ± 2°C), with inside dimensions large enough to hold several tiles horizontally on aluminum exposure plates.

5.2 *Specimen Exposure Plates,* consisting of flat 14–gage, 0.0625–in. (1.6–mm), thick aluminum. The aluminum exposure plates may be contained in a rack, either fixed in or removable from the rack, and should be at least 1 in. (25.4 mm) larger in each linear dimension than the linear dimension of the specimen tested. If contained in a rack, the spacing between each plate should be at least 0.625–in. (16–mm). The rack shall be constructed with all four sides open.

5.3 *Block and Dial Gage Assembly,* as described in Test Method F2055.

5.4 *Forced Air Cooling (Fan, Blower, etc.),* may be used for accelerating specimen conditioning before heating and after cooling exposure to ensure proper equilibrium of test specimen (see 6.1 and 7.1).

6. Test Specimen

6.1 The test specimen consists of a resilient floor tile. Typical floor tile dimensions are 9 by 9 in. (229 by 229 mm) or 12 by 12 in. (305 by 305 mm). Other sizes in square or rectangular dimensions may also be tested.

7. Conditioning

7.1 A conditioned room maintained at a temperature of 73.4 ± 1.8°F (23 ± 1°C) and 50 ± 5 % relative humidity.

8. Procedure

8.1 *Reference Plates*—Different tile sizes, with respective reference plates, can be specified if the size and squareness apparatus is designed to handle the testing and measurement of alternate sizes.

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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 F06.30 on Test Methods - Performance.

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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.

8.2 *Conditioning Before Exposure*—Condition the specimens at 73.4 ± 1.8°F (23 ± 1°C) and 50 ± 5 % relative humidity for not less than 24 h prior to starting the test unless otherwise specified.

8.3 *Conditions for Measurement*—Measure the tile specimen (6.1) in the conditioning room (7.1).

8.4 *Calibration of Block and Dial Gage Indicators*—Calibrate the block and dial gage indicators as indicated in Test Method F2055.

8.5 *Initial Measurement*—Place the tile specimen, after conditioning (8.2), on the block and dial gage assembly (5.3) face up and measure in the machine direction (MD), if identifiable, and the across machine direction (AMD), if identifiable, according to the procedure in Test Method F2055. These points shall be marked as a reference on the tile so that the final measurements will be made at the same exact locations. Measure the tile according to Test Method F2055 and eliminating the squareness measurement step.

8.6 *Exposure*—Place the tile specimen face up in the exposure rack (5.2) on the aluminum exposure plates. Position the plates on racks in the heated cabinet (5.1) at 180 ± 3.6°F (82 ± 2°C) for 6 ± 0.25 h. Expose the four open sides of the rack to the direction of the airflow within the cabinet so that the circulating air passes freely over the tile specimens.

8.7 *Conditioning after Exposure*—Remove the tile/plate assembly from the oven cabinet (5.1). Allow the assembly to condition at room temperature (7.1) for at least 24 h. Wear gloves when handling the hot aluminum plate.

8.8 *Final Measurements*—Determine the dimensional stability by measuring the change in tile size before and after the heat exposure for both the MD and AMD at the reference locations. Remove the tile from the aluminum plate after re-conditioning and re-measure on the block and dial gage assembly (5.3) according to 8.5. Make the measurements at the same reference points as the initial measurements.

NOTE 1—Squareness measurements are not to be taken or recorded since they are not directly considered in the dimensional stability determination.

9. Calculations

9.1 The final MD average measurements are subtracted from initial MD average measurements. The dimensional stability is recorded and reported in inches (0.001 in.) A negative value indicates shrinkage, and a positive value indicates expansion.

9.2 The final AMD average measurements are subtracted from initial AMD average measurements. The dimensional stability is recorded and reported in inches (0.001 in.) A negative value indicates shrinkage, and a positive value indicates expansion.

9.3 The MD and AMD dimensional stability results are calculated, recorded, and reported as individual measurements on an applicable characteristic chart or report form. The calculated linear dimensional change may also be represented as a percentage change as follows:

$$\text{Linear Change } \% = \left[\frac{(D_f - D_i)}{D_i}\right] \times 100 \quad (1)$$

where:

D_f = the average final length, and
D_i = the average initial length.

10. Precautions

10.1 While no supporting data exist, it is important that the aluminum exposure plates for supporting the specimen be kept smooth and polished so that surface friction does not interfere with free shrinkage or growth of the specimens. The plates must be flat and free of convex or concave warp.

10.2 For any type of block and dial gage, care must be taken so that the tile is properly seated against the base horizontal index guide when a specific measurement is being taken. Tile with concave or convex edges can easily be read incorrectly.

10.3 The zero setting of the multiple dial indicators should be checked prior to, during use (if a large quantity of specimens are to be tested), and at the conclusion of the test (see 8.4).

10.4 All foreign matter or loose particles must be removed from the edges of the tile and from the angle between the block base and the horizontal index guide prior to making measurements. A simple brush-off by hand of each edge is usually sufficient.

10.5 Each dial gage foot must be flat, no rounded or worn surfaces.

10.6 When making measurements, care must be taken so as not to apply undue pressure and distort the tile.

10.7 Check horizontal index guide for abrasive wear.

10.8 The three reference points for measurement (MD and AMD) shall be marked on the face of the tile and measured with the face-up on the block and dial gage assembly to ensure that any embossing along the edge of the tile wear surface will not affect the measurements.

10.9 Check that the tile specimen is placed face-up on the aluminum exposure plate.

10.10 Make sure that the dial gage foot is at the same reference points for both the initial and final measurements. The tile must be held flat. A domed or curled tile could be confused with dimensional change.

10.11 Prior to specimen exposure, it is important that the oven cabinet (5.1) be checked to be certain that it is controlling at 180 ± 3.6°F (82 ± 2°C).

10.12 After exposure, do not remove the tile from the aluminum plate until the reconditioning time elapses (see 6.1).

11. Precision and Bias[3]

11.1 The precision was determined by inter-laboratory round robin testing according to Practices E177 and E691 and is listed in 11.2 for machine direction measurements and in 11.3 for across machine direction measurements.

[3] A research report is available from ASTM International Headquarters. Request RR:F06-1007.

11.2 *Precision Statement for Machine Direction Dimensional Stability:*

11.2.1 *Requirements for Determining Precision of Test Method: Analysis*—The number of laboratories, materials, and determinations in this study does meet the minimum requirements for determining precision prescribed in Practice E691:

	This Study	ASTM E691 Minimum
Laboratories	6	6
Materials	5	4
Determinations	12	2

11.2.2 *Precision Statement for Test Method: Analysis*—Precision, characterized by repeatability, *Sr*, *r*, and reproducibility, *SR*, *R* has been determined for the materials to be:

Materials	Average	*Sr*	*SR*	*r*	*R*
Material A	-0.0034583	0.0052579	0.0052579	0.0147220	0.0147220
Material B	-0.0051181	0.0041771	0.0057826	0.0116958	0.0161913
Material C	0.0015764	0.0020731	0.0026663	0.0058046	0.0074657
Material D	-0.0023333	0.0029237	0.0384626	0.0081863	0.1076954
Material E	-0.0040972	0.0029009	0.0033733	0.0081226	0.0094452

11.3 *Precision Statement for Across Machine Direction Dimensional Stability:*

11.3.1 *Requirements for Determining Precision of Test Method: Analysis*—The number of laboratories, materials, and determinations in this study does meet the minimum requirements for determining precision prescribed in Practice E691:

	This Study	ASTM E691 Minimum
Laboratories	6	6
Materials	5	4
Determinations	12	2

11.3.2 *Precision Statement for Test Method: Analysis*—Precision, characterized by repeatability, *Sr*, *r*, and reproducibility, *SR*, *R* has been determined for the materials to be:

Materials	Average	*Sr*	*SR*	*r*	*R*
Material A	0.004979	0.003809	0.003970	0.010665	0.011116
Material B	-0.003299	0.005647	0.007118	0.015811	0.019931
Material C	0.003000	0.002077	0.002271	0.005817	0.006360
Material D	-0.002049	0.01907	0.034792	0.053396	0.097418
Material E	-0.005146	0.002418	0.003577	0.006771	0.010017

average = the numerical average of test results for all replicates from all laboratories,

Sr = the within-laboratory standard deviation of the average, and

R = 2.83*SR*.

11.4 *Repeatability (Sr, r)*—In comparing two average values for the same material obtained by the same operator using the same equipment on the same day, the means should be judged not equivalent if they differ by more than the *r* value for that material and condition.

11.5 *Reproducibility (SR, R)*—In comparing two average values for the same material obtained by different operators using different equipment on different days, the means should be judged not equivalent if they differ by more than the *R* value for that material and condition. (This applies between different laboratories or between different equipment within the same laboratory).

11.6 The previous judgments will have an approximate 0.95 (95 %) probability of being correct. Other materials would be expected to give somewhat different results. For further information on the methodology used in this section or for further clarification please refer to Practice E691.

11.7 *Bias*—No information can be presented on the bias of the test method procedure because material having an accepted reference value is unavailable.

12. Keywords

12.1 dimensional stability; resilient flooring; tile