Designation: E3142 – 18

Standard Test Method for Thermal Lag of Thermal Analysis Apparatus[1]

This standard is issued under the fixed designation E3142; 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.

INTRODUCTION

In thermal analysis, the temperature of a test specimen is changed while a physical property is measured. The measured physical property is the dependent variable and temperature (also measured) is the independent variable. In the majority of thermal analysis apparatus, temperature sensors cannot be attached directly to the specimen but can only touch the surface or be placed adjacent or close to the specimen such that the indicated temperature will be different to that of the specimen itself. In consequence the specimen temperature will lag the indicated temperature upon heating and cooling due to thermal resistance between sensor and specimen. The larger the test specimen, the greater the thermal lag is likely to be. To obtain the correct specimen temperature, thermal analysis apparatus is temperature calibrated so that the recorded temperature correctly indicates the specimen temperature. Such temperature calibration compensates for the temperature offset (τ) between the specimen temperature and that of the temperature sensor. This temperature offset changes linearly with temperature rate-of-change (β) (heating or cooling). The slope of this linear relationship is known as "thermal lag" ($\Delta T/\Delta\beta$). The thermal lag for an apparatus permits temperature calibration determined at one temperature rate-of-change to be adjusted to that at other rates. It is the purpose of this standard to aid the user to determine the thermal lag for an apparatus and to apply that thermal lag to measurements made at temperature rates-of-change different from that at which the temperature calibration is performed.

1. Scope

1.1 This test method addresses the dependence of temperature calibration on the temperature rate-of-change. This test method describes the determination of the thermal lag of thermal analysis apparatus and its application to the modification of the temperature calibration for that apparatus obtained at alternative linear temperature rates-of-change.

1.2 This test method is applicable, but not limited to, the temperature calibration of differential thermal analyzers (DTAs), differential scanning calorimeters (DSCs), thermogravimetric analyzers (TGAs), thermomechanical analyzers (TMAs), and dynamic mechanical analyzers (DMAs).

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

1.4 *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.*

1.5 *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]

E473 Terminology Relating to Thermal Analysis and Rheology

E698 Test Method for Kinetic Parameters for Thermally Unstable Materials Using Differential Scanning Calorimetry and the Flynn/Wall/Ozawa Method

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

[1] This test method is under the jurisdiction of ASTM Committee E37 on Thermal Measurements and is the direct responsibility of Subcommittee E37.10 on Fundamental, Statistical and Mechanical Properties.

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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.