



Standard Test Method for Measurement of Thickness of Coatings Over Fabric Reinforcement¹

This standard is issued under the fixed designation D7635/D7635M; 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 measuring the thickness of the coating over fiber backing or reinforcing fabric.

1.2 The values stated in either SI units or inch-pound units are to be regarded separately as standard. The values stated in each system may not be exact equivalents; therefore, each system shall be used independently of the other. Combining values from the two systems may result in non-conformance with the standard.

1.3 This standard may involve hazardous materials, operations, and equipment. *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

D4434 Specification for Poly(Vinyl Chloride) Sheet Roofing

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

MEASUREMENT METHOD

3. Principle

3.1 The thickness of coating material over fiber, fabric, or scrim can be measured with a standard or digital optical or reflectance microscope. Measurement is made with a calibrated viewing device.

¹ This test method is under the jurisdiction of ASTM Committee D08 on Roofing and Waterproofing and is the direct responsibility of Subcommittee D08.18 on Nonbituminous Organic Roof Coverings.

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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.

4. Apparatus

4.1 *Microscope*, 30 to 100 $\times$ magnification capability.

4.1.1 *Light Source*—If the light source on the microscope is not adequate, use a small high-intensity lamp.

4.1.2 *Stage Micrometer*, 25 μm [0.001 in.] divisions.

4.2 *Calibrated Viewing Device*—A digital or analog device designed to provide an enlarged electronic image with calibrations to provide measurements.

5. Calibration Procedure

5.1 Place a standard reflectance stage micrometer or calibrated sample blocks in place of the specimen.

5.2 Turn on the light source.

5.3 Position the viewing device (calibrated reticule or camera) such that the scales are superimposed. For electronic imaging, place the calibrated scale marker on the microscope stage. Focus the viewing device on the specimen.

5.4 Calibrate using micrometer or calibrated sample blocks to nearest 10 μm .

5.5 If using digital image for calibration step, record resolution and magnification of calibration image.

6. Specimen Preparation

6.1 Make a clean cut perpendicular to the plane of the specimen, normal to one of the thread intersections, completely through the sheet exposing the area to be measured (see Fig. 1).

6.2 Remove the razor-cut section and mount with the cut surface (analytical plane) facing downward into a sample clip. Secure sample clip in 3.175-cm [1.25-in.] sample cup with cap. Use a piece of double-sided tape to securely attach clip to the cap part of the cup. Record sample orientation and position within cup. Multiclips can be used for mounting multiple samples per mount. Assure all that all samples are oriented normal to the plane of the sample cup cap.

6.3 Mixed long-cure epoxy at a ratio of 6.3 parts resin to one part hardener, per volume. A 3.175-cm [1.25-in.] mount requires 19 ml of epoxy.

6.4 The mounts are allowed to cure for at least 24 h at ambient temperature and humidity.

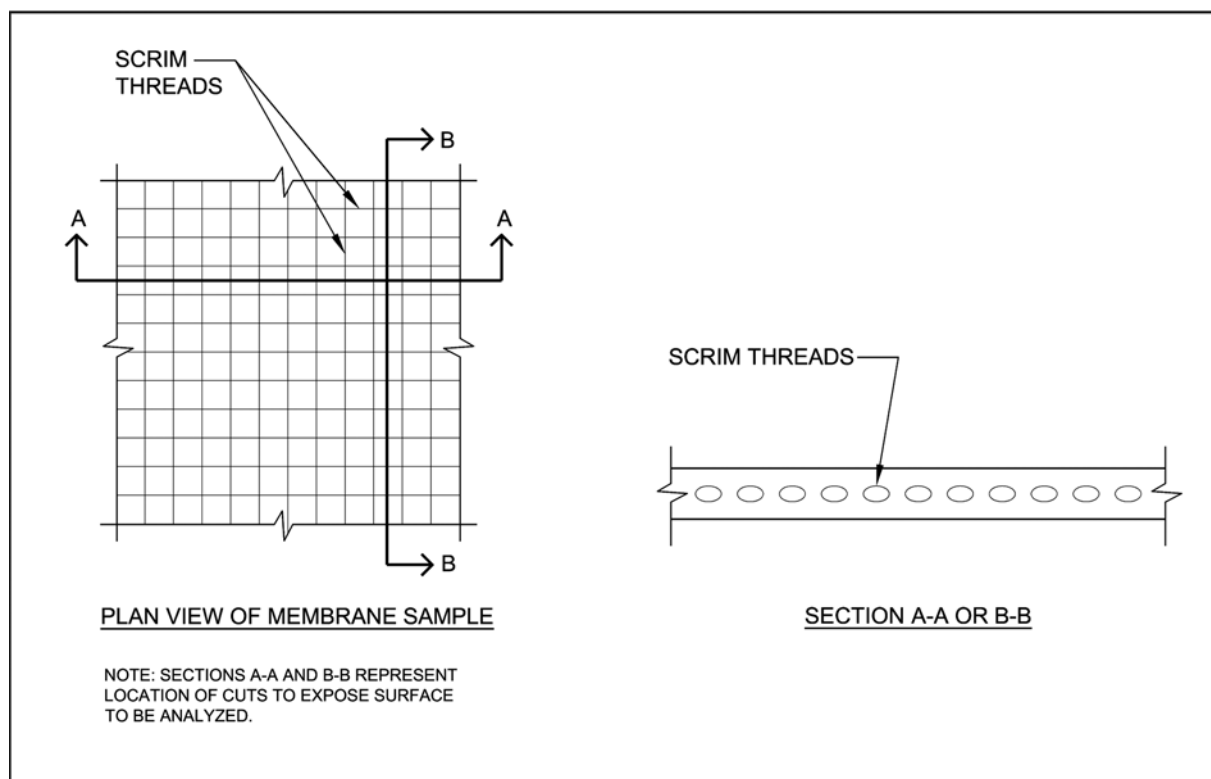


FIG. 1 Schematic of Preparation Illustrating Cuts Normal to Scrim Directions

6.5 After curing (24 hours), polish using the procedure exhibited in Table 1. Clean and dry mounts after each step to insure that all lubricant and polishing compound are removed to prevent contamination in subsequent polishing steps.

7. Specimen Analysis

7.1 During analyses use the same image resolution and magnification used for calibration.

7.2 Observe the cut surface. Measure the thickness of the coating over three of the Machine direction threads, and three of the cross-machine direction threads (ignore tie yarn scrim if present) (see Fig. 2 and Fig. 3).

7.3 Average all the results.

7.4 If using electronic imaging technology, save all of the image files generated for archiving.

8. Calculation and Report

8.1 Report the average results from all areas measured as statistically representative of overall film thickness of the film

to the nearest 10 μm [0.0005 in.] and the estimated or calculated standard deviation.

9. Precision and Bias

9.1 *Precision Statement*—The precision of this specification is based on an interlaboratory study (ILS) of D4434-06, Standard Specification for Poly (Vinyl Chloride) Sheet Roofing, conducted in 2008 and submitted under number ILS-351. Analysts from six laboratories tested three different coatings under four different conditions. Every “test result” represents an individual determination. Each laboratory was asked to report five replicate measurements for each material. Except for the use of data from only five laboratories, Practice E691 was followed for the design and analysis of the data; the details are given in ASTM Research Report No. D08-1014.³

³ Supporting data have been filed at ASTM International Headquarters and may be obtained by requesting Research Report RR:D08-1014.

TABLE 1 Recommended Metallographic Polishing Procedure

Grinding	Lubricant	Time Min:Sec	Pressure KPa [psi]	Wheel Speed RPM	Material Removed (approximate) mm [mils]	
320 Grit	Water	0:30	241.2 [35]	300	0.7	[28]
400 Grit	Water	0:30	241.2 [35]	300	0.5	[19]
600 Grit	Water	0:30	241.2 [35]	300	0.25	[10]
800 Grit	Water	0:30	241.2 [35]	300	0.13	[5]
6 μm diamond/cloth	Oil	3:00	241.2 [35]	200	0.025	[1]
3 μm diamond/cloth	Oil	3:00	241.2 [35]	200	0.013	[0.5]
0.05 μm colloidal Si/cloth	—	1:30	206.84 [30]	150	0.003	[0.1]

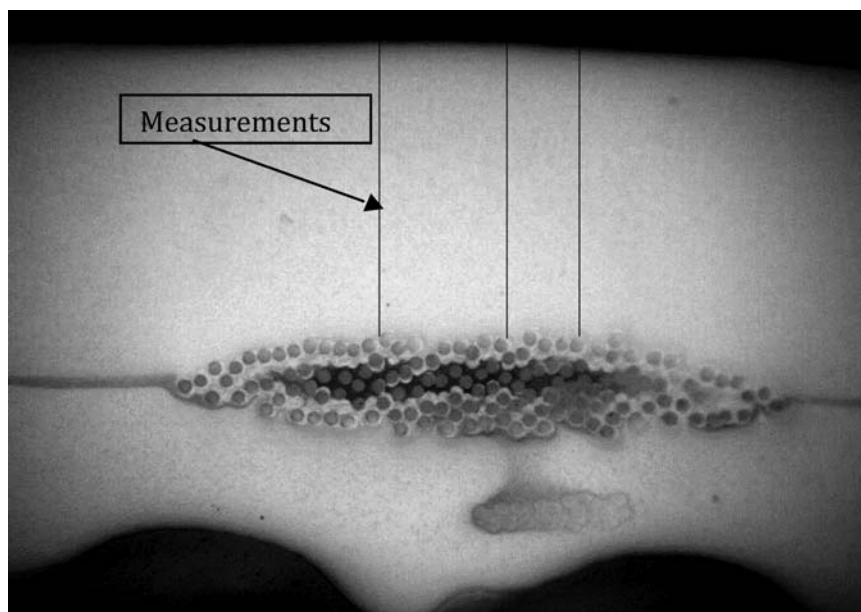


FIG. 2 Representative Area Over Cross Machine Direction Thread

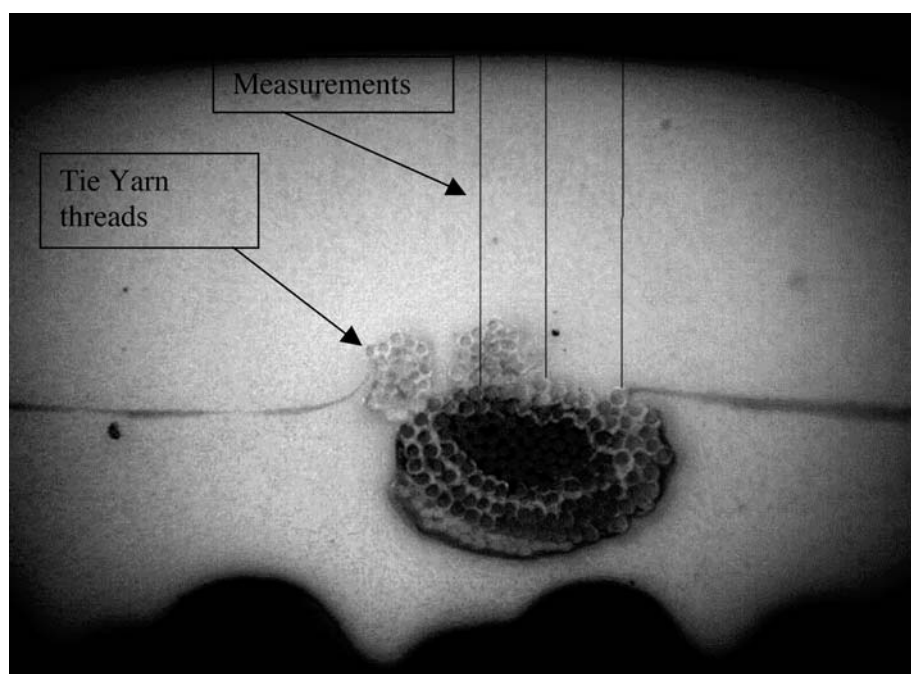


FIG. 3 Representative Area Over Machine Direction Thread

NOTE—Weft yarns are indicated and excluded from measurement because of their insignificant area of film coverage relative to the major scrim threads.

9.1.1 *Repeatability Limit (r)*—Two test results obtained within one laboratory shall be judged not equivalent if they differ by more than the “ r ” value for that material; “ r ” is the interval representing the critical difference between two test results for the same material, obtained by the same operator using the same equipment on the same day in the same laboratory.

9.1.1.1 Repeatability limits are listed in Table 2 and Table 3 below.

9.1.2 *Reproducibility Limit (R)*—Two test results shall be judged not equivalent if they differ by more than the “ R ” value for that material; “ R ” is the interval representing the critical difference between two test results for the same material, obtained by different operators using different equipment in different laboratories.

9.1.2.1 Reproducibility limits from ILS 351 are listed in Table 2 and Table 3 below.

TABLE 2 Machine Direction (mm [mils])

NOTE—Actual measurements conducted using mils.

Top Film	Average ^A	Repeatability Standard Deviation	Reproducibility Standard Deviation	Repeatability Limit	Reproducibility Limit
	Average Thickness	S_r	S_R	r	R
07-007	0.6343 [24.974]	0.0132 [0.517]	0.0142 [0.560]	0.0368 [1.445]	0.0399 [1.570]
07-010	0.6196 [24.395]	0.0078 [0.308]	0.0146 [0.576]	0.0219 [0.863]	0.0410 [1.6138]
07-016	0.6265 [24.666]	0.0160 [0.628]	0.0160 [0.628]	0.0447 [1.759]	0.0447 [1.759]

^A The average of the laboratories' calculated averages.

TABLE 3 Cross-Machine Direction (mm [mils])

NOTE—Actual measurements conducted using mils.

Top Film	Average ^A	Repeatability Standard Deviation	Reproducibility Standard Deviation	Repeatability Limit	Reproducibility Limit
	Average Thickness	S_r	S_R	r	R
07-007	0.6009 [23.656]	0.0151 [0.593]	0.0152 [0.598]	0.0422 [1.660]	0.0425 [1.675]
07-010	0.5968 [23.498]	0.0077 [0.303]	0.0079 [0.312]	0.0216 [0.849]	0.0222 [0.874]
07-016	0.6002 [23.628]	0.0095 [0.373]	0.0122 [0.479]	0.0265 [1.045]	0.0340 [1.340]

^A The average of the laboratories' calculated averages.

9.1.3 The above terms (repeatability limit and reproducibility limit) are used as specified in Practice E177.

9.1.4 Any judgment in accordance with statement 9.1.2 would normally have an approximate 95 % probability of being correct, however the precision statistics obtained in this ILS must not be treated as exact mathematical quantities which are applicable to all circumstances and uses. The limited number of materials tested and laboratories reporting results guarantees that there will be times when differences greater than predicted by the ILS results will arise, sometimes with considerably greater or smaller frequency than the 95 % probability limit would imply. Consider the reproducibility limit as general guides, and the associated probability of 95 % as only a rough indicator of what can be expected.

9.2 *Bias*—The bias statement of this test method is based on an interlaboratory study of D4434, Standard Specification for Poly (Vinyl Chloride) Sheet Roofing, conducted in 2009, submitted under ILS 511. Five laboratories participated in this study. Each of the five labs reported a single test result for four different certified reference materials. Every “test result” reported represents an individual determination. Except for the use of only five laboratories, and the absence of replicate data,

Practice E691 was followed for the design and analysis of the data; the details are given in ASTM Research Report No. D08-1015.⁴ The bias reported for each material in Table 4 is based on the average difference from the known or certified value as reported by Defelsko Corporation, Certificate Number 08-127081. Date of Calibration, December 12, 2008.

9.3 The bias statement was determined through statistical examination of 20 results, from five laboratories, on four materials.

A. White:	0.9845 mm [38.76 mils]	(S/N 011710)
B. Yellow:	0.5014 mm [19.74 mils]	(S/N 011709)
C. Brown:	0.2578 mm [10.15 mils]	(S/N 011708)
D. Blue:	0.1283 mm [5.05 mils]	(S/N 011707)

9.3.1 To judge the equivalency of two test results, it is recommended to choose the material closest in characteristics to the test material.

⁴ Supporting data have been filed at ASTM International Headquarters and may be obtained by requesting Research Report RR:D08-1015.

TABLE 4 Thickness (mm [mils])

NOTE—Actual measurements conducted using mils.

Material	Average ^A	Repeatability Standard Deviation	Reproducibility Standard Deviation	Repeatability Limit	Reproducibility Limit	Bias
	$\bar{x}$	S_r	S_R	r	R	%
A	1.0034 [39.505]	...	0.0225 [0.885]	...	0.0630 [2.479]	1.92 %
B	0.5075 [19.981]	...	0.0119 [0.469]	...	0.0333 [1.312]	0.926
C	0.2557 [10.067]	...	0.00114 [0.045]	...	0.0032 [0.126]	-0.81 %
D	0.1376 [5.416]	...	0.00841 [0.331]	...	0.0235 [0.926]	7.26 %

^A The average of the laboratories' calculated averages.



10. Keywords

10.1 coating; fabric reinforcement; film; optical microcopy; scrim; thickness

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