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Plastics - Determination of resistance to environmental stress cracking (ESC) - Part 4:
Ball or pin impression method (ISO 22088-4:2006)

Kunststoffe - Bestimmung der Beständigkeit gegen umgebungsbedingte
Spannungsrisssbildung (ESC) - Teil 4: Kugel- oder Stifteindruckverfahren (ISO 22088-
4:2006)

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Plastiques - Détermination de la fissuration sous contrainte dans un environnement
donné (ESC) - Partie 4: Méthode par enfoncement de billes ou de goupilles (ISO 22088-
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Ta slovenski standard je istoveten z: EN ISO 22088-4:2006

ICS:

83.080.01	Polimerni materiali na splošno	Plastics in general
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SIST EN ISO 22088-4:2006

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English Version

Plastics - Determination of resistance to environmental stress
cracking (ESC) - Part 4: Ball or pin impression method (ISO
22088-4:2006)

Plastiques - Détermination de la fissuration sous contrainte
dans un environnement donné (ESC) - Partie 4: Méthode
par enfoncement de billes ou de goupilles (ISO 22088-
4:2006)

Kunststoffe - Bestimmung der Beständigkeit gegen
umgebungsbedingte Spannungsrissbildung (ESC) - Teil 4:
Kugel- oder Stifteindruckverfahren (ISO 22088-4:2006)

This European Standard was approved by CEN on 21 July 2006.

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This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CEN member into its own language and notified to the Central Secretariat has the same status as the official versions.

CEN members are the national standards bodies of Austria, Belgium, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland and United Kingdom.



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COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

Management Centre: rue de Stassart, 36 B-1050 Brussels

Foreword

This document (EN ISO 22088-4:2006) has been prepared by Technical Committee ISO/TC 61 "Plastics" in collaboration with Technical Committee CEN/TC 249 "Plastics", the secretariat of which is held by IBN.

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 February 2007, and conflicting national standards shall be withdrawn at the latest by February 2007.

This document supersedes EN ISO 4600:1997.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland and United Kingdom.

Endorsement notice

The text of ISO 22088-4:2006 has been approved by CEN as EN ISO 22088-4:2006 without any modifications.

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**Plastics — Determination of resistance to
environmental stress cracking (ESC) —**

**Part 4:
Ball or pin impression method**

*Plastiques — Détermination de la fissuration sous contrainte dans un
environnement donné (ESC) —
Partie 4: Méthode par enfoncement de billes ou de goupilles*

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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 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 22088-4 was prepared by Technical Committee ISO/TC 61, *Plastics*, Subcommittee SC 6, *Ageing, chemical and environmental resistance*.

It cancels and replaces ISO 4600:1992, which has been technically revised.

ISO 22088 consists of the following parts, under the general title *Plastics — Determination of resistance to environmental stress cracking (ESC)*:

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- [SIST EN ISO 22088-4:2006](https://standards.iteh.ai/catalog/standards/sist/66b17631-c7a4-4Ba-8f87-c6bb439a702e/sist-en-iso-22088-4-2006)
<https://standards.iteh.ai/catalog/standards/sist/66b17631-c7a4-4Ba-8f87-c6bb439a702e/sist-en-iso-22088-4-2006>
- *Part 1: General guidance* (replacement of ISO 6252:1992)
 - *Part 2: Constant tensile load method* (replacement of ISO 4599:1986)
 - *Part 3: Bent strip method* (replacement of ISO 4600:1992)
 - *Part 4: Ball or pin impression method* (new test method)
 - *Part 5: Constant tensile deformation method* (new test method)
 - *Part 6: Slow strain rate method*

Plastics — Determination of resistance to environmental stress cracking (ESC) —

Part 4: Ball or pin impression method

1 Scope

1.1 This part of ISO 22088 specifies a ball or pin impression method for the determination of the environmental stress cracking (ESC) behaviour of plastics by means of a constant-strain test.

1.2 The method is applicable to finished products and to test specimens prepared by moulding and/or machining, and can be used for the assessment of the ESC behaviour of a plastic product or material exposed to different environments, as well as for the determination of the ESC behaviour of different plastics materials exposed to a specific environment.

NOTE Alternative methods for the determination of environmental stress cracking by means of a constant-strain test are specified in ISO 22088-3 and ISO 22088-5. A method for the determination of environmental stress cracking by means of a constant-stress test is specified in ISO 22088-2.

1.3 The ball and pin impression methods are both quick and sensitive procedures for assessing the ESC behaviour of plastics. The methods are well suited for amorphous plastics. They are less appropriate for materials displaying a pronounced tendency for creep and/or stress relaxation, i.e. for semi-crystalline materials. If semi-crystalline materials are tested, pins are more appropriate than balls.

1.4 The ball impression method is useful for assessing the principal ESC behaviour of the material/chemical combination under consideration. It is less influenced by the near-surface orientation state of the specimens than the pin impression method and the methods in the other parts of this International Standard, where the chemical attacks only the original surface of the material. This, depending on the manner of specimen preparation, may show a considerable degree of orientation.

1.5 The pin impression method is useful for testing specimens of small thickness and finished parts.

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 178, *Plastics — Determination of flexural properties*

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

ISO 293, *Plastics — Compression moulding of test specimens of thermoplastic materials*

ISO 294-1, *Plastics — Injection moulding of test specimens of thermoplastic materials — Part 1: General principles, and moulding of multipurpose and bar test specimens*

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

ISO 527-2, *Plastics — Determination of tensile properties — Part 2: Test conditions for moulding and extrusion plastics*

ISO 2557-1, *Plastics — Amorphous thermoplastics — Preparation of test specimens with a specified maximum reversion — Part 1: Bars*

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

ISO 3167, *Plastics — Multipurpose test specimens*

ISO 3290, *Rolling bearings — Balls — Dimensions and tolerances*

ISO 4287, *Geometrical Product Specifications (GPS) — Surface texture: Profile method — Terms, definitions and surface texture parameters*

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3 Terms and definitions

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

**3.1
oversize**
 d_d
difference between the diameter of an impressed ball or pin (d_b) and the diameter of the drilled and reamed hole (d_h) in the test specimen:

$$d_d = d_b - d_h \tag{1}$$

**3.2
deformation step**
determination made at a defined oversize

**3.3
deformation step zero**
determination made using test specimens that are drilled and reamed only, i.e. without impressing a ball or pin

**3.4
deformation series**
number of successive deformation steps beginning with deformation step zero

NOTE Normally, a deformation series consists of seven deformation steps of increasing severity.

3.5 failure limit

oversize in a deformation series that produces failure, as specified in terms of the following failure criteria:

- a) for type A test specimens (test specimens taken from products), as visible cracks, observable by means of a lens of magnification $\times 5$;
- b) for type B test specimens (moulded or machined test specimens), by the following criteria (see 9.2 and Figure 4):
 - 1) a 5 % reduction in the maximum tensile force measured at deformation step zero (criterion B1 in Figure 1),
 - 2) a 5 % reduction in the maximum flexural force measured at deformation step zero (criterion B2 in Figure 1),
 - 3) a 20 % reduction in the tensile elongation at rupture measured at deformation step zero (criterion B3 in Figure 1).

NOTE 1 If there is no rupture immediately after application of the maximum tensile force, the tensile elongation at 50 % of the preceding maximum tensile force (see Figure 1) may be measured. Failure is then defined by a 20 % reduction in the value at deformation step zero (criterion B4).

NOTE 2 It is sufficient to measure the elongation at break between the grips.

NOTE 3 If the value of the tensile stress is required, refer the force to the smallest cross-sectional area of the specimen at the location of the hole. Calculate the tensile stress in accordance with Equation (2):

$$\sigma = \frac{F}{h \cdot (w - d_h)} \quad \text{iTeh STANDARD PREVIEW} \quad (2)$$

where

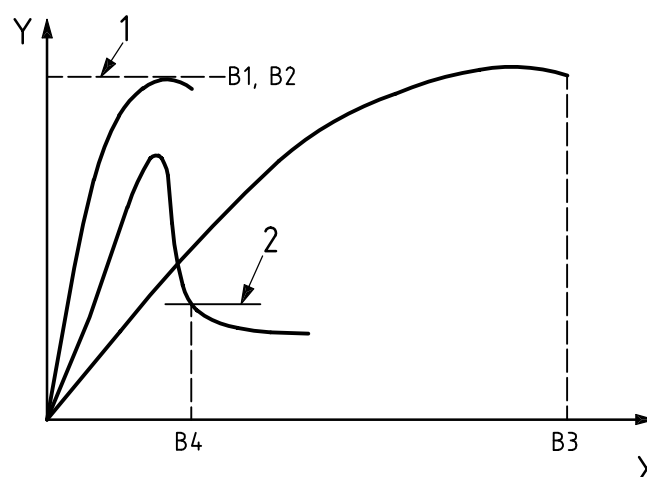
σ is the tensile stress, in MPa or $\text{N}\cdot\text{mm}^{-2}$;

F is the tensile force, in N;

h is the thickness of the specimen, in mm;

d_h is the diameter of the hole, after reaming, in mm;

w is the width of the specimen, in mm.



Key

X	elongation	B1	5 % reduction in the maximum tensile force
Y	stress	B2	5 % reduction in the maximum flexural force
1	maximum	B3	20 % reduction in the tensile elongation at rupture
2	$0,5 \times$ preceding max. tensile force	B4	tensile elongation at 50 % of the preceding maximum tensile force

Figure 1 — Failure criteria for type B test specimens