

Plastics — Determination of tension-tension fatigue crack propagation — Linear elastic fracture mechanics (LEFM) approach

ICS 83.080.10

National foreword

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The UK participation in its preparation was entrusted to Technical Committee PRI/21, Plastics test methods, which has the responsibility to:

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Plastics — Determination of tension-tension fatigue crack propagation — Linear elastic fracture mechanics (LEFM) approach

*Plastiques — Détermination de la propagation de fissure par fatigue en
traction — Approche de la mécanique linéaire élastique de la rupture
(LEFM)*



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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.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 3.

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 International Standard may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO 15850 was prepared by Technical Committee ISO/TC 61, *Plastics*, Subcommittee SC 2, *Mechanical properties*.

Plastics — Determination of tension-tension fatigue crack propagation — Linear elastic fracture mechanics (LEFM) approach

1 Scope

This International Standard specifies a method for measuring the propagation of a crack in a notched specimen subjected to a cyclic tensile load varying between a constant positive minimum and a constant positive maximum value. The test results include the crack length as a function of the number of load cycles and the crack length increase rate as a function of the stress intensity factor and energy release rate at the crack tip. The possible occurrence of discontinuities in crack propagation is detected and reported.

The method is suitable for use with the following range of materials:

- rigid and semi-rigid thermoplastic moulding and extrusion materials (including filled and short-fibre-reinforced compounds) plus rigid and semi-rigid thermoplastic sheets;
- rigid and semi-rigid thermosetting materials (including filled and short-fibre-reinforced compounds) plus rigid and semi-rigid thermosetting sheets.

2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this International Standard. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. For undated references, the latest edition of the normative document referred to applies. Members of ISO and IEC maintain registers of currently valid International Standards.

ISO 291, *Plastics — Standard atmospheres for conditioning and testing*

ISO 527 (all parts), *Plastics — Determination of tensile properties*

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

ISO 13586, *Plastics — Determination of fracture toughness (G_{IC} and K_{IC}) — Linear elastic fracture mechanics (LEFM) approach*

3 Terms and definitions

For the purposes of this International Standard, the following terms and definitions apply.

3.1 cycle

smallest segment of a load-time or stress-time function which is repeated periodically

NOTE The terms fatigue cycle, load cycle and stress cycle are also commonly used.

3.2

number of cycles completed

N

number of load cycles since the beginning of a test

3.3

waveform

shape of the load-time curve within a single cycle

3.4

maximum load

$P_{\max}$

highest value of the load during a cycle

NOTE 1 It is expressed in newtons.

NOTE 2 Only positive, i.e. tensile, loads are used in this test method.

3.5

minimum load

$P_{\min}$

lowest value of the load during a cycle

NOTE 1 It is expressed in newtons.

NOTE 2 Only positive, i.e. tensile, loads are used in this test method.

3.6

load range

ΔP

difference between the maximum and the minimum loads in one cycle, given by:

$$\Delta P = P_{\max} - P_{\min}$$

3.7

load ratio

stress ratio

R

ratio of the minimum to the maximum load in one cycle, i.e.:

$$R = P_{\min}/P_{\max}$$

3.8

stress intensity factor

K

limiting value of the product of the stress $\sigma(r)$ perpendicular to the crack area at a distance r from the crack tip and of the square root of $2\pi r$, as r tends to zero:

$$K = \lim_{r \rightarrow 0} \sigma(r) \sqrt{2\pi r}$$

NOTE 1 It is expressed in pascal root metres ($\text{Pa} \cdot \text{m}^{1/2}$).

NOTE 2 The term factor is used here because it is in common usage, even though the quantity has dimensions.

[ISO 13586]

3.9

maximum stress intensity factor

$K_{\max}$

highest value of the stress intensity factor in one cycle