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Plastics — Determination of fracture toughness (G_{IC} and K_{IC}) — Linear elastic fracture mechanics (LEFM) approach

Plastiques — Détermination de la ténacité à la rupture (G_{IC} et K_{IC}) — Application de la mécanique linéaire élastique de la rupture (LEFM)

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Foreword

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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).

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. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 61, *Plastics*, Subcommittee SC 2, *Mechanical behaviour*.

This second edition cancels and replaces the first edition (ISO 13586:2000), which has been technically revised. It also incorporates the Amendment ISO 13586:2000/Amd.1:2003, with the introduction of a new Annex B.

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.

Introduction

This document is based on a testing protocol developed by the European Structural Integrity Society (ESIS), Technical Committee 4, *Polymers, Polymer Composites and Adhesives*, who carried out the preliminary enabling research through a series of round-robin exercises which covered a range of material samples, specimen geometries, test instruments and operational conditions. This activity involved nearly 10 laboratories from different countries. See References [1] and [3].

Plastics — Determination of fracture toughness (G_{IC} and K_{IC}) — Linear elastic fracture mechanics (LEFM) approach

1 Scope

This document specifies the principles for determining the fracture toughness of plastics in the crack-opening mode (mode I) under defined conditions. Two test methods with cracked specimens are defined, namely three-point-bending tests and compact-specimen tensile tests in order to suit different types of equipment available or different types of material.

The methods are suitable for use with the following range of materials, including their compounds containing short fibres of the length ≤ 7,5 mm:

— rigid and semi-rigid thermoplastic moulding, extrusion and casting materials;

— rigid and semi-rigid thermosetting moulding and casting materials.

In general, short fibre lengths of 0,1 mm to 7,5 mm are known to cause heterogeneity and anisotropy in the crack tip fracture process zone. Therefore, where relevant, Annex B offers some guidelines to extend the application of the same testing procedure, with some reservations, to rigid and semi-rigid thermoplastic or thermosetting plastics containing such short fibres.

Certain restrictions on the linearity of the load-displacement diagram, on the specimen width and on the thickness are imposed to ensure validity (see 6.4) since the scheme used assumes linear elastic behaviour of the cracked material and a state of plane strain at the crack tip. Finally, the crack needs to be sharp enough so that an even sharper crack does not result in significantly lower values of the measured properties.

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 527-1, *Plastics — Determination of tensile properties — Part 1: General principles*

ISO 604, *Plastics — Determination of compressive properties*

ISO 2818, *Plastics — Preparation of test specimens by machining*

ISO 7500-1, *Metallic materials — Calibration and verification of static uniaxial testing machines — Part 1: Tension/compression testing machines — Calibration and verification of the force-measuring system*

ISO 9513, *Metallic materials — Calibration of extensometer systems used in uniaxial testing*

3 Terms and definitions

For the purposes of this document, the following terms and definitions 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/