



Standard Test Method for Heat of Reaction of Thermally Reactive Materials by Differential Scanning Calorimetry¹

This standard is issued under the fixed designation E2160; 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 determines the exothermic heat of reaction of thermally reactive chemicals or chemical mixtures, using milligram specimen sizes, by differential scanning calorimetry. Such reactive materials may include thermally unstable or thermoset materials.

1.2 This test method also determines the extrapolated onset temperature and peak heat flow temperature for the exothermic reaction.

1.3 This test method may be performed on solids, liquids or slurries.

1.4 The applicable temperature range of this method is 25 to 600°C.

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

1.6 There is no ISO method equivalent to this standard.

1.7 This standard is related to Test Method E537 and to NAS 1613, but provides additional information.

1.8 *This standard may involve hazardous materials, operations, and equipment. 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

E473 Terminology Relating to Thermal Analysis and Rheology

¹ This test method is under the jurisdiction of ASTM Committee E37 on Thermal Measurements and is the direct responsibility of Subcommittee E37.01 on Calorimetry and Mass Loss.

Current edition approved Sept. 1, 2012. Published September 2012. Originally approved in 2001. Last previous edition approved in 2004 as E2160 – 04. DOI: 10.1520/E2160-04R12.

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.

E537 Test Method for The Thermal Stability of Chemicals by Differential Scanning Calorimetry

E967 Test Method for Temperature Calibration of Differential Scanning Calorimeters and Differential Thermal Analyzers

E968 Practice for Heat Flow Calibration of Differential Scanning Calorimeters

E1142 Terminology Relating to Thermophysical Properties

E1231 Practice for Calculation of Hazard Potential Figures-of-Merit for Thermally Unstable Materials

E1860 Test Method for Elapsed Time Calibration of Thermal Analyzers

2.2 *Other Standard:*

NAS 1613 Seal Element, Packing, Preformed, Ethylene Propylene Rubber, National Aerospace Standard, Aerospace Industries Association of America, 1725 DeSales St., NM, Washington, DC 20036

3. Terminology

3.1 Specific technical terms used in this standard are defined in Terminologies E473 and E1142.

4. Summary of Test Method

4.1 A small (milligram) quantity of the reactive material is heated at 10°C/min through a temperature region where a chemical reaction takes place. The exothermic heat flow produced by the reaction is recorded as a function of temperature and time by a differential scanning calorimeter. Integration of the exothermic heat flow over time yields the heat of reaction. If the heat flow is endothermic, then this test method is not to be used.

4.2 The test method can be used to determine the fraction of a reaction that has occurred in a partially reacted sample. The heat of reaction is determined for a specimen that is known to be 100 % unreacted and is compared to the heat of reaction determined for the partially reacted sample. Appropriate calculation yields the fraction of the latter sample that was unreacted.

4.3 Subtracting the reaction fraction remaining from unity (1) yields the fraction reacted. The fraction reacted may be expressed as percent. If the sample tested is a thermoset resin, the percent reacted is often called the percent of cure.