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AMERICAN SOCIETY FOR TESTING AND MATERIALS
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Standard Test Method for Determining Temperatures and Heats of Transitions of Fluoropolymers by Differential Scanning Calorimetry¹

This standard is issued under the fixed designation D 4591; 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 defines conditions for the use of differential scanning calorimetry (DSC) with fluoropolymers. It covers the use of DSC analyses with the fluoropolymers, PTFE, PVDF, PCTFE, and PVF and their copolymers PFA, FEP, ECTFE, EFEP, VDF/HFP, VDF/TFE/HFP, VDF/CTFE. The test method is applicable to the analysis of powders as well as samples taken from semi-finished or finished products. The nature of fluoropolymers is such that special procedures are needed for running DSC analysis and interpreting the results.

1.2 The values stated in SI units as detailed in Practice E 380 are to be regarded as the standard and the practices of Practice E 380 incorporated herein.

1.3 *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.*

NOTE 1—There is currently no ISO standard that duplicates this test method. Pending ISO 12086-1 and ISO 12086-2 cover similar testing and reference this test method for testing conditions.

2. Referenced Documents

2.1 ASTM Standards:

- D 1600 Terminology for Abbreviated Terms Relating to Plastics²
- D 3417 Test Method for Heats of Fusion and Crystallization of Polymers by Thermal Analysis³
- D 3418 Test Method for Transition Temperatures of Polymers by Thermal Analysis³
- D 4894 Specification for Polytetrafluoroethylene (PTFE) Granular Molding and Ram Extrusion Materials⁴
- D 4895 Specification for Polytetrafluoroethylene (PTFE) Resins Produced From Dispersion⁴
- E 380 Practice for Use of the International System of Units

¹ This test method is under the jurisdiction of ASTM Committee D-20 on Plastics and is the direct responsibility of Subcommittee D20.15 on Thermoplastic Materials.

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² Annual Book of ASTM Standards, Vol. 08.01.

³ Annual Book of ASTM Standards, Vol. 08.02.

⁴ Annual Book of ASTM Standards, Vol. 08.03.

(SI) (the Modernized Metric System)⁵

E 473 Terminology Relating to Thermal Analysis⁵

E 793 Test Method for Heats of Fusion and Crystallization by Differential Scanning Calorimetry⁵

2.2 ISO Standards:⁶

ISO 12086-1 Plastics—Fluoropolymer Dispersion and Molding and Extrusion Materials—Part 1: Designation and Specification

ISO 12086-2 Plastics—Fluoropolymer Dispersion and Molding and Extrusion Materials—Part 2: Preparation of Test Specimen and Determination of Properties

3. Terminology

3.1 Definitions:

3.1.1 *differential scanning calorimetry (DSC)*—a technique in which the difference in energy inputs into a substance and a reference material is measured as a function of temperature, while the substance and reference material are subjected to a controlled increase or decrease in temperature.

3.1.2 Refer to Terminology E 473 for general terminology used in this test method.

3.2 Abbreviated Terms:

3.2.1 Abbreviations used in this test method are in accordance with Terminology D 1600.

3.2.2 PTFE—polytetrafluoroethylene.

3.2.3 PFA—perfluoro(alkoxy alkane) resin.

3.2.4 FEP—perfluoro(ethylene-propene) copolymer.

3.2.5 ETFE—ethylene-tetrafluoroethylene copolymer.

3.2.6 PVDF—poly(vinylidene fluoride).

3.2.7 PCTFE—polymonochlorotrifluoroethylene.

3.2.8 ECTFE—ethylene-monochlorotrifluoroethylene copolymer.

3.2.9 EFEP—ethylene-perfluoroethylene-propene copolymer.

3.2.10 VDF/HFP—vinylidene fluoride-hexafluoropropene copolymer.

3.2.11 VDF/TFE—vinylidene fluoride-tetrafluoroethylene copolymer.

3.2.12 VDF/TFE/HFP—vinylidene fluoride-tetrafluoroethylene-hexafluoropropene copolymer.

⁵ Annual Book of ASTM Standards, Vol. 14.02.

⁶ Available from American National Standards Institute, 11 W. 42nd St., 13th Floor, New York, NY 10036.