



Designation: D4591 – 17

Standard Test Method for Determining Temperatures and Heats of Transitions of Fluoropolymers by Differential Scanning Calorimetry¹

This standard is issued under the fixed designation D4591; 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.

This standard has been approved for use by agencies of the U.S. Department of Defense.

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, MFA, 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 [IEEE/ASTM SI-10](#) are to be regarded as the standard.

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

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

1.4 *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

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

[D1600 Terminology for Abbreviated Terms Relating to Plastics](#)

[D3418 Test Method for Transition Temperatures and Enthalpies of Fusion and Crystallization of Polymers by Differential Scanning Calorimetry](#)

[D4894 Specification for Polytetrafluoroethylene \(PTFE\) Granular Molding and Ram Extrusion Materials](#)

[D4895 Specification for Polytetrafluoroethylene \(PTFE\) Resin Produced From Dispersion](#)

[E473 Terminology Relating to Thermal Analysis and Rheology](#)

[E793 Test Method for Enthalpies of Fusion and Crystallization by Differential Scanning Calorimetry](#)

[IEEE/ASTM SI-10 Standard for Use of the International System of Units \(SI\) \(the Modern Metric System\)](#)

2.2 ISO Standards:³

[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 [E473](#) 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 [D1600](#).

3.2.2 PTFE—polytetrafluoroethylene.

3.2.3 PFA—perfluoro(alkoxy alkane) resin.

3.2.4 FEP—perfluoro(ethylene-propene) copolymer.

³ Available from American National Standards Institute (ANSI), 25 W. 43rd St., 4th Floor, New York, NY 10036, <http://www.ansi.org>.

*A Summary of Changes section appears at the end of this standard