



Standard Test Method for Kinetic Parameters for Thermally Unstable Materials Using Differential Scanning Calorimetry and the Flynn/Wall/Ozawa Method¹

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INTRODUCTION

The kinetics of exothermic reactions are important in assessing the potential of materials and systems for thermal explosion. This test method provides a means for determining Arrhenius activation energies and pre-exponential factors using differential thermal methods. This test method is to be used in conjunction with other tests to characterize the hazard potential of chemicals.

1. Scope*

1.1 This test method covers the determination of the overall kinetic parameters for exothermic reactions using the Flynn/Wall/Ozawa method and differential scanning calorimetry.

1.2 This technique is applicable to reactions whose behavior can be described by the Arrhenius equation and the general rate law.

1.3 *Limitations*—There are cases where this technique is not applicable. Limitations may be indicated by curves departing from a straight line (see 11.2) or the isothermal aging test not closely agreeing with the results predicted by the calculated kinetic values. In particular, this test method is not applicable to reactions that are partially inhibited. The technique may not work with reactions that include simultaneous or consecutive reaction steps. This test method may not apply to materials that undergo phase transitions if the reaction rate is significant at the transition temperature.

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

1.5 *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.*

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.

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2. Referenced Documents

2.1 ASTM Standards:²

- E473 Terminology Relating to Thermal Analysis and Rheology
- E691 Practice for Conducting an Interlaboratory Study to Determine the Precision of a Test Method
- 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
- E1445 Terminology Relating to Hazard Potential of Chemicals
- E1860 Test Method for Elapsed Time Calibration of Thermal Analyzers
- E1970 Practice for Statistical Treatment of Thermoanalytical Data
- E2890 Test Method for Kinetic Parameters for Thermally Unstable Materials by Differential Scanning Calorimetry Using the Kissinger Method

3. Terminology

3.1 Technical terms used in this test method are defined in Terminologies E473, E1142, and E1445 including *activation energy*, *Arrhenius equation*, *Celsius*, *differential scanning calorimetry*, *enthalpy*, *general rate law*, *Kelvin*, *kinetics*, *peak value*, *pre-exponential factor*, *reaction*, *reaction order*, and *temperature*.

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.

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