Designation: D6004 – 21

Standard Test Method for
Determining Adhesive Shear Strength of Resilient Flooring and Carpet Adhesives[1]

1. Scope

1.1 This test method describes a procedure to measure shear strength development for adhesives used to bond resilient flooring and carpet to selected substrates.

1.2 This test method provides a quantitative means of measuring and recording shear strength of the adhesive when it is applied to the desired substrate.

1.3 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.

1.4 *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, health, and environmental practices and determine the applicability of regulatory limitations prior to use.*

1.5 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

2. Referenced Documents

2.1 *ASTM Standards:*[2]
D907 Terminology of Adhesives
D8089 Practice for Accelerated Heat Aging for Floor Covering Adhesives
E4 Practices for Force Verification of Testing Machines
E177 Practice for Use of the Terms Precision and Bias in ASTM Test Methods

2.2 *Voluntary Product Standards:*[3]
PS1 Construction and Industrial Plywood
PS2 Structural Use Panels

3. Terminology

3.1 *Definitions*—Many of the terms in this test method are defined in Terminology D907.

4. Significance and Use

4.1 In selecting or developing a resilient flooring or carpet adhesive, it is critical to have knowledge regarding how well the adhesive will bond to the desired substrate. Shear loading simulates a common failure mode.

4.2 The test method determines the failure shear load for the test adhesive and specific substrate combination.

5. Apparatus

5.1 *Applicator Trowel*—Use trowel notching as recommended by flooring manufacturer or appropriate.

5.2 Three 10-lb (4.54-kg) weight equivalents.

5.3 Three 2 × 3-in. (51 × 76 mm) sections of substrate for dead weight distribution.

5.4 Floor covering seam roller or similar type.

5.5 *Convection Oven,* capable of maintaining a temperature of 122 ± 2°F (50 ± 1°C).

5.6 *Calibrated Universal Testing Machine,* capable of a controlled application of force with a force measurement accuracy of ±1 % when calibrated in compliance with Practices E4 requirements.

6. Materials

6.1 *Adhesive*—Any appropriate adhesive for resilient flooring or carpet installation.

6.2 *Duck Cloth*—Natural, untreated, #10, 14.73 oz.

6.3 *Substrate*—Minimum of ¼-in. (6.35-mm) plywood classified as flooring substrate type warrantied by the manufacturer. Common wood-based products such as PS2 grade mark stamped oriented strand board substrate or PS1 grade mark stamped plywood substrate. Other products, recommended by the adhesive manufacturer may also be used.

6.4 *Flooring Material*—As recommended by manufacturer.

7. Conditioning

7.1 Condition the duck cloth, underlayment and adhesive to be tested for 24 h at 73 ± 3°F (23 ± 2°C) and 50 % ± 5 % relative humidity prior to testing.

8. Sample Preparation

8.1 *Carpet:*

8.1.1 Cut the carpet to be tested into three 2 × 6-in. (51 × 127-mm) pieces.

8.1.2 Cut one section of substrate into a 16 × 5-in. (406 × 127-mm) section.

8.2 *Resilient Flooring:*

8.2.1 Cut substrate into 2 × 7-in. (51 × 177-mm) pieces.

8.2.2 Cut flooring material into 1 × 4-in. (25 × 101-mm) pieces.

9. Procedure

9.1 *Carpet:*

9.1.1 Hold the trowel at a 45° angle and spread sufficient adhesive to cover the bonding areas.

9.1.2 Wait 10 min and place three pieces of carpet specimen perpendicular to the trowel pattern, each covering a 6-in.^{2} or 3 × 2-in. (38.7 cm^2 or 51 × 76 mm) area of the adhesive (Fig. 1).

9.1.3 Place a 2 × 3-in. (51 × 76 mm) substrate section on top of each carpet specimen for dead weight distribution (Fig. 2).

9.1.4 Place a 10-lb weight on each 2 × 3-in. (51 × 76 mm) dead weight distribution substrate section. Follow manufacturer's recommendations for bonding and installation.

9.1.5 Remove the weights and the dead weight substrate sections from the test panel.

9.1.6 Allow the test panel to dry 24 h at 73 ± 3°F (22 ± 1°C) and 50 ± 5 % relative humidity.

9.1.7 Place the test panel in a 122°F (50°C) oven for 72 h.

9.1.8 Remove the test panel from the oven and allow it to cool at 73 ± 3°F (22 ± 1°C) and 50 ± 5 % relative humidity for 3 h.

9.1.9 Test the specimens in tension shear using a calibrated universal testing machine, aligning the upper and lower jaws as perpendicular as possible. Set the test speed at 1 in. (25.4 mm) per minute. The test area will be 6 in.^{2} (38.7 cm^2).

9.1.10 Record the three shear values in pounds-force.

NOTE 1—A flooring roller as described may be used to replace the dead weights as described above; the roller will provide more weight or downward force than what it normally used for carpet installs and may require modification if utilized for carpet alone.

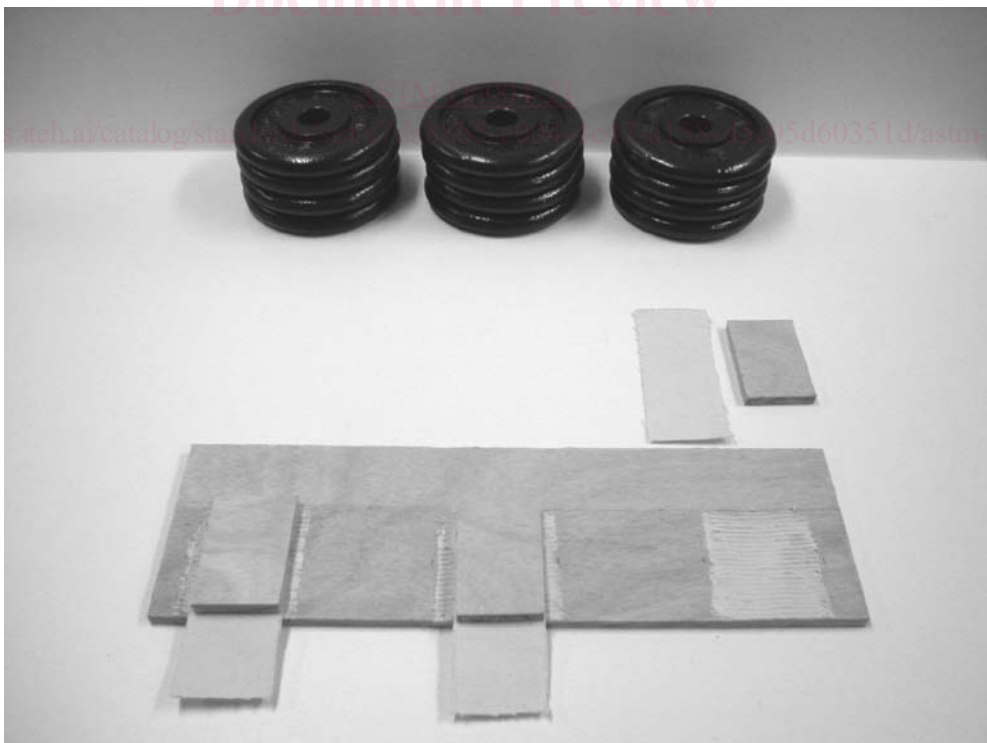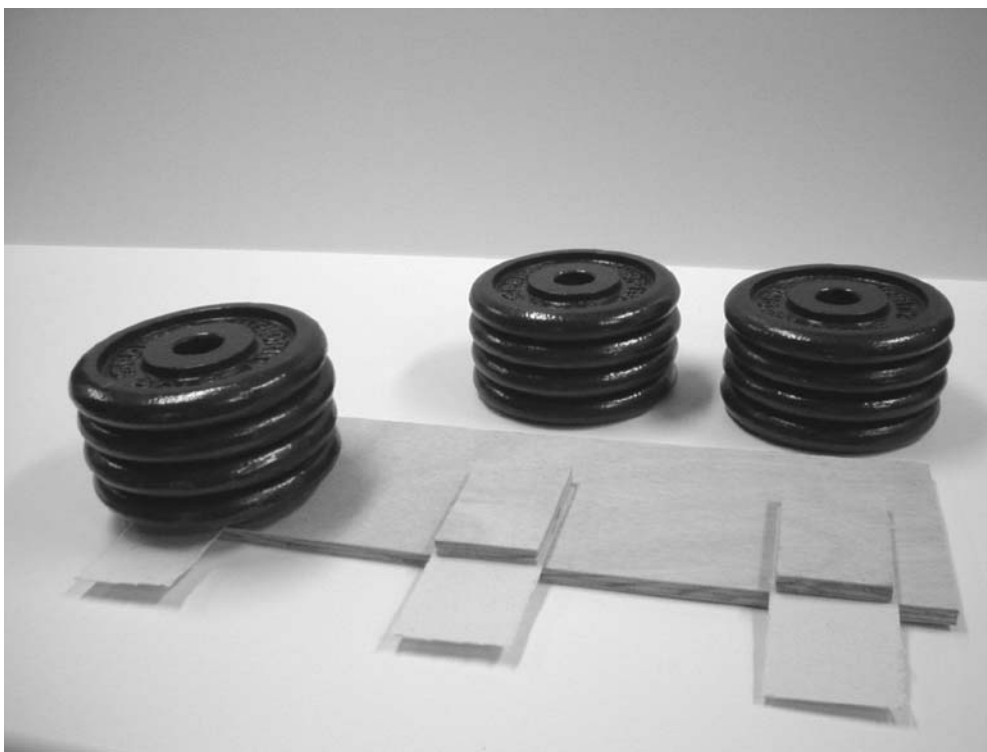NOTE 2—See 12.1 for additional information on use of "Duck Cloth."

FIG. 1 Shear Strength Carpet Assembly Pattern
Original photo of Duck Cloth used for P&B

NOTE 1—Each weight group weighs 10 lb (composed of four 2.5 lb weight discs).
FIG. 2 Shear Strength Carpet Assembly Dead Weight Configuration

9.2 *Resilient Flooring:*

9.2.1 Follow manufacturer's recommendations for adhesive installation requirements and application. Apply adhesive to substrate so that adhesive covers an area 2-in. (51-mm) wide and 2-in. (51-mm) long.

9.2.2 Follow manufacturer's recommendations for adhesive open time.

9.2.3 Place the 1 × 4-in. (25 × 101-mm) sample of flooring into the adhesive on substrate with a 2-in. (51-mm) bond area and a 2-in. (51-mm) overhang. Bonded area shall be 1 × 2 in. (25 × 51 mm).

9.2.4 Use a floor covering seam-roller or similar type method as shown in Fig. 3 to ensure firm and even contact between back of flooring and substrate.

9.2.5 Allow the test panel to dry 24 h at 73 ± 3°F (22 ± 1°C) and 50 ± 5 % relative humidity.

9.2.6 Test one set of specimens after 24 h dry time and one set after accelerated heat aging (Practice D8089).

9.2.7 Test the specimens in tension shear using a calibrated universal testing machine, aligning the upper and lower jaws as perpendicular as possible. Set the test speed at 1 in. (25.4 mm) per minute. The test area will be 2 in.² (12.9 cm²).

9.2.8 Record the three shear values in pounds-force.

10. Calculation

10.1 Calculate the shear strength (psi) of the individual specimens as follows:

$$S = \frac{SV}{A} \qquad (1)$$

where:

S = shear strength (psi),
SV = shear value reading from the universal test machine, and
A = area tested.

10.2 Calculate the average shear strength of the individual specimens as follows:

$$S_{AVE} = \frac{\sum S}{3} \qquad (2)$$

where:

S_{AVE} = the average shear strength (psi) of the three shear strength values, and
3 = number of samples tested.