Designation: D 4518 – 91

AMERICAN SOCIETY FOR TESTING AND MATERIALS
100 Barr Harbor Dr., West Conshohocken, PA 19428

Standard Test Methods for Measuring Static Friction of Coating Surfaces[1]

This standard is issued under the fixed designation D 4518; 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 These test methods cover the determination of the resistance to sliding on coating surfaces by measuring the static friction.

1.2 Two test methods are described as follows:

	Sections
Method A—Inclined Plane Test	8-13
Method B—Horizontal Pull Test	14-19

1.3 *This standard does not purport to address all of 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 Test Methods for Producing Films of Uniform Thickness of Paint, Varnish, and Related Products on Test Panels[2]

3. Terminology

3.1 *Definition:*

3.1.1 *static friction*—the force required to start the test sled moving, divided by the mass of the sled.

4. Summary of Test Methods

4.1 With the inclined plane test (Test Method A), a weighted sled is placed on a test specimen and the specimen is gradually inclined from the horizontal until the sled begins to slide. The tangent of this angle of inclination is reported as the static friction.

4.2 With the horizontal pull test (Test Method B), a weighted sled is placed on a horizontal test specimen and is pulled across the specimen. The static friction is reported as the force required to start the sled moving, divided by the mass of the sled.

5. Significance and Use

5.1 The friction characteristics of coating surfaces can be important to the use of the coatings. For example, low friction of exterior can coatings is beneficial to the flow of the cans on production lines. Also low friction of interior pipeline coatings is beneficial to the flow of materials through pipes. On the other hand, low friction of floor coatings can be hazardous to foot traffic.

5.2 Under some conditions, measurement of the static friction can be used to evaluate the slip resistance of coatings under use conditions. However, results can be extremely dependent on the type of coating surface and the type of sliding unit used.

5.3 The tendency for footwear to slip may be influenced by foreign materials or lubricants on the shoe materials or on the walking surfaces. Also, these test methods do not incorporate all the directional forces involved in the walking process. Consequently, levels of slip resistance as determined by these test methods may not predict a person's resistance to slipping when walking on various surfaces.

5.4 The best precision and sensitivity are obtained when stainless steel is used as the facing of the sliding unit. In some tests where a leather facing is used, poor precision is obtained because of the inability to control the uniformity of its surface during the test. The use of a hard synthetic rubber facing provides somewhat better precision.

5.5 These test methods provide for static friction measurements when the sled facing and the coating surfaces are wet with water. Results from such tests must be treated with caution because frequently the static friction values obtained for wet, smooth coatings are higher than those obtained for the same surfaces dry. This is because, when stationary at the beginning of the test, the sled contact can produce a" suction cup" effect on a wet surface. Measurements performed on wet coatings with rough surfaces have been more satisfactory.

5.6 A test procedure is offered that eliminates the "suction cup" effect of wet surfaces. The wet sled is dropped onto the wet coating surface at the start of the test.

5.7 Results obtained by these test methods may be extremely sensitive to the age of the test coating because the blooming action of additives or plasticizers is often time-dependent. It may be meaningless to compare slip and frictional properties of test coatings applied at different times unless this effect is being studied.

5.8 The measurement of static friction may be influenced by the length of time that the sled rests on the test specimen before motion is initiated.

[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.

Current edition approved Sept. 15, 1991. Published November 1991. Originally published as D4518 – 85. Last previous edition D4518 – 90.

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

5.9 Static friction measurements have been useful in evaluating (*1*) the suitability of coatings for the exterior of cans, (*2*) the slipperiness of floor polishes, and (*3*) the slip resistance characteristics of footwear on floor tiles and floor coatings. Also, static friction measurements have been useful in determining the effect of coating additives (for example waxes, silicones) on the slipperiness of coating surfaces.

6. Test Specimens

6.1 Apply test coatings in accordance with Test Methods D 823 to substrates of at least 4 in. (100 mm) in width and length. The substrates may be of glass, steel, aluminum, or other appropriate material that remains smooth and plane after the test coating has been applied and cured at 73.5 ± 3.5°F (23 ± 2°C) and 50 ± 5% relative humidity for 7 days, unless otherwise specified. Prepare at least two test panels for each coating.

6.2 Take care during application of the test coating to minimize entrainment of dust and particulate matter in the surface of the coating. Extreme care is required when handling the panels, even after sufficient cure. The surface should be kept free of all dust, lint, fingerprints, or any foreign matter that may change the characteristics of the surface.

7. Conditions for Testing

7.1 Test the coated test specimens under one or more of the following conditions as agreed upon by the purchaser and the seller:

7.1.1 Both sled facing and coating surfaces dry at 73.5± 3.5°F (23± 2°C).

7.1.2 Both the sled face and the coating surface wet with water containing a slight amount of wetting agent at 73.5 ± 3.5°F (23 ± 2°C). Sea water containing a slight amount of wetting agent may be used when it is appropriate. A wetting solution consisting of 1 mL of surfactant[3] added to 200 mL of water has been found to be satisfactory.

7.1.3 One or both of the above at 35.5 ± 3.5°F (2 ± 2°C).

TEST METHOD A—INCLINED PLANE TEST

8. Apparatus

8.1 *Inclined Plane*, having a smooth, incompressible surface, at least 1 in. (25 mm) wider than the sliding unit and of sufficient length to allow the test sled to move by gravity at least 0.5 in. (12 mm), provided with clamps for the test specimen, and an inclinometer to indicate the angular displacement of the plane to within 0.5°.

NOTE 1—A suitable apparatus is shown in Fig. 1. It may be assembled from items obtained from laboratory instrument supply houses.

8.2 *Test Sleds*—Alternative sleds that may be used are:

8.2.1 *Stainless Rounded Edge Steel Block*, with a highly polished plane lower surface 3 by 3 in. (75 by 75 mm) in area and a mass of 1.8 lb (0.82 kg) to provide a pressure of 0.2 psi (1.4 kPa) when horizontal.

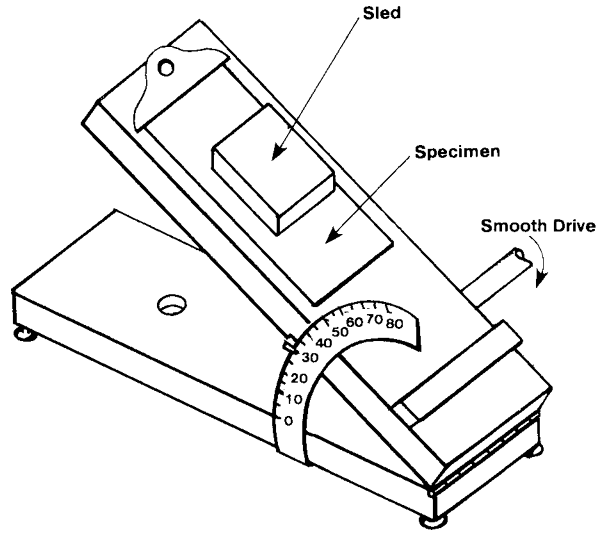

FIG. 1 Schematic of Inclined Plane Apparatus

8.2.2 *Stainless Steel Block*, with a plane lower surface of 3 by 3 in. (75 by 75 mm) and a mass of 1.8 lb (0.82 kg). Adhered to the lower surface is a ¼-in. (6-mm) thick vulcanized neoprene rubber having a Shore "A" hardness of 65 ± 5. A screw eye or other means to attach the sled to the force-measuring device is provided.

8.3 *Inclinator*—Means to smoothly increase the inclination of the plane from the horizontal through an arc of at least 45° at a rate of 1.5 ± 0.5°/s.

NOTE 2—Procedures found suitable for smoothly increasing the inclination of the plane are (*1*) pulling the top of the plane upward with a motor driven dip coater and (*2*) pushing the top of the plane upward with a laboratory jack equipped with a hand crank.

9. Preparation of Apparatus

9.1 *Preparation of Sled Facing*:

9.1.1 If a synthetic rubber facing is used on the test sled, it must be preconditioned by light sanding before each determination.

9.1.2 Place a sheet of 400A wet or dry silicon carbide abrasive paper on a flat surface. Sand the synthetic rubber facing by rubbing it gently back and forth over the paper four times. Repeat at 90° to the first direction. Wipe the surface of the synthetic rubber facing with a clean, dry cloth to remove dust or loose material from the surface.

10. Procedure

10.1 Level the plane so it is horizontal when the inclinometer reads zero.

10.2 Clamp the test specimen to the plane. Recheck the levelness of the panel in two directions (along the length of the panel and across the panel at 90° to the first measurement).

10.3 *Dry Surfaces*:

10.3.1 Center the sled on the test coating. Immediately commence inclining at a rate of 1.5 ± 0.5°/s. When the sled starts to move, stop the inclinometer immediately and read the angle of displacement at the moment the sled starts to move.

10.3.2 Return the plane to a level position and make two additional tests on the test specimen as described in 8.3.

[3] A surfactant such as Aerosol OT manufactured by American Cyanamid Co., Chemical Group, One Cyanamid Plaza, Wayne, NJ 07470, has been found suitable for this purpose.