



Designation: E 1420 - 91

Standard Practice for Specifying Polymeric Materials for Service in Ionizing Radiation Environments¹

This standard is issued under the fixed designation E 1420; 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 practice provides information about the preparation of documents that specify selection and test procedures for evaluating polymeric materials for use in ionizing radiation environments. Emphasis is placed on careful consideration of several environmental influence factors in addition to ionizing radiation.

1.2 In testing various types and forms of polymeric materials for service conditions, specification of appropriate critical physical-property parameters is essential. Reference is made, therefore, to various relevant ASTM standards covering mechanical, electrical, optical, and other properties associated with various physical forms of materials including adhesives, coatings, films, castings, and composites.

1.3 Typical applications of this practice are intended to be for materials incorporated into components of radiation accelerators, isotope sources, nuclear reactor facilities, and space vehicles and satellites. In industrial applications of radiation processing and effects testing of material products this practice may not be applicable, and should be considered on a case-by-case basis.

2. Referenced Documents

2.1 ASTM Standards:

- D 124 Specification for Degummed Soybean Oil²
- D 149 Test Method for Dielectric Breakdown Voltage and Dielectric Strength of Solid Electrical Insulating Materials at Commercial Power Frequencies³
- D 150 Test Methods for A-C Loss Characteristics and Permittivity (Dielectric Constant) of Solid Electrical Insulating Materials³
- D 229 Test Methods for Rigid Sheet and Plate Materials Used for Electrical Insulation³
- D 256 Test Methods for Impact Resistance of Plastics and Electrical Insulating Materials⁴
- D 297 Test Methods for Rubber Products—Chemical Analysis⁵
- D 349 Test Methods for Laminated Round Rods Used for Electrical Insulation³
- D 350 Test Methods for Flexible Treated Sleeving Used for Electrical Insulation³

- D 374 Test Methods for Thickness of Solid Electrical Insulation³
- D 542 Test Methods for Index of Refraction of Transparent Organic Plastics⁴
- D 618 Practice for Conditioning Plastics and Electrical Insulating Materials for Testing⁴
- D 621 Test Methods for Deformation of Plastics Under Load⁴
- D 638 Test Method for Tensile Properties of Plastics⁴
- D 638M Test Method for Tensile Properties of Plastics (Metric)⁴
- D 647 Practice for Design of Molds for Test Specimens of Plastic Molding Materials⁶
- D 648 Test Method for Deflection Temperature of Plastics Under Flexural Load⁴
- D 651 Test Method for Tensile Strength of Molded Electrical Insulating Materials³
- D 669 Test Method for Dissipation Factor and Permittivity Parallel with Laminations of Laminated Sheet and Plate³
- D 671 Test Method for Flexural Fatigue of Plastics by Constant-Amplitude-of-Force⁴
- D 695 Test Method for Compressive Properties of Rigid Plastics⁴
- D 695M Test Method for Compressive Properties of Rigid Plastics (Metric)⁴
- D 696 Test Method for Coefficient of Linear Thermal Expansion of Plastics⁴
- D 709 Specification for Laminated Thermosetting Materials³
- D 732 Test Method for Shear Strength of Plastics by Punch Tool⁴
- D 746 Test Method for Brittleness Temperature of Plastics and Elastomers by Impact⁴
- D 747 Test Method for Apparent Bending Modulus of Plastics by Means of a Cantilever Beam⁴
- D 756 Practice for Determination of Weight and Shape Changes of Plastics Under Accelerated Service Conditions⁴
- D 785 Test Method for Rockwell Hardness of Plastics and Electrical Insulating Materials⁴
- D 790 Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials⁴
- D 790M Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials (Metric)⁴

¹ This practice is under the jurisdiction of ASTM Committee E-10 on Nuclear Technology and Applications and is the direct responsibility of Subcommittee E10.07 on Radiation Dosimetry for Radiation Effects on Materials and Devices. Current edition approved May 15, 1991. Published July 1991.

² Annual Book of ASTM Standards, Vol 06.03.

³ Annual Book of ASTM Standards, Vol 10.01.

⁴ Annual Book of ASTM Standards, Vol 08.01.

⁵ Annual Book of ASTM Standards, Vol 09.01.

⁶ Annual Book of ASTM Standards, Vol 08.01.

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- D 792 Test Methods for Specific Gravity (Relative Density) and Density of Plastics by Displacement⁴
- D 794 Practice for Determining Permanent Effect of Heat on Plastics⁴
- D 796 Practice for Compression Molding Test Specimens of Phenolic Molding Compounds⁴
- D 797 Test Method for Rubber Property—Young's Modulus at Normal and Subnormal Temperatures⁵
- D 881 Test Method for Deviation of Line of Sight Through Transparent Plastics⁴
- D 882 Test Methods for Tensile Properties of Thin Plastic Sheet⁴
- D 897 Test Method for Tensile Properties of Adhesive Bonds⁷
- D 902 Test Methods for Flexible Resin-Coated Glass Fabrics and Glass Fabric Tapes Used for Electrical Insulation³
- D 903 Test Method for Peel or Stripping Strength of Adhesive Bonds⁷
- D 905 Test Method for Strength Properties of Adhesive Bonds in Shear by Compression Loading⁷
- D 907 Terminology of Adhesives⁷
- D 950 Test Method for Impact Strength of Adhesive Bonds⁷
- D 952 Test Method for Bond or Cohesive Strength of Sheet Plastics and Electrical Insulating Materials⁴
- D 953 Test Method for Bearing Strength of Plastics⁴
- D 1002 Test Method for Strength Properties of Adhesives in Shear by Tension Loading (Metal-to-Metal)⁷
- D 1003 Test Method for Haze and Luminous Transmittance of Transparent Plastics⁴
- D 1004 Test Method for Initial Tear Resistance of Plastic Film and Sheet⁴
- D 1042 Test Method for Linear Dimensional Changes of Plastics Under Accelerated Service Conditions⁴
- D 1044 Test Method for Resistance of Transparent Plastics to Surface Abrasion⁴
- D 1062 Test Method for Cleavage Strength of Metal-to-Metal Adhesive Bonds⁷
- D 1084 Test Methods for Viscosity of Adhesives⁷
- D 1144 Practice for Determining Strength Development of Adhesive Bonds⁷
- D 1183 Test Methods for Resistance of Adhesives to Cyclic Laboratory Aging Conditions⁷
- D 1204 Test Method for Linear Dimensional Changes of Nonrigid Thermoplastic Sheet or Film at Elevated Temperature⁴
- D 1299 Test Method for Shrinkage of Molded and Laminated Thermosetting Plastics at Elevated Temperature⁴
- D 1304 Methods of Testing Adhesives Relative to Their use as Electrical Insulation⁷
- D 1344 Method of Testing Cross-Lap Specimens for Tensile Properties of Adhesives⁸
- D 1389 Test Method for Proof-Voltage Testing of Thin Solid Electrical Insulating Materials³
- D 1494 Test Method for Diffuse Light Transmission Factor of Reinforced Plastics Panels⁹
- D 1503 Specification for Cellulose Acetate Butyrate (CAB) Plastic Pipe, Schedule 40⁹
- D 1505 Test Method for Density of Plastics by the Density-Gradient Technique⁴
- D 1531 Test Method for Relative Permittivity (Dielectric Constant) and Dissipation Factor of Polyethylene by Liquid Displacement Procedure³
- D 1600 Terminology Relating to Abbreviations, Acronyms, and Codes for Terms Relating to Plastics⁴
- D 1621 Test Method for Compressive Properties of Rigid Cellular Plastics¹⁰
- D 1623 Test Method for Tensile and Tensile Adhesion Properties of Rigid Cellular Plastics¹⁰
- D 1637 Test Method for Tensile Heat Distortion Temperature of Plastic Sheet¹⁰
- D 1673 Test Methods for Relative Permittivity and Dissipation Factor of Expanded Cellular Plastics Used for Electrical Insulation¹⁰
- D 1708 Test Method for Tensile Properties of Plastics by Use of Microtensile Specimens¹⁰
- D 1711 Terminology Relating to Electrical Insulation³
- D 1729 Practice for Visual Evaluation of Color Differences of Opaque Materials¹¹
- D 1746 Test Method for Transparency of Plastic Sheet¹⁰
- D 1747 Test Method for Refractive Index of Viscous Materials¹²
- D 1780 Practice for Conducting Creep Tests of Metal-to-Metal Adhesives⁷
- D 1790 Test Method for Brittleness Temperature of Plastic Sheet by Impact¹⁰
- D 1822 Test Method for Tensile-Impact Energy to Break Plastics and Electrical Insulating Materials¹⁰
- D 1822M Test Method for Tensile-Impact Energy to Break Plastics and Electrical Insulating Materials (Metric)¹⁰
- D 1830 Test Method for Thermal Endurance of Flexible Sheet Materials Used for Electrical Insulation by the Curved Electrode Method³
- D 1870 Practice for Elevated Temperature Aging Using a Tubular Oven¹⁰
- D 1876 Test Method for Peel Resistance of Adhesives (T-Peel Test)⁷
- D 1879 Practice for Exposure of Adhesive Specimens to High-Energy Radiation⁷
- D 1897 Practice for Injection Molding Test Specimens of Thermoplastic Molding and Extrusion Materials¹⁰
- D 1898 Practice for Sampling of Plastics¹⁰
- D 1916 Test Method for Penetration of Adhesives⁷
- D 1928 Practice for Preparation of Compression-Molded Polyethylene Test Sheets and Test Specimens¹⁰
- D 2093 Practice for Preparation of Surfaces of Plastics Prior to Adhesive Bonding⁷
- D 2094 Practice for Preparation of Bar and Rod Specimens for Adhesion Tests⁷
- D 2182 Test Method for Strength Properties of Metal-to-Metal Adhesives by Compression Loading (Disk Shear)¹³

⁷ Annual Book of ASTM Standards, Vol 15.06.

⁸ Discontinued; see 1986 Annual Book of ASTM Standards, Vol 15.06.

⁹ Annual Book of ASTM Standards, Vol 08.04.

¹⁰ Annual Book of ASTM Standards, Vol 08.02.

¹¹ Annual Book of ASTM Standards, Vol 14.02.

¹² Annual Book of ASTM Standards, Vol 05.01.

¹³ Discontinued; see 1984 Annual Book of ASTM Standards, Vol 15.06.

- D 2244 Test Method for Calculation of Color Differences from Instrumentally Measured Color Coordinates¹⁴
- D 2290 Test Method for Apparent Tensile Strength of Ring or Tubular Plastics and Reinforced Plastics by Split Disk Method¹⁵
- D 2293 Test Method for Creep Properties of Adhesives in Shear by Compression Loading (Metal-to-Metal)⁷
- D 2294 Test Method for Creep Properties of Adhesives in Shear by Tension Loading (Metal-to-Metal)⁷
- D 2295 Test Method for Strength Properties of Adhesives in Shear by Tension Loading at Elevated Temperatures (Metal-to-Metal)⁷
- D 2304 Test Method for Thermal Endurance of Rigid Electrical Insulating Materials³
- D 2305 Test Methods for Polymeric Films Used for Electrical Insulation³
- D 2343 Test Method for Tensile Properties of Glass Fiber Strands, Yarns, and Rovings Used in Reinforced Plastics¹⁰
- D 2344 Test Method for Apparent Interlaminar Shear Strength of Parallel Fiber Composites by Short Beam Method¹⁵
- D 2370 Test Method for Tensile Properties of Organic Coatings¹⁴
- D 2381 Test Methods for Flexible Composite Materials Used for Electrical Insulation³
- D 2445 Test Method for Thermal Oxidative Stability of Propylene Plastics¹⁶
- D 2454 Practice for Determining the Effect of Overbaking on Organic Coatings¹⁴
- D 2485 Test Methods for Evaluating Coatings for High Temperature Service¹⁴
- D 2557 Test Method for Strength Properties of Adhesives in Shear by Tension Loading in the Temperature Range from -267.8 to -55°C (-450 to -67°F)⁷
- D 2562 Practice for Classifying Visual Defects in Parts Molded from Reinforced Thermosetting Plastics¹⁰
- D 2582 Test Method for Puncture-Propagation Tear Resistance of Plastic Film and Thin Sheet¹⁰
- D 2583 Test Method for Indentation Hardness of Rigid Plastics by Means of Barcol Impressor¹⁰
- D 2633 Method of Testing Thermoplastic Insulations and Jackets for Wire and Cable¹⁷
- D 2651 Practice for Preparation of Metal Surfaces for Adhesive Bonding⁷
- D 2732 Test Method for Unrestrained Linear Thermal Shrinkage of Plastic Film and Sheet¹⁰
- D 2739 Test Method for Volume Resistivity of Conductive Adhesives⁷
- D 2794 Test Method for Resistance of Organic Coatings on the Effects of Rapid Deformation (Impact)¹⁴
- D 2861 Test Methods for Flexible Composites of Copper Foil with Dielectric Film or Treated Fabrics¹⁷
- D 2918 Practice for Determining Durability of Adhesive Joints Stressed in Peel⁷
- D 2919 Test Method for Determining Durability of Adhesive Joints Stressed in Shear by Tension Loading⁷
- D 2990 Test Methods for Tensile, Compressive, and Flexural Creep and Creep Rupture of Plastics¹⁰
- D 3029 Test Method for Impact Resistance of Rigid Plastic Sheet or Parts by Means of a Tup (Falling Weight)¹⁰
- D 3039 Test Method for Tensile Properties of Fiber-Resin Composites¹⁵
- D 3045 Practice for Heat Aging of Plastics Without Load¹⁰
- D 3106 Test Method for Permanent Deformation of Elastomeric Yarns¹⁸
- D 3151 Test Method for Thermal Failure Under Electric Stress of Solid Electrical Insulating Materials¹⁷
- D 3163 Practice for Determining the Strength of Adhesively Bonded Rigid Plastic Lap-Shear Joints in Shear by Tension Loading⁷
- D 3164 Practice for Determining the Strength of Adhesively Bonded Plastic Lap-Shear Sandwich Joints in Shear by Tension Loading⁷
- D 3165 Test Method for Strength Properties of Adhesives in Shear by Tension Loading of Laminated Assemblies⁷
- D 3379 Test Method for Tensile Strength and Young's Modulus for High-Modulus Single-Filament Materials¹⁵
- D 3380 Test Method for Permittivity (Dielectric Constant) and Dissipation Factor of Plastic-Based Microwave Circuit Substrates¹⁷
- D 3386 Test Method for Coefficients of Linear Thermal Expansion of Electrical Insulating Materials³
- D 3394 Methods of Sampling and Testing Electrical Insulating Board¹⁷
- D 3410 Test Method for Compressive Properties of Unidirectional or Crossply Fiber-Resin Composites¹⁵
- D 3417 Test Method for Heats of Fusion and Crystallization of Polymers by Thermal Analysis¹⁹
- D 3418 Test Method for Transition Temperatures of Polymers by Thermal Analysis¹⁹
- D 3420 Test Method for Dynamic Ball Burst (Pendulum) Impact Resistance of Plastic Film¹⁹
- D 3426 Test Method for Dielectric Breakdown Voltage and Dielectric Strength of Solid Electrical Insulating Materials Using Impulse Waves¹⁷
- D 3433 Test Method for Fracture Strength in Cleavage of Adhesives in Bonded Joints⁷
- D 3479 Test Methods for Tension-Tension Fatigue of Oriented Fiber, Resin Matrix Composites¹⁵
- D 3518 Practice for In-Plane Shear Stress-Strain Response of Unidirectional Reinforced Plastics¹⁵
- D 3528 Test Method for Strength Properties of Double Lap Shear Adhesive Joints by Tension Loading²⁰
- D 3636 Practice for Sampling and Judging Quality of Solid Electrical Insulating Materials¹⁷
- D 3638 Test Method for Comparative Tracking Index of Electrical Insulating Materials¹⁷
- D 3755 Test Method for Dielectric Breakdown Voltage and Dielectric Strength of Solid Electrical Insulating Materials Under Direct Voltage Stress¹⁷

¹⁴ Annual Book of ASTM Standards, Vol 06.01.

¹⁵ Annual Book of ASTM Standards, Vol 15.03.

¹⁶ Discontinued; see 1986 Annual Book of ASTM Standards, Vol 08.02.

¹⁷ Annual Book of ASTM Standards, Vol 10.02.

¹⁸ Annual Book of ASTM Standards, Vol 07.01.

¹⁹ Annual Book of ASTM Standards, Vol 08.03.

²⁰ Annual Book of ASTM Standards, Vol 15.01.