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Standard Guide for Testing Materials for Aerospace Plastic Transparent Enclosures¹

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1. Scope

1.1 This guide is intended to summarize the standard test methods available on individual and composite materials utilized in fabrication of aerospace plastic transparent enclosures. As such, it is intended to specifically include transparent thermoplastics, transparent elastomers, and reinforced plastics, whether thermoplastic or thermosetting.

1.2 This guide is intended as an aid in the search for test methods pertinent to Aerospace Plastic Transparent Enclosures. It should be understood that all methods listed may not apply to all enclosures.

1.3 The standards included refer to the properties or aspects listed in Table 1. The properties or aspects are listed in alphabetical order and the descriptions used are intended to facilitate the search.

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, health, and environmental practices and determine the applicability of regulatory limitations prior to use.*

1.5 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

2. Referenced Documents

2.1 ASTM Standards:²

C117 Test Method for Materials Finer than 75- μ m (No. 200) Sieve in Mineral Aggregates by Washing

¹ This guide is under the jurisdiction of ASTM Committee F07 on Aerospace and Aircraft and is the direct responsibility of 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.

- D149 Test Method for Dielectric Breakdown Voltage and Dielectric Strength of Solid Electrical Insulating Materials at Commercial Power Frequencies**
- D150 Test Methods for AC Loss Characteristics and Permittivity (Dielectric Constant) of Solid Electrical Insulation**
- D256 Test Methods for Determining the Izod Pendulum Impact Resistance of Plastics**
- D257 Test Methods for DC Resistance or Conductance of Insulating Materials**
- D412 Test Methods for Vulcanized Rubber and Thermoplastic Elastomers—Tension**
- D542 Test Method for Index of Refraction of Transparent Organic Plastics**
- D543 Practices for Evaluating the Resistance of Plastics to Chemical Reagents**
- D570 Test Method for Water Absorption of Plastics**
- D624 Test Method for Tear Strength of Conventional Vulcanized Rubber and Thermoplastic Elastomers**
- D638 Test Method for Tensile Properties of Plastics**
- D695 Test Method for Compressive Properties of Rigid Plastics**
- D696 Test Method for Coefficient of Linear Thermal Expansion of Plastics Between –30°C and 30°C with a Vitreous Silica Dilatometer**
- D746 Test Method for Brittleness Temperature of Plastics and Elastomers by Impact**
- D785 Test Method for Rockwell Hardness of Plastics and Electrical Insulating Materials**
- D790 Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials**
- D792 Test Methods for Density and Specific Gravity (Relative Density) of Plastics by Displacement**
- D953 Test Method for Pin-Bearing Strength of Plastics**
- D1003 Test Method for Haze and Luminous Transmittance of Transparent Plastics**
- D1004 Test Method for Tear Resistance (Graves Tear) of Plastic Film and Sheet**
- D1044 Test Method for Resistance of Transparent Plastics to Surface Abrasion by the Taber Abraser**
- D1238 Test Method for Melt Flow Rates of Thermoplastics by Extrusion Plastometer**

- D1499** Practice for Filtered Open-Flame Carbon-Arc Exposures of Plastics
- D1525** Test Method for Vicat Softening Temperature of Plastics
- D2240** Test Method for Rubber Property—Durometer Hardness
- D2565** Practice for Xenon-Arc Exposure of Plastics Intended for Outdoor Applications
- D2583** Test Method for Indentation Hardness of Rigid Plastics by Means of a Barcol Impressor (Withdrawn 2022)³
- D2584** Test Method for Ignition Loss of Cured Reinforced Resins
- D2766** Test Method for Specific Heat of Liquids and Solids (Withdrawn 2018)³
- D3167** Test Method for Floating Roller Peel Resistance of Adhesives
- D5420** Test Method for Impact Resistance of Flat, Rigid Plastic Specimen by Means of a Striker Impacted by a Falling Weight (Gardner Impact)
- E1269** Test Method for Determining Specific Heat Capacity by Differential Scanning Calorimetry
- E2716** Test Method for Determining Specific Heat Capacity by Modulated Temperature Differential Scanning Calorimetry
- E1640** Test Method for Assignment of the Glass Transition Temperature By Dynamic Mechanical Analysis
- F319** Practice for Polarized Light Detection of Flaws in Aerospace Transparency Heating Elements
- F320** Test Method for Hail Impact Resistance of Aerospace Transparent Enclosures
- F330** Test Method for Bird Impact Testing of Aerospace Transparent Enclosures
- F428** Test Method for Intensity of Scratches on Aerospace Glass Enclosures
- F484** Test Method for Stress Craze of Acrylic Plastics in Contact with Liquid or Semi-Liquid Compounds
- F520** Test Method for Environmental Resistance of Aerospace Transparencies to Artificially Induced Exposures
- F521** Test Methods for Bond Integrity of Transparent Laminates
- F548** Test Method for Intensity of Scratches on Aerospace Transparent Plastics
- F733** Practice for Optical Distortion and Deviation of Transparent Parts Using the Double-Exposure Method
- F734** Test Method for Shear Strength of Fusion Bonded Polycarbonate Aerospace Glazing Material
- F735** Test Method for Abrasion Resistance of Transparent Plastics and Coatings Using the Oscillating Sand Method
- F736** Test Method for Impact Resistance of Monolithic Polycarbonate Sheet by Means of a Falling Weight
- F791** Test Method for Stress Craze of Transparent Plastics
- F801** Test Method for Measuring Optical Angular Deviation of Transparent Parts
- F942** Guide for Selection of Test Methods for Interlayer Materials for Aerospace Transparent Enclosures
- F1164** Test Method for Evaluation of Transparent Plastics Exposed to Accelerated Weathering Combined with Biaxial Stress
- F1165** Test Method for Measuring Angular Displacement of Multiple Images in Transparent Parts
- F1181** Test Method for Measuring Binocular Disparity in Transparent Parts
- F1252** Test Method for Measuring Optical Reflectivity of Transparent Materials
- F1316** Test Method for Measuring the Transmissivity of Transparent Parts
- F1362** Test Method for Shear Strength and Shear Modulus of Aerospace Glazing Interlayer Materials
- F1864** Test Method for Dust Erosion Resistance of Optical and Infrared Transparent Materials and Coatings
- F2108** Practice for Inspection of Transparent Parts by Prism
- F2156** Test Method for Measuring Optical Distortion in Transparent Parts Using Grid Line Slope
- F2469** Test Method for Measuring Optical Angular Deviation of Transparent Parts Using the Double-Exposure Method
- G154** Practice for Operating Fluorescent Ultraviolet (UV) Lamp Apparatus for Exposure of Materials

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

3. Significance and Use

3.1 This guide is intended for use by material suppliers, aircraft transparent enclosure fabricators, air-frame manufacturers, government agencies, and others that may become involved in the testing of transparency components. These test methods provide data on both individual materials and material combinations commonly utilized in the fabrications of aerospace transparent enclosures comprised of monolithic plastic, coated monolithic plastic or laminated constructions containing plastics.

3.2 Primary properties and their long term stability are critical to the performance of aerospace transparent enclosures. Property measurement tests define as-manufactured material properties of these materials. Aging procedures provide for exposure of parts or representative sections to environments that induce changes in material properties as determined in property measurement tests. Property measurement tests performed before and after aging exposure provide a means of estimating the potential usable life span of a transparency or to compare the durability of one material with another.

3.3 When employing these test methods for comparison of materials for weathering effects the user should be aware that the many factors influencing degradation due to weathering vary from one location to another. For direct weathering comparisons, all material(s) shall undergo exposure conditions and property measurements testing at the same time.

3.4 The test methods listed include those considered critical to the performance of aircraft transparent enclosures. Other test methods to evaluate materials shall also be performed where

necessary. Additional test methods are in preparation and will be incorporated. The user is advised to employ the latest revision of any test method.

3.5 The dominant component of all transparent enclosures is one, or more, rigid transparent sheet(s). The sheet(s) must permit the necessary visibility while providing structural integrity and protecting the aircraft interior from external environments as required by the specific aircraft design.

3.6 In its most simple form, the rigid transparent sheet may be the only component of a transparent enclosure.

3.7 When more than one rigid transparent sheet is employed, the sheets are laminated with a controlled thickness with either an air gap or with a transparent adhesive known as an interlayer.

3.8 Transparent enclosure designs often use multiple rigid transparent sheets to take advantage of specific properties of different materials. In this instance, there will be functions required of one of the sheets but not the other.

3.9 The test methods, practices and guides listed are a summary of the available test methods applicable to plastic transparent enclosures. They are presented in this format to simplify the search and to enable the user to determine if a method applicable to his requirements is available.

4. Keywords

4.1 abrasion; acrylic; adhesion; aerospace; bonding; electrical; enclosures; environmental; impact; interlayers; materials; mechanical; optical; physical; plastic; polycarbonate; properties; thermal; transparent

[ASTM F790-23](https://standards.iteh.ai/catalog/standards/sist/1ff053c-352d-4370-b9a9-d4f959aebaf1/astm-f790-23)

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