Designation: D 968 – 93

Standard Test Methods for Abrasion Resistance of Organic Coatings by Falling Abrasive[1]

This standard is issued under the fixed designation D 968; 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 These test methods cover the determination of the resistance of organic coatings to abrasion produced by abrasive falling onto coatings applied to a plane rigid surface, such as a metal or glass panel.

1.2 Two test methods based on different abrasives are covered as follows:

	Sections
Method A—Falling Sand Abrasion Test	1-12
Method B—Falling Silicon Carbide Abrasion Test	13-19

1.3 These methods should be restricted to testing in only one laboratory when numerical values are used because of the poor reproducibility of the methods (see 13.1.2 and 21.1.2). Interlaboratory agreement is improved significantly when ranking is used in place of numerical values.

1.4 *This standard does not purport to address the safety problems, 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:*

D 823 Practices for Producing Films of Uniform Thickness of Paint, Varnish, and Related Products on Test Panels[2]

D 1005 Test Method for Measurement of Dry-Film Thickness of Organic Coatings Using Micrometers[2]

D 1186 Test Methods for Nondestructive Measurement of Dry Film Thickness of Nonmagnetic Coatings Applied to a Ferrous Base[2]

D 1400 Test Method for Nondestructive Measurement of Dry Film Thickness of Nonconductive Coatings Applied to a Nonferrous Metal Base[2]

E 11 Specification for Wire-Cloth Sieves for Testing Purposes[3]

3. Terminology

3.1 *Description of Term Specific to This Standard:*

3.1.1 *abrasion resistance*—the amount of abrasive required to wear through a unit film thickness of the coating.

4. Summary of Test Methods

4.1 Abrasive is allowed to fall from a specified height through a guide tube onto a coated panel until the substrate becomes visible. The amount of abrasive per unit film thickness is reported as the abrasion resistance of the coating on the panel. Silica sand or silicon carbide may be used, as specified.

5. Significance and Use

5.1 Silica sand produces a slower rate of abrasion for organic coatings than provided by silicon carbide but, for some types of coatings, it provides greater discrimination.

5.2 The abrasion resistance scales produced by the two methods differ, but the methods provide approximately the same rankings of coatings for abrasion resistance.

5.3 Each of the methods has been found useful for rating the abrasion resistance of specific types of coatings. For example Method A (falling sand) has been used for rating floor coatings while Method B (falling silicon carbide) has been used for rating coatings for ship decks.

METHOD A—FALLING SAND ABRASION TEST[4]

6. Apparatus and Materials

6.1 *Abrasion Tester*, as illustrated in Fig. 1 and Fig. 2.[5] A gate for starting the flow of abrasive is located near the top of the guide tube. It consists of a metal disk inserted into a slit in the side of the guide tube with a collar covering the slit. The guide tube shall be firmly supported in a vertical position over a suitable receptacle, which shall contain a support for holding the coated panel at an angle of 45° to the vertical, so that the opening of the tube is directly above the area to be abraded and the distance from the tube to the coated surface face at the nearest point is 1 in. (25 mm) when measured in the vertical

[1] These test methods are under the jurisdiction of ASTM Committee D-1 on Paint and Related Coatings, Materials, and Applications and are the direct responsibility of Subcommittee D01.23 on Physical Properties of Applied Paint Films.

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[2] *Annual Book of ASTM Standards*, Vol 06.01.

[3] *Annual Book of ASTM Standards*, Vol 14.02.

[4] Hipkins, C. C., and Phain, R. J., "The Falling Sand Abrasion Tester," *ASTM Bulletin*, No. 143, December 1946, pp. 18–22.

[5] A suitable abrasion tester may be obtained from Gardner/BYK-Gardner, Inc., Gardner Laboratory, 2435 Linden Lane, Silver Spring, MD 20910.

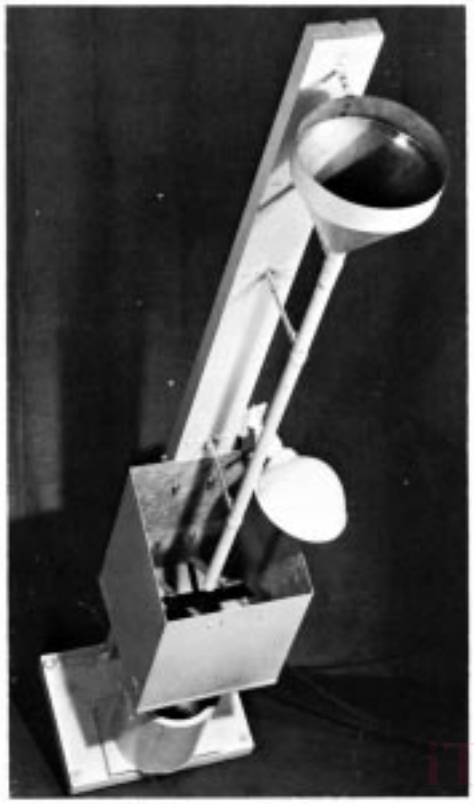
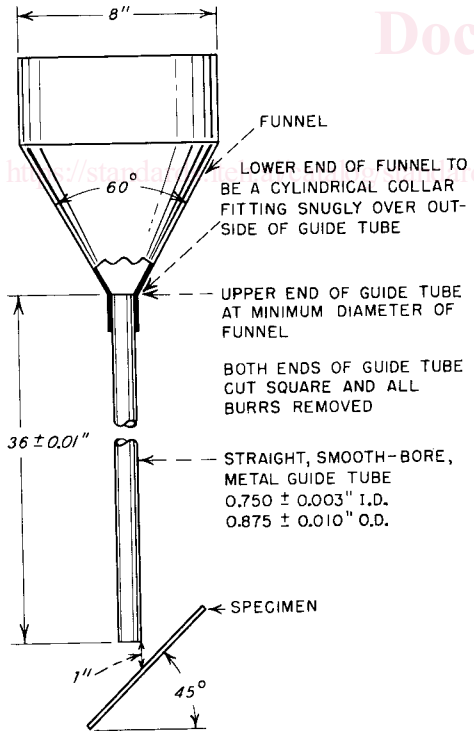


FIG. 1 Apparatus for Falling Sand Abrasion Test



NOTE 1—All dimensions are given in inches. 1 in. = 25.4 mm.

FIG. 2 Design Details of Abrasion Test Apparatus

direction. The base of the apparatus shall be fitted with adjusting screws for properly aligning the equipment.

6.2 *Standard Abrasive*—Natural silica sand from the St. Peters or Jordan sandstone deposits (located in the central United States) shall be considered standard when not more than 15 % of the grains in a sample are retained on a No. 20 (850 µm) sieve and not more than 5% of the grains pass a No. 30 (600 µm) sieve after 5 min of continuous sieving. The sand is characterized by its roundness of grains and its exceptionally high silicon dioxide content. Use the sieves described in Specification E 11.

NOTE 1—The abrading qualities of sand obtained from different sources may differ slightly even though the sand meets the sieve requirements. Therefore, for maximum precision of test results, purchaser and seller should use sand from the same source.[6]

7. Test Specimens

7.1 Apply uniform coatings of the material to be tested to a plane, rigid surface such as a metal or glass panel. Prepare a minimum of two coated panels for the material.

7.2 Cure the coated panels under the conditions of humidity and temperature agreed upon between the purchaser and seller.

NOTE 2—The coatings should be applied in accordance with Practice D 823, or as agreed upon between the purchaser and the seller.

NOTE 3—The thickness of the dry coatings should be measured in accordance with Test Methods D 1005, D 1186 or D 1400.

8. Standardization

8.1 Pour a quantity of standard sand into the funnel. Examine the sand stream falling from the lower end of the guide tube and align the apparatus by means of the adjusting screws in the base until the inner concentrated core of the sand stream falls in the center of the flow when viewed at two positions at 90° to each other. Introduce a measured volume of sand (2000 ± 10 mL is a convenient amount) and determine the time of efflux. The rate of flow shall be 2 L of sand in 21 to 23.5 s.

8.2 Secure a trial panel in the testing position, as described in 6.1, and introduce the sand in increments until a spot 5⁄32 in. (4 mm) in diameter is worn through to the base material. The overall abraded area shall be elliptical in shape, about 1 in. (25 mm) in width and 1¼ in. (30 mm) in length. The center of the area of maximum abrasion shall be on the center line through the longer axis of the abraded pattern and within 9⁄16 to 11⁄16 in. (14 to 17 mm) of the top edge. Slight final adjustment of the instrument may be required to center the abrasion spot in the pattern. A final check on alignment is made by determining the amount of sand that passes through a 5⁄32-in. (4-mm) hole in a metal panel placed directly under the tube. Place a container under the hole in the panel and allow a weighed amount of sand to pass through the tube onto the panel. Weigh the amount of sand that passed through the hole into the container. The apparatus can be considered to be in calibration if the amount of sand that passed through the hole is 90 to 93 % of the amount of sand that impinged on the panel.

9. Conditioning

9.1 Unless otherwise agreed upon between purchaser and

[6] Sources of acceptable sand are the Quakenbush Company, 500 East Main Street, Lake Zurich, IL 60047 and the U.S. Silica Co., P.O. Box 577, Ottawa, IL 61350.