



Standard Test Method for Decomposition Kinetics by Thermogravimetry Using the Ozawa/Flynn/Wall Method¹

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1. Scope*

1.1 This test method describes the determination of the kinetic parameters, Arrhenius activation energy, and pre-exponential factor by thermogravimetry, based on the assumption that the decomposition obeys first-order kinetics using the Ozawa/Flynn/Wall isoconversional method (**1, 2**).²

1.2 This test method is generally applicable to materials with well-defined decomposition profiles, namely, a smooth, continuous mass change with a single maximum rate.

1.3 This test method is normally applicable to decomposition occurring in the range from 400 to 1300 K (nominally 100 to 1000°C). The temperature range may be extended depending on the instrumentation used.

1.4 This test method is similar to ISO 11358-2 but differs in its mathematical treatment.

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 *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:³

- E29 Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications
- 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.

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² The boldface numbers in parentheses refer to the list of references at the end of this standard.

³ 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.

E691 Practice for Conducting an Interlaboratory Study to Determine the Precision of a Test Method

E1142 Terminology Relating to Thermophysical Properties

E1582 Practice for Calibration of Temperature Scale for Thermogravimetry

E1877 Practice for Calculating Thermal Endurance of Materials from Thermogravimetric Decomposition Data

E1970 Practice for Statistical Treatment of Thermoanalytical Data

E2040 Test Method for Mass Scale Calibration of Thermogravimetric Analyzers

2.2 Other Standard:⁴

ISO 11358-2 Plastics Thermogravimetry (TG) of Polymers Part 2: Determination of Kinetic Parameters

3. Terminology

3.1 *Definitions*—Technical terms used in this test method are defined in Terminologies E473 and E1142 and include activation energy, Celsius, failure, failure criterion, and thermogravimetric analyzer.

4. Summary of Test Method

4.1 This test method is based upon the general rate equation that takes the form of:

$$d\alpha/dT = A(1 - \alpha) \exp[-E/RT]^\beta \quad (1)$$

where:

- α = fraction reacted (dimensionless),
- A = pre-exponential factor (min^{-1}),
- β = heating rate (K/min),
- E = activation energy (J/mol),
- R = gas constant ($=8.316 \text{ J/(mol K)}$),
- T = absolute temperature (K),
- $\exp$ = Euler's number exponential, and
- $d\alpha/dT$ = rate of change of α with T .

4.2 Using the method of Ozawa, Flynn and Wall (**1, 2**), Eq 1 may be solved for activation energy:

$$E = (R/b) \Delta \log[\beta] / \Delta(1/T) \quad (2)$$

⁴ 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