
**Plastics — Determination of thermal
conductivity and thermal diffusivity —**

Part 3:

Temperature wave analysis method

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

Partie 3: Méthode par analyse de l'oscillation de la température



PDF disclaimer

This PDF file may contain embedded typefaces. In accordance with Adobe's licensing policy, this file may be printed or viewed but shall not be edited unless the typefaces which are embedded are licensed to and installed on the computer performing the editing. In downloading this file, parties accept therein the responsibility of not infringing Adobe's licensing policy. The ISO Central Secretariat accepts no liability in this area.

Adobe is a trademark of Adobe Systems Incorporated.

Details of the software products used to create this PDF file can be found in the General Info relative to the file; the PDF-creation parameters were optimized for printing. Every care has been taken to ensure that the file is suitable for use by ISO member bodies. In the unlikely event that a problem relating to it is found, please inform the Central Secretariat at the address given below.

This document is a preview generated by EVS



COPYRIGHT PROTECTED DOCUMENT

© ISO 2008

All rights reserved. Unless otherwise specified, no part of this publication may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying and microfilm, without permission in writing from either ISO at the address below or ISO's member body in the country of the requester.

ISO copyright office
Case postale 56 • CH-1211 Geneva 20
Tel. + 41 22 749 01 11
Fax + 41 22 749 09 47
E-mail copyright@iso.org
Web www.iso.org

Published in Switzerland

Contents

Page

Foreword.....	iv
Introduction.....	v
1 Scope.....	1
2 Normative references.....	1
3 Terms and definitions.....	1
4 Symbols and units.....	2
5 Principle.....	2
6 Apparatus.....	2
6.1 General.....	2
6.2 Constant-temperature enclosure.....	3
6.3 Heater and sensor elements.....	3
6.4 Heating circuit.....	5
6.5 Measurement circuit.....	5
6.6 Phase-shift measurement device.....	5
6.7 Devices for measuring the specimen temperature.....	5
7 Test specimen.....	6
7.1 Dimensions.....	6
7.2 Thickness.....	6
7.3 Specimen-backing plates.....	6
8 Procedure.....	6
9 Analysis of results.....	7
10 Calibration and verification of apparatus and method.....	8
10.1 Calibration.....	8
10.2 Verification.....	8
11 Precision and bias.....	9
11.1 Uncertainty.....	9
11.2 Repeatability.....	9
12 Test report.....	9
Annex A (informative) Mathematical background to temperature wave analysis.....	10
Annex B (informative) Typical thermal-diffusivity data for a typical polyimide.....	11
Annex C (informative) Example of frequency-thickness relationships required for acceptable measurements.....	12
Annex D (informative) Numerical simulations of the phase shift, $\Delta\theta$, as a function of kd and ξ.....	14
Annex E (informative) Examples of uncertainties in thermal-diffusivity measurements.....	15
Bibliography.....	16

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.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

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

ISO 22007-3 was prepared by Technical Committee 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*

Introduction

Thermal-transport properties of plastics are indispensable not only in the plastics industry but also in other fields. Plastics are used in various manufacturing processes in new application areas, such as nanotechnologies, and in the biomedical industry. Accurate but simple small-scale measurements are required which can be performed quickly.

High sensitivity and excellent temperature resolution are peculiar to the modulation techniques used for the measurement of thermal-transport properties. Temperature wave analysis is a method of measuring the thermal diffusivity of thin specimens and is also suitable for use with small specimens.

This document is a preview generated by EVS

This document is a preview generated by EVS

Plastics — Determination of thermal conductivity and thermal diffusivity —

Part 3: Temperature wave analysis method

1 Scope

This part of ISO 22007 specifies a temperature wave analysis method for the determination of the thermal diffusivity of thin films and plates of plastics in the through-thickness direction. The method can be used on plastics in either the solid or molten state, and having either an isotropic or an orthotropic structure.

The method covers values of the thermal diffusivity, α , in the range $1,0 \times 10^{-8} \text{ m}^2 \cdot \text{s}^{-1} < \alpha < 1,0 \times 10^{-4} \text{ m}^2 \cdot \text{s}^{-1}$.

Measurements can be performed either in air or in another atmosphere, e.g. an inert gas, at atmospheric pressure or at other, reduced or elevated, pressures, or under a vacuum, at a variety of temperatures.

2 Normative references

The following referenced documents are indispensable for the application 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 22007-1, *Plastics — Determination of thermal conductivity and thermal diffusivity — Part 1: General principles*

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

ISO/IEC Guide 98-3, *Uncertainty of measurement — Part 3: Guide to the expression of uncertainty in measurement (GUM:1995)*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 472, ISO 22007-1 and ISO 80000-5 and the following apply.

3.1

temperature wave

temperature oscillation produced by a power-modulated heat source

3.2

phase shift

$\Delta\theta$

phase difference of the temperature wave between the front and rear surfaces of a specimen

NOTE A delay is defined as a negative phase shift.