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Plastics — Differential scanning calorimetry (DSC) —

Part 4: Determination of specific heat capacity

Plastiques — Analyse calorimétrique différentielle (DSC) —

Partie 4: Détermination de la capacité thermique massique

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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This document was prepared by Technical Committee ISO/TC 61, *Plastics*, Subcommittee SC 5, *Physical-chemical properties,* in collaboration with the European Committee for Standardization (CEN) Technical Committee CEN/TC 249, *Plastics,* in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement).

This third edition cancels and replaces the second edition (ISO 11357-4:2014), which has been technically revised. The main changes compared to the previous edition are as follows:

— the measurement procedure has been updated;

— reference data of α-alumina have been updated.

A list of all parts in the ISO 11357 series can be found on the ISO website.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Plastics — Differential scanning calorimetry (DSC) —

Part 4:
Determination of specific heat capacity

1 Scope

This document specifies methods for determining the specific heat capacity of plastics by differential scanning calorimetry.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 472, *Plastics — Vocabulary*

ISO 11357-1, *Plastics — Differential scanning calorimetry (DSC) — Part 1: General principles*

ISO 80000-1, *Quantities and units — Part 1: General*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 472, ISO 11357-1 and the following apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at http://www.electropedia.org/

3.1
calibration material
material of known specific heat capacity

Note 1 to entry: Usually, α-alumina (such as synthetic sapphire) of 99,9 % or higher purity is used as the calibration material.

3.2
specific heat capacity at constant pressure
c_p
quantity of heat necessary to raise the temperature of unit mass of material by 1 K at constant pressure

Note 1 to entry: It is given by the following formula:

$$c_p = m^{-1} \cdot C_p = m^{-1} \cdot \left(\frac{dQ}{dT} \right)_p$$

where

c_p is the specific heat capacity and is expressed in kilojoules per kilogram per K ($kJ \cdot kg^{-1} \cdot K^{-1}$) or in joules per gram per K ($J \cdot g^{-1} \cdot K^{-1}$); subscript p indicates an isobaric process;

m is the mass of material, expressed in kilogram (kg) or gram (g);

C_p is the total heat capacity and is expressed in kilojoules per K ($kJ \cdot K^{-1}$) or in joules per K ($J \cdot K^{-1}$); subscript p indicates an isobaric process;

$\left(\frac{dQ}{dT}\right)_p$ is the quantity of heat dQ necessary to raise the temperature of the material by dT, expressed in kilojoules per K ($kJ \cdot K^{-1}$) or in joules per K ($J \cdot K^{-1}$), measured at constant pressure.

This formula is valid in a temperature range where a material shows no first-order phase transition.

The quotient $\left(\frac{dQ}{dT}\right)$ can be obtained by dividing the heat flow rate by the heating rate:

$$(dQ/dT) = \frac{(dQ/dt)}{(dT/dt)}$$

where

(dQ/dt) is the heat flow rate, expressed in kilojoules per second ($kJ \cdot s^{-1}$) or in joules per second ($J \cdot s^{-1}$) or in watts (W);

(dT/dt) is the heating rate, expressed in kelvins (K) per second (s) ($K \cdot s^{-1}$).

Note 2 to entry: At phase transitions, there is a discontinuity in the heat capacity. Part of the heat is consumed to produce a material state of higher energy and it is not all used in raising the temperature. For this reason, the specific heat can only be determined properly outside regions of phase transitions.

4 Principle

4.1 General

Each measurement consists of three runs at the same scanning rate (see Figure 1):

a) a blank run (empty crucibles in sample and reference holders);

b) a calibration run (calibration material in sample holder crucible and empty crucible in reference holder);

c) a specimen run (specimen in sample holder crucible and empty crucible in reference holder).

