Irish Standard
I.S. EN ISO 22007-6:2015

Plastics - Determination of thermal conductivity and thermal diffusivity - Part 6: Comparative method for low thermal conductivities using a temperature-modulation technique (ISO 22007-6:2014)

I.S. EN ISO 22007-6:2015

Incorporating amendments/corrigenda/National Annexes issued since publication:

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This document is based on:	*Published:*
EN ISO 22007-6:2015	2015-03-18

This document was published under the authority of the NSAI and comes into effect on:	ICS number:
2015-04-06	83.080.01
	NOTE: If blank see CEN/CENELEC cover page

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EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

EN ISO 22007-6

March 2015

ICS 83.080.01

English Version

Plastics - Determination of thermal conductivity and thermal diffusivity - Part 6: Comparative method for low thermal conductivities using a temperature-modulation technique (ISO 22007-6:2014)

Plastiques - Détermination de la conductivité thermique et de la diffusivité thermique - Partie 6: Méthode comparative pour faibles conductivités thermiques utilisant une technique de modulation de la température (ISO 22007-6:2014)

Kunststoffe - Bestimmung der Wärmeleitfähigkeit und der Temperaturleitfähigkeit - Teil 6: Vergleichsmethoden für geringe Wärmeleitfähigkeit unter Anwendung einer Temperaturanpassungsmethode (ISO 22007-6:2014)

This European Standard was approved by CEN on 12 March 2015.

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Foreword

The text of ISO 22007-6:2014 has been prepared by Technical Committee ISO/TC 61 “Plastics” of the International Organization for Standardization (ISO) and has been taken over as EN ISO 22007-6:2015 by Technical Committee CEN/TC 249 “Plastics” the secretariat of which is held by NBN.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by September 2015, and conflicting national standards shall be withdrawn at the latest by September 2015

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN [and/or CENELEC] shall not be held responsible for identifying any or all such patent rights.

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INTERNATIONAL STANDARD

ISO 22007-6

First edition
2014-06-01

Plastics — Determination of thermal conductivity and thermal diffusivity —

Part 6: Comparative method for low thermal conductivities using a temperature-modulation technique

Plastiques — Détermination de la conductivité thermique et de la diffusivité thermique —

Partie 6: Méthode comparative pour faibles conductivités thermiques utilisant une technique de modulation de la température

Reference number
ISO 22007-6:2014(E)

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Published in Switzerland

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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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For an explanation on the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the WTO principles in the Technical Barriers to Trade (TBT) see the following URL: Foreword - Supplementary information

The committee responsible for this document is ISO/TC 61, *Plastics*, Subcommittee SC 5, *Physical-chemical properties*.

ISO 22007 consists of the following parts, under the general title *Plastics — Determination of thermal conductivity and thermal diffusivity*:

— *Part 1: General principles*

— *Part 2: Transient plane heat source (hot disc) method*

— *Part 3: Temperature wave analysis method*

— *Part 4: Laser flash method*

— *Part 5: Results of interlaboratory testing of poly(methyl methacrylate) samples* [Technical Report]

— *Part 6: Comparative method for low thermal conductivities using a temperature-modulation technique*

Introduction

Thermal insulating properties have become more important in view of power-saving technology. The method which is applicable to measure the lower thermal conductivity in smaller scale with a small amount of a specimen, such as a tray for food, a thermal printing film, a gelled sheet for the electric parts inside laptop PC, an adhesive paste, etc., is required for the micro-scale thermal design of plastics. A double-sensor system of high-sensitivity thermopile located in the different distances in the modulated temperature field, which is controlled by the Peltier thermo-module, is proposed for the determination of thermal conductivity of plastics. A decay parameter is utilized to determine the thermal conductivity of the sample. This method is applied to the measurement of low thermal conductivity in the range below 1,0 W/mK.

In contrast to a pulse or a transient method, high sensitivity and high-temperature resolution are characteristic of temperature modulated technique, in which employment of a lock-in amplifier reduces any influence of noise and interference.

The thermal conductivity of materials that are poor conductors of heat is usually determined by measuring the larger temperature gradients in the sample produced by a steady flow of heat in one-dimensional geometry. In order to reduce the errors of radiation and convection, it often requires large, precisely shaped samples and extreme care to be used successfully.

This part of ISO 22007 specifies a modulated temperature method to determine the thermal conductivity with a small temperature variation, minimizing the influence of radiation and convection.

Plastics — Determination of thermal conductivity and thermal diffusivity —

Part 6: Comparative method for low thermal conductivities using a temperature-modulation technique

1 Scope

This part of ISO 22007 specifies a modulated temperature method realizing the measurement of thermal conductivity. An input of temperature deviation is less than 1 K, and a double lock-in method is applied to amplify the small temperature modulation.

ISO 22007-3 specifies one of the modulated temperature methods where the phase shift is measured in the thermally thick condition, $kd >> 1$ [$k = (\omega/2\alpha)^{1/2}$, ω: angular frequency of temperature wave, α: thermal diffusivity, and d: thickness of the specimen]. In this condition, the backing material does not affect on the phase shift results on the sensor, on which temperature wave decays exponentially.

On the other hand, if $kd << 1$, the decay of temperature modulation is influenced by the backing materials. Based on this principle, this part of ISO 22007 specifies the method to determine the thermal conductivity of the sample (as a backing material), comparing the decay of temperature wave detected on both surfaces of the probe material.

Thermal conductivity is determined from the correlation between the thermal impedance and the decay ratio of amplitude using two reference materials measured at the same frequency and temperature.

The covering thermal conductivity range is adjusted with the reference materials and the probe materials. Basically, thermal conductivity is determined in the range from 0,026 W/mK to 0,6 W/mK.

In the case applying the method to inhomogeneous materials, cares must be taken to choose the appropriate measurement conditions in accordance with the thermal penetration depth.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. 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 22007-1, *Plastics — Determination of thermal conductivity and thermal diffusivity — Part 1: General principles*

ISO 22007-3, *Plastics — Determination of thermal conductivity and thermal diffusivity — Part 3: Temperature wave analysis method*

ISO/TR 22007-5, *Plastics — Determination of thermal conductivity and thermal diffusivity — Part 5: Results of interlaboratory testing of poly(methyl methacrylate) samples*

ISO 80000-5, *Quantities and units — Part 5: Thermodynamics*