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Standard Test Method for Abrasion Resistance of Transparent Plastics and Coatings Using Salt Impingement Method[1]

This standard is issued under the fixed designation F 1128; 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 This test method determines the resistance of transparent plastics and transparent coatings, utilized in windshields, windows, or viewing ports, to surface abrasion using the impingement of salt driven by air blasts.

1.2 *This standard may involve hazardous materials, operations, and equipment. This standard does not purport to address all of the safety problems 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 Method for Sieve Analysis of Fine and Coarse Aggregates[2]

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

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

D 1044 Test Method for Resistance of Transparent Plastics to Surface Abrasion[3]

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

3. Summary of Test Method

3.1 This test method consists of measuring and recording the haze and light transmission of a test specimen, mounting the specimen in the test fixture, and subjecting the specimen to a specific number of salt-blast cycles. After exposure to the abrasion, the haze and light transmission are remeasured to determine any change in these values.

3.2 The degree of abrasion is measured by the amount of change in haze and luminous transmission 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 method to provide a means of determining the relative abrasion resistance of plastics or coatings, or both, to such operational uses as flying through frozen rain, snow, and light hail. Impingement by dust, sand, and other small particles can also cause abrasion damage.

5. Apparatus

5.1 *Abrader*, as illustrated in Fig. 1 consisting of a specimen holder, a nozzle, a salt supply, a dry-air supply, a mixing chamber, and a control panel.

5.1.1 *Specimen Holder*, to support a test specimen in a horizontal position. A mask shall shield the specimen, on its bottom side, such that a 25.4-mm (1-in.) diameter area centered 19 mm (0.75 in.) from the sides is exposed for testing.

5.1.2 *Nozzle*, conforming to the requirements of Fig. 1[5] shall be positioned perpendicular to the test area with the tip of the nozzle located 127 mm (5.0 in.) from the test area.

5.1.3 The salt shall be dispensed into the airstream to serve as the abrading medium for the specimen. Salt shall be injected into the airstream at controlled intervals to provide cyclic abrasion pulses of 0.5-s salt blast followed by 2.0 s off, which can be counted to provide a prescribed number of abrasion cycles in a given time. Discard spent salt.

5.1.4 Dry air or nitrogen, supplied at 25 ± 0.5 psig setting at beginning of pulse, shall flow through the mixing chamber and nozzle to impinge on the test area of the specimen.

5.1.5 *Mixing Chamber*, capable of drawing in and dispersing a quantity of salt throughout the airstream in such a manner that it leaves the nozzle in high concentration and uniformly distributed within the pulse period. Determine the average quantity of salt dispensed in each pulse by measurement of the quantity of salt available before the series of cycles less the quantity remaining after the series of cycles divided by the number of cycles.

5.1.6 *Control Panel*, including the devices necessary for operation of the test equipment. It shall include a means of selecting the number of salt impingement cycles desired and a counter to record the number of cycles operated during the test.

5.2 *Integrating Sphere Photoelectric Photometer*, as described in Method D 1003, to measure the light transmitted and scattered by the abraded surface.

6. Reagents and Materials

6.1 *Sodium Chloride Abrading Medium*[6]—The salt crystals shall be dry, nonclogging, grid size 60/325, and shall

[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 on Transparent Enclosures and Materials.

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[2] *Annual Book of ASTM Standards*, Vol 04.03.

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

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

[5] The Sand Blast Gun, Model 7201, available from Jas. H. Mathew Co., has been found satisfactory.

[6] Morton's extra fine flake salt available from Morton Salt Division of Morton Thiokol, Inc., Chicago, IL 60606, has been found satisfactory for this purpose.

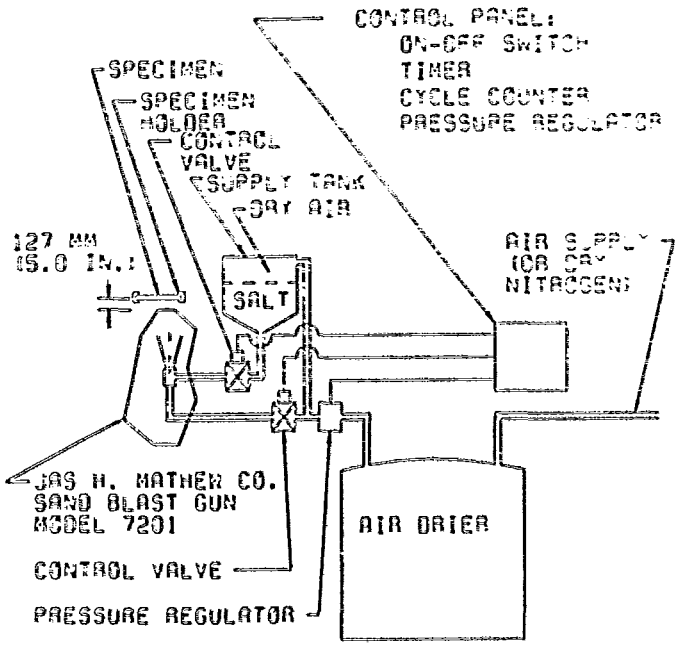

FIG. 1 Salt Blast Abrasion Tester (Schematic)

meet the requirements of Table 1 (see Test Method C 136).

6.2 *Compressed Air or Nitrogen.*

7. Test Specimen

7.1 The specimens shall be clean, transparent plates, 76-mm (3-in.) square, having both sides substantially plane and parallel. (See Fig. 2.) Four tests can be performed on one specimen. Any specimen thickness can be utilized when positioned in the specimen holder at the lower test surface location.

8. Conditioning

8.1 Condition the test specimen in accordance with Procedure A of Method D 618.

8.2 Conduct tests in the standard laboratory atmosphere of 23 ± 2°C (73 ± 4°F) and 50 ± 5 % relative humidity.

9. Procedure

9.1 Code mark each specimen to be tested and mark each corner as 1, 2, 3, and 4 near the corner out of the test area of each specimen.

9.2 Measure and record light transmission and haze in each of the four test areas in each specimen in accordance with 9.6 prior to abrasion testing.

9.3 Mount the specimen in the specimen holder such that one of the four test areas is in position for testing. Use protective means to prevent abrasion or scratching of the other three test areas as well as the top surface of the specimen.

9.4 Subject each test area to 2, 4, 8, 16, 25, 50, and 100 abrasion pulses or until no further degradation is observed in successive cycles unless otherwise specified.

9.5 After each increment of cycles on a test area in accordance with 9.4, remove the specimen from the holder. Handle the specimen by the edges only. Wash the specimens with distilled water for a minimum of 10 s by holding them under a stream or by swirling under water in a container. Dry the specimens by blowing lightly with filtered air, nitrogen, or other compressed gas compatible with the test specimen material. Reclean with a 50:50 solution of isopropanol and water and dry as above. Remove water marks by a second wash with distilled water if required and dry as above.

9.6 Using a photoelectric integrating sphere photometer in accordance with Test Method D 1003, measure the percentage of transmitted light and percent of haze. For hazemeter adjustments refer to Test Method D 1044.

TABLE 1 Sodium Chloride Crystal Size Requirements

Screen Designation[A]	Mesh Size, μm	Mean Retained on Sieve, %	Cumulative Mean Retained, %
60	250	<1	<1
120	125	48	48
200	75	39	87
325	45	10	97
Pan	...	<3	100

[A] Conform to Specification E 11.

10. Report

10.1 The report shall include the following:

10.1.1 Type of material being tested.

10.1.2 The percentage of the transmitted light and the percent haze for each test area of each specimen tested, both before and after exposure to abrasion in accordance with 9.4.

10.1.3 Summarize test results as the average of the four test areas on each specimen.

11. Precision and Bias

11.1 No statement can be made about either the precision or bias of this test method until completion of an intralaboratory test program.

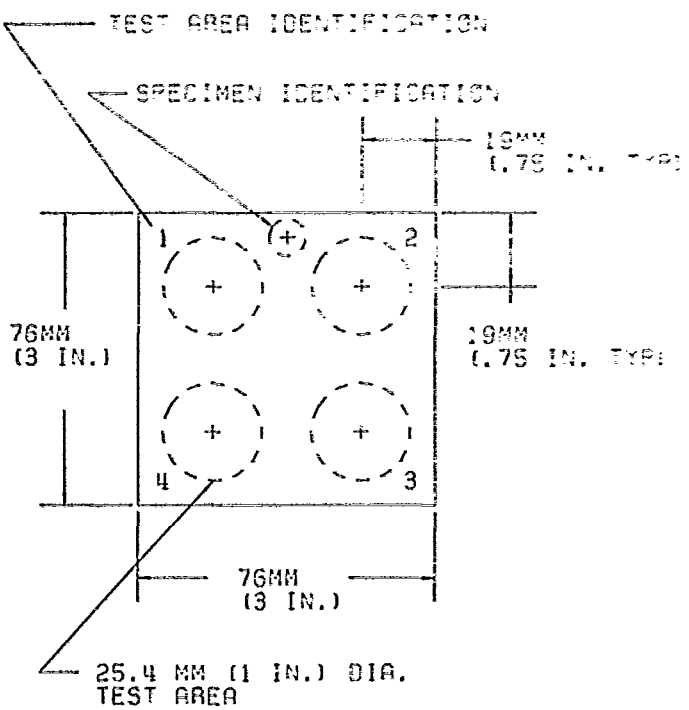

FIG. 2 Test Specimen

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