Designation: F520 – 10

StandardTest Method for Environmental Resistance of Aerospace Transparencies to Artificially Induced Exposures[1]

This standard is issued under the fixed designation F520; 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 covers determination of the effects of exposure to thermal shock, condensing humidity, and simulated weather on aerospace transparent enclosures.

1.2 This test method is not recommended for quality control nor is it intended to provide a correlation to actual service life.

1.3 The values stated in SI units are to be regarded as standard. No other units of measurement are included in this standard.

1.3.1 *Exceptions*—Certain inch-pound units are furnished in parentheses (not mandatory) and certain temperatures in Fahrenheit associated with other standards are also furnished.

1.4 *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:*[2]

D1003 Test Method for Haze and Luminous Transmittance of Transparent Plastics

D4329 Practice for Fluorescent UV Exposure of Plastics

F319 Practice for Polarized Light Detection of Flaws in Aerospace Transparency Heating Elements

F521 Test Methods for Bond Integrity of Transparent Laminates

F790 Guide for Testing Materials for Aerospace Plastic Transparent Enclosures

G53 Practice for Operating Light-and Water-Exposure Apparatus (Fluorescent UV-Condensation Type) for Exposure of Nonmetallic Materials (Withdrawn 2000)[3]

G113 Terminology Relating to Natural and Artificial Weathering Tests of Nonmetallic Materials

G151 Practice for Exposing Nonmetallic Materials in Accelerated Test Devices that Use Laboratory Light Sources

G154 Practice for Operating Fluorescent Light Apparatus for UV Exposure of Nonmetallic Materials

3. Summary of Test Method

3.1 Two types of test specimens, duplicating the aerospace transparent enclosure design, are subjected to thermal shock, condensing humidity, and artificial weathering. Edge sealing may be used if representative of the design.

3.1.1 Type A specimens are used to determine the effect of environmental exposure on electrical and optical properties.

3.1.2 Type B specimens are used to determine the effect of environmental exposure on bond integrity.

4. Significance and Use

4.1 This test method, when applied to aerospace transparencies of either monolithic glass/plastic or laminated combinations, is a measure of the ability of the transparency to withstand the effects of artificially induced environments. The test may be used on configurations employing electrically conductive coatings, and also to evaluate the integrity of noncoated materials.

4.2 The resistance of the transparent enclosure to environmental effects may vary appreciably depending on the size, geometry, material of construction, coating integrity, coating density, and other factors.

5. Test Specimens

5.1 Each Type A specimen to be evaluated for external coating durability shall be a 250 by 250-mm (9.8 by 9.8-in.) cross section of the design and shall contain, as applicable, surface coatings of operational, electrically conducting coating systems complete with bus bars, braids, and temperature sensors.

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

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[2] For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

[3] The last approved version of this historical standard is referenced on www.astm.org.

5.1.1 Type A test specimens shall have a fully operational coating system, when applicable, with an average resistivity consistent with the average resistivity of the representative design. Reproduction of multiphase electrical circuits is not required for these test specimens since this type of circuitry is only a design technique used to accommodate limited voltage resources at installation.

5.1.2 Type A specimen testing exposure of an external coating only, are independent of size but shall be of sufficient size to produce representative coatings. When testing external coatings the recommended specimen size is 250 by 250-mm (9.8 by 9.8-in.). Type A specimens which are monolithic, or laminated samples where only an external coating system is being tested shall be tested to the same exposure intervals as 50 by 50-mm (2 by 2-in.), Type B specimens (5.2).

5.1.3 Type A specimen testing for effects of exposure to components within a laminated construction, such as electrical components, heating films, and interlayers, taking place due to moisture ingress are dependent on size and shall receive increasing exposure levels as the length of the sides of the specimen increase. 250 by 250-mm specimens shall be exposed to humidity 27 times the duration of 50 by 50-mm specimens. Use of 150 by 150-mm specimen shall be allowed with exposure of 9 times that of corresponding 50 by 50-mm specimens, or 1/3 the duration of 250 by 250-mm specimens.

5.1.4 Type A that are both laminated and contain external coatings where both external and internal effects are to be tested after exposure, must be tested independently as externally coated samples, and as laminated samples, since the exposure durations will be different. To test effects on both layers of a particular design, the number of samples must be doubled, the external coating tested on one set, and internal components tested on a second set of specimens.

5.2 Each Type B test specimen shall be 50 by 50 mm (2 by 2 in.) and shall be of a cross section consistent with the edge configuration of the representative design. Type B test specimens are not intended to be operational electrically, but they shall be representative of the average resistivity of the design.

6. Preparation of Test Specimens

6.1 Prepare a minimum of three Type A specimens for each design configuration. If the design contains an electrically activated coating, only one temperature sensor per specimen is required.

6.2 Prepare a minimum of five Type B specimens for each design configuration. Prepare the specimen in such a manner as to produce smooth edges and corners to prevent chipping during testing. Polish at least one edge of each specimen to allow inspection of the internal bonded surfaces during tensile loading. Do not apply edge sealant to the specimens.

6.3 Condition all test specimens by exposing them to not less than 40 h at 23 ± 2°C (73.4 ± 3.6°F) and 50 ± 5 % relative humidity.

7. Procedure

7.1 *Visual Examination*—Carefully examine Type A and Type B specimens for any signs of material or manufacturing defects. A microscope or magnifying lens, dark background, and cross lighting may be used, as appropriate, to assist in the identification and classification of visible defects.

7.2 *Optical Tests*—Measure each Type A specimen for luminous transmittance and haze in accordance with Procedure B of Test Method D1003. Make at least two measurements, one in the center and one near the edge, on each specimen. Six measurements are preferred. If greater than 1 % variation exists, prepare a template from polyester film or other suitable material to record these locations for indexing and correlation to readings to be taken after environmental exposure.

NOTE 1—Paragraphs 7.3-7.6 are applicable to systems using electrically conductive coatings.

7.3 *Electrical Tests:*

7.3.1 *Bus Bar-to-Bus Bar Resistance*—Measure each Type A specimen for bus bar-to-bus bar resistance. Take precautions to minimize the effects of variable contact resistance. Record results and repeat the measurement after environmental exposure prior to application of over-voltage power.

7.3.2 *Sensing Element*—Measure the resistance of the sensing elements at a specified temperature to assure conformance to the temperature resistance ranges certified by the element manufacturer.

7.3.3 *Electrical Insulation*—Test the electrical insulation by measuring leakage current on each test specimen. Apply an alternating current potential between 1500 and 2500 V rms, depending upon the design application and specified requirements, at 50 or 60 Hz for a period of 1 min between the following:

(1) each sensor lead and each heater lead;

(2) each sensor lead and metal insert or spacer;

(3) each heater lead and the metal insert or spacer;

(4) each heater lead and metal strip placed in contact with the edge of the glass panel; test the entire edge of the glass panel;

(5) each anti-ice and defog heater lead.

Leakage current in excess of 1 mA at 1500 V rms or 4 mA at 2500 V rms is objectionable. Monitor the current during a preliminary low voltage application and terminate the test if the current leakage exceeds the allowable amount prior to full voltage application. Determine the resistance and decide whether to proceed to full voltage in conformance with the test procedure.

7.3.4 Monitor the current during gradual application of a dc voltage. Current in excess of 5 µA is objectionable. If the current exceeds 5 µA dc before 500 V dc is reached, suspend the test and determine the resistance before deciding whether to continue. Gradually apply and remove the potential at no greater rate than 500 V rms/s.

7.3.5 *Electrically Conductive Coating Test*—Test each Type A specimen for electrically conductive coating uniformity in accordance with Test Method F319.

7.3.5.1 For electrically conductive coatings on plastic materials, apply a minimum of 110 % of the nominal design voltage.

7.3.5.2 For electrically conductive coatings on glass, apply a minimum of 125 % of the nominal design voltage.

7.3.5.3 Alternative voltage levels and power-on times may be as specified by contractual documents.