Designation: F 735 – 94

Standard Test Method for Abrasion Resistance of Transparent Plastics and Coatings Using the Oscillating Sand Method[1]

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1. Scope

1.1 This test method determines the resistance of transparent plastics and transparent coatings utilized in windows or viewing ports, to surface abrasion using oscillating sand.

1.2 *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:*

C 136 Test Method for Sieve Analysis of Fine and Coarse Aggregates[2]

D 618 Practice for Conditioning Plastics and Electrical Insulating Materials for Testing[3]

D 1003 Test Method for Haze and Luminous Transmittance of Transparent Plastics[3]

E 11 Specification for Wire-Cloth Sieves for Testing Purposes[4]

E 691 Practice for Conducting an Interlaboratory Study to Determine the Precision of a Test Method[4]

3. Summary of Test Method

3.1 The test method consists of measuring and recording the haze and light transmission of a test specimen, mounting the specimen so that it forms part of the bottom of a tray (sand cradle), covering the specimen with abrading media, and subjecting the cradle to a specific number of to-and-fro motions. After exposure to the abrasion, the haze and light transmission are remeasured to determine any change in these values.

3.2 At the stroke velocity specified in this practice, the entire mass of sand shifts significantly within the sand cradle because of its inertia; therefore the relative motion between sand and specimen at the interface is large.

3.3 The thickness or height of the sand, which rests on top of the test specimen, remains relatively constant over the test specimen itself during the motion of the cradle. Therefore, the average pressure of the sand also remains constant, giving highly reproducible results over the entire surface of the test specimen.

3.4 The degree of abrasion is measured by the amount of change in luminous transmission and haze after exposure to the test.

4. Significance and Use

4.1 Many types of plastics are used in the making of transparencies and enclosures or covers. It is the intent of this test to provide a means of determining the relative abrasion resistance of plastics or coatings, or both, to such operational uses as the cleaning of dirt, removal of bug residue, or any other rubbing action that can cause abrasion.

5. Apparatus

5.1 *Abrader*—The abrader illustrated in Fig. 1 consists of a specimen holder, sand cradle, drive mechanism, variable power supply and counter.

5.1.1 The specimen holder shall have a cutout approximately 100 by 100 mm (4 by 4 in.) to receive the specimen. The specimen shall be mounted flush to within 1 mm (0.04 in.) high with the specimen holder.

5.1.2 The specimen holder forms the bottom of the sand cradle.

TABLE 1 Properties

E11 Sieve Designation		Mean % on Sieve	Standard Deviation, %	Cululative % Retained, Mean
U.S. No	mm			
8	2.36	30.0	7.4	30.0
10	2.00	40.0	8.4	70.0
12	1.70	22.0	7.8	92.0
14	1.40	6.0	1.1	98.0
Pan	...	2.0	0.7	100.0

[A] Effective size at 90 % retained = 1.70 ± 0.10 mm. Uniformity Coefficient = 1.29 ± 0.05 mm Shape Factor = 0.40± 0.07 mm.

5.1.3 The cradle size, as defined in Fig. 1 will provide a 13-mm (0.50-in.) head of sand, utilizing 1000 g (2.2 lb).

5.1.4 A drive mechanism shall provide 300 strokes per minute of reciprocating motion of approximately 100-mm (4-in.) travel. Motion in one direction is defined as one stroke.

[1] This test method is under the jurisdiction of ASTM Committee F-7 on Aerospace and Aircraft and is the direct responsibility of Subcommittee F07.08 in Transparent Enclosures and Materials.

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[2] *Annual Book of ASTM Standards*, Vol 04.02.

[3] *Annual Book of ASTM Standards*, Vol 08.01.

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

FIG. 1 Oscillating Sand Abrader

5.1.5 A variable power supply shall be utilized to control the abrader motor to operate at 300 strokes per minute.

5.1.6 A counter shall record the number of strokes during a test.

5.2 *Photometer*—An integrating sphere photoelectric photometer, described in Test Method D 1003, shall be used to measure the light scattered by the abraded surface.

6. Reagents and Materials

6.1 *Abrading Medium—Quartz Sand*[5]—The sand shall be quartz silica grid sized 6/14 and shall meet the following requirements:

6.1.1 *Properties*—See Table 1.

6.1.2 *Test Methods*:

NOTE 1—These tests need be applied only when qualifying a new supply of sand.

6.1.2.1 Perform sieve analysis in accordance with Method C 136.

6.1.2.2 Plot the cumulative percent retained, on logarithmic probability paper.

6.1.2.3 Read from the plot the sizes in millimetres at 40, 50, and 90 % retained.

6.1.2.4 Calculate the uniformity coefficient as the ratio (millimetres at 40 %/millimetres at 90 %).

6.1.2.5 Count out 100 grains, taking care to be nonselective, and weigh to ± 10 mg.

6.1.2.6 Calculate the shape factor as

$$\frac{\text{(weight of 100 particles)}}{265\ \text{(millimetres at 50 \% retained)}^3} \quad (1)$$

NOTE 2—There are many conflicting definitions of shape factor.[6] The definition given in 6.1.2.6 is arbitrary and not comparable with any others, except that for a single quartz sphere it has the usual value of 0.524 ($\pi/6$).

7. Test Specimens

7.1 The specimens shall be clean, transparent plates, 100-mm (4-in.) square, having both sides substantially plane

[5] Satisfactory sand (Texsan Filter Sand #7) has been procured from Vulcan Materials Company, White Mines Division, Industrial Sand Products. 1-(800)-537-6371.

[6] Orr, C., and Dallavalle, J. M., *Fine Particle Measurement*, The Macmillan Co., New York, NY 1959, pp 35–36.