INTERNATIONAL

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Standard Test Method for Wear Layer Thickness of Resilient Floor Coverings by Optical Measurement[1]

This standard is issued under the fixed designation F 410; 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.

This standard has been approved for use by agencies of the Department of Defense.

1. Scope

1.1 This test method covers the determination of the thickness of the wear layer of resilient non-textile floor coverings, in tile or sheet form, with or without felt backing or foam layer, by optical measurement.

1.2 This test method is applicable for wear layers with a minimum thickness of 0.0004 in. (0.01 mm) to a maximum thickness of 0.1 in. (2.54 mm), where measurements within 0.0001 in. or 0.0025 mm are tolerable.

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]

E 691 Practice for Conducting an Interlaboratory Study to Determine the Precision of a Test Method

3. Significance and Use

3.1 This test method is applicable for wear layers with a minimum thickness of 0.001 in. (0.02 mm) to a maximum thickness of 0.1 in. (2.54 mm), where measurements within 0.0005 in. or 0.01 mm are tolerable.

4. Apparatus

4.1 *Compound Microscope*, having a magnification of at least 40×, equipped with an eyepiece micrometer of the ruled disk or filar type. The scale shall cover approximately 0.1 in. (2.54 mm) and each division shall be equal to approximately 0.0004 in. (0.01 mm) at the object. Either a binocular or standard microscope may be used.

4.2 *Vertical Illuminator* (recommended), to illuminate the specimen. If another source is used, the light should fall on the specimen from as nearly vertical direction as possible.

4.3 *Stage Micrometer*~~, for calibrating the eyepiece micrometer. The scale shall have the smallest division equal to 0.0004 in. (0.01 mm) and shall cover at least 0.1 in. (2.54 mm).~~ , for calibrating the eyepiece micrometer. The scale shall have the smallest division equal to 0.0004 in. (0.01 mm) and shall cover at least 0.1 in. (2.54 mm). The reference standard used for calibration shall be traceable to a National Standard.

4.4 *Holder*—A means for holding the specimen, without distortion, so that the cut edge is perpendicular to the optical axis of the microscope.

4.5 *Sharp Knife*, or razor blade in a holder, for cutting the specimen.

4.6 *Cutting Board* of plastic, hardboard or fine-grained hardwood.

4.7 *Straightedge*, for guiding the cutting edge.

5. Test Specimen

5.1 The specimen shall be cut from a properly selected sample, representing the area to be measured. It shall be approximately

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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 F06.20 on Test Methods - Products Construction/Materials.

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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* ~~, Vol 14.02.~~volume information, refer to the standard's Document Summary page on the ASTM website.

2 in. (50 mm) long on the edge to be measured by about 0.5 in. (13 mm) in width.

6. Procedure

6.1 *Preparation of Specimen*—Place the sample on the cutting board with the face side up. Hold the cutting instrument so that the plane of the blade is perpendicular to the face of the sample. The cutting edge of the blade should be at an angle to the horizontal that produces a clean cut. It is essential that the cut is perpendicular to the face of the sample. Apply sufficient pressure so that a clean cut can be made completely through the sample in one stroke, being careful not to distort the sample or turn the knife from the perpendicular. The cut should be straight, and at least 2 in. (50 mm) long. Make a similar cut parallel to the first cut, about 0.5 in. (13 mm) apart. Cut each end, so the specimen can be removed from the sample.

6.2 *Thickness Measurement*:

6.2.1 Mount the specimen with the long edge up, the cut surface perpendicular to the optical axis of the microscope (see Appendix X1).

6.2.2 *Calibration*—Calibrate the eyepiece micrometer against the stage micrometer, and record the calibration factor. If a variable magnification (zoom) instrument, or one with adjustable tube length is used, be sure that these adjustments are not disturbed between calibration and measurement of the sample.

6.2.3 *Measurement with Ocular Micrometer*— Locate the specimen under the microscope and adjust the light source. Focus the microscope so that both edges of the wear layer are sharp. If this cannot be done, remount or recut the specimen. Measure the thickness by counting the rulings or the divisions on the ruled disk in the eyepiece that cover the distance from one edge of the wear layer to the other, and by applying the appropriate calibration factor. Then record this distance to the nearest 0.0001 in. or 0.0025 mm. Take three readings in the areas selected, at least 0.5 in. (13 mm) apart.

7. Report

7.1 Average the values of the readings from the specimen to the nearest 0.0001 in. (0.0025 mm) and record as the average thickness of the wear layer. Also report minimum and maximum readings to the nearest 0.0001 in. (0.0025 mm).

8. Precision and Bias

8.1 *Precision*—Optical thickness measured in mils (for example, a numerical value of 18 equals 0.018 in.). Precision (characterized by repeatability, Sr, r, and reproducibility, SR, R) has been determined in Table 1 for the materials.

8.1.1 This study, which used 6 laboratories, 5 materials, and 25 determinations per material, meets the minimum requirements for determining precision prescribed in Practice E 691.[3]

8.1.2 *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* (statistically different) if they vary by more then the r value for that material and condition. If the difference between the means is less than the r value for that material and condition, the averages should be considered statistically equivalent.

8.1.3 *Reproducibility (SR, R)*—In comparing two average values of the same material obtained by different operators, using different equipment, on different days, the means should be judged *not equivalent* (statistically different) if they vary by more than the R value for that material and condition. If the difference between the means is less than the R value for that material and condition, the averages should be considered statistically equivalent. (This applies between different laboratories or between different equipment within the same laboratory.)

8.1.4 The judgments in 8.1.2 and 8.1.3 will have an approximate 0.95 (95 %) probability of being correct. Other materials will give somewhat different results. For further information on the methodology used in this section or the explanations given, consult Practice E 691.

8.2 *Material Identification*:

[3] Supporting data have been filed at ASTM International Headquarters and may be obtained by requesting Research Report: RR F06–1006.

TABLE 1 Precision

Materials	Average[A]	Sr[B]	SR[C]	r[D]	R[E]
Material A	18.2147	0.5340	1.0808	1.4952	3.0261
Material B	19.5567	1.2854	1.3938	3.5992	3.9028
Material C	33.8173	0.5305	0.9218	1.4855	2.5811
Material D	10.7353	0.3833	0.3992	1.0734	1.1176
Material E	21.0273	0.7411	1.306	2.0750	2.8858

[A] Average is the arithmetic mean of optical thickness measurements for all replicates from all laboratories of each material.
[B] Sr is the within-laboratory standard deviation of the average.
[C] SR is the between-laboratory standard deviation of the average.
[D] r = 2.83 Sr.
[E] R = 2.83 SR.