



Designation: D4977/D4977M – 20

## Standard Test Method for Granule Adhesion to Mineral-Surfaced Roofing by Abrasion<sup>1</sup>

This standard is issued under the fixed designation D4977/D4977M; 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 ( $\epsilon$ ) indicates an editorial change since the last revision or reapproval.

### 1. Scope

1.1 This test method covers the determination of granule adhesion to mineral-surfaced roofing due to abrasion.

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

1.4 *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. Summary of Test Method

2.1 A brush with bristles is used to abrade the granule surface of the specimen on mineral-surfaced roofing. The adhesion is assessed by weighing the amount of granules that are displaced and become loose as a result of the abrasion test.

### 3. Significance and Use

3.1 This test method is used to determine the quality of adhesion of the granular surfacing to the coating asphalt in a sample of mineral-surfaced roofing. The results determine compliance with the applicable specification requirements or for comparative analysis. This test method applies to “as manufactured” material and may not be applicable to material that has had weathering exposure.

<sup>1</sup> This test method is under the jurisdiction of ASTM Committee D08 on Roofing and Waterproofing and is the direct responsibility of Subcommittee D08.02 on Steep Roofing Products and Assemblies.

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### 4. Apparatus

4.1 *Granule Adhesion Test Apparatus*<sup>2</sup>—A machine designed to cycle a test brush back and forth horizontally across a specimen at a rate of 50 cycles for 60 to 70 s. The brush assembly rests on the specimen with a downward mass of  $2268 \pm 7$  g [ $5$  lb  $\pm$   $\frac{1}{4}$  oz]; the stroke length is  $152 \pm 6$  mm [ $6 \pm \frac{1}{4}$  in.]. A typical machine is shown in Fig. 1.

4.2 *Abrasion Test Brush*<sup>3</sup>—A brush with 22 holes containing bristles made of 0.305-mm [0.012-in.] diameter tempered steel wire, 40 wires per hole, set with epoxy. The design of the brush is shown in Fig. 2.

4.3 *Balance Minimums*, 200 g capacity with 0.01 g sensitivity.

### 5. Test Specimens

5.1 Cut a minimum of two 50.8 by 229-mm [2 by 9-in.] specimens with the long dimension in the machine direction. For shingles whose geometry does not allow a continuous 50.8 by 229-mm [2 by 9-in.] specimen, two-piece specimens are permitted. The minimum machine-direction dimension of any given piece is  $101.6$  mm [ $4 \pm \frac{1}{4}$  in.]. It is permitted to join the two pieces with self-stick tape applied to the nongranulated surfaces.

NOTE 1—The test result shall be discarded if the specimen fails to remain flat or the two pieces become separated during the 50 complete abrasion cycles.

5.2 Condition specimens at room temperature  $23 \pm 2$  °C [ $73.4 \pm 3.6$  °F] for 30 min before testing. In case of dispute, condition specimen for 24 h in a desiccator.

### 6. Preparation of Apparatus

6.1 Insert the brush in the holder with the 38.1-mm [ $1\frac{1}{2}$ -in.] side parallel to the stroke line.

<sup>2</sup> The sole source of supply of the apparatus (3M Granule Embedding Test Machine and Abrasion Test Brushes) known to the committee at this time is C. G. Hill & Sons, 5150 Quincy Street, Mounds View, MN 55112; phone: 763-783-9055; www.cghill.com. If you are aware of alternative suppliers, please provide this information to ASTM International Headquarters. Your comments will receive careful consideration at a meeting of the responsible technical committee,<sup>1</sup> which you may attend.

<sup>3</sup> Use the brush specified by the test machine manufacturer.

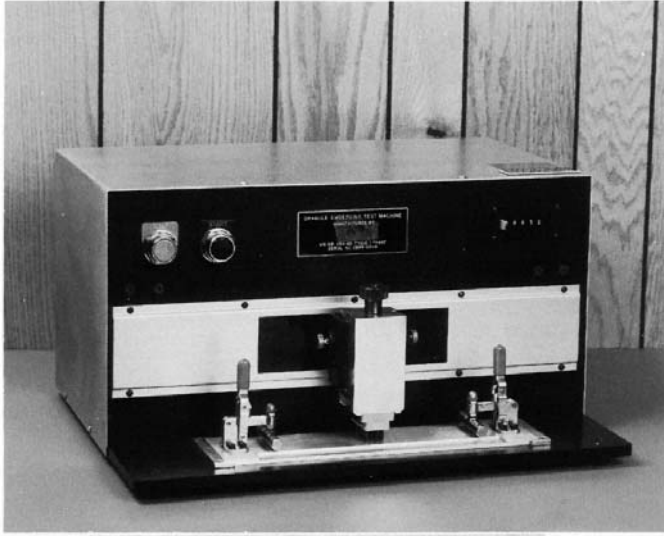


FIG. 1 Granule Adhesion Test Apparatus

7.3 Clean sample holder and clamp the specimen into the sample holder with the mineral granule surface side up. (Visually check and make sure the strip is centered.)

7.4 Place the brush in contact with the specimen.

7.5 Activate the machine so that the specimen is abraded 50 complete cycles (50 forward and 50 back strokes) with the brush travel parallel to the long axis of the specimen.

7.6 Remove the specimen from the sample holder, and gently tap to remove loose granules.

7.7 Weigh the specimen to the nearest 0.01 g and record the mass.

## 8. Calculation

8.1 Determine the weight in grams of granules that are displaced in the abrasion test as follows:

$$\text{weight of displaced granules} = A - B \quad (1)$$

where:

$A$  = weight of specimen before test, g, and

$B$  = weight of specimen after test, g.

8.2 Average the specimen results to obtain a value for the weight of granules displaced from the sample during the abrasion test.

## 9. Report

9.1 Identify sample and report the average weight of granules displaced from the sample, to the nearest 0.1 g.

## 10. Precision and Bias

10.1 *Repeatability and Reproducibility*—For materials evaluated in the loss range of 0.22 to 0.51 g, the repeatability standard deviation averaged 0.0556. The 95 % repeatability range was  $\pm 0.15$  g ( $\pm 36$  %) around the true average, 0.41 g. The reproducibility standard deviation averaged 0.1098. The 95 % reproducibility range was  $\pm 0.31$  g ( $\pm 74$  %).

## 11. Keywords

11.1 abrasion loss; asphalt shingles; granule adhesion; mineral-surfaced roofing

6.2 Before using a new brush, run it a minimum of 150 cycles on scrap mineral-surfaced roofing to condition the brush.

6.3 Check the bristle length. Make certain that all bristles are the same length and that the plane of the bristles' ends is parallel to the plane of the specimen. The maximum length is 16.5 mm [ $2\frac{1}{32}$  in.] and minimum length is 14.5 mm [ $\frac{9}{16}$  in.] as measured with a steel rule having a resolution of at least 0.5 mm [ $\frac{1}{32}$  in.].

6.4 Secure the centered brush in the holder.

## 7. Procedure

7.1 Remove any loose granules from the specimen with gentle tapping.

7.2 Weigh the specimen to the nearest 0.01 g and record the mass.