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01-april-2016

Polimerni materiali - Določanje gorljivosti s kisikovim indeksom - 3. del: Preskus pri zvišani temperaturi (ISO/DIS 4589-3:2016)

Plastics - Determination of burning behaviour by oxygen index - Part 3: Elevated-temperature test (ISO/DIS 4589-3:2016)

Kunststoffe - Bestimmung des Brennverhaltens durch den Sauerstoff-Index - Teil 3: Prüfung bei erhöhter Temperatur (ISO/DIS 4589-3:2016)

Plastiques - Détermination du comportement au feu au moyen de l'indice d'oxygène - Partie 3: Essai à haute température (ISO/DIS 4589-3:2016)

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13.220.40	Sposobnost vžiga in obnašanje materialov in proizvodov pri gorenju	Ignitability and burning behaviour of materials and products
83.080.01	Polimerni materiali na splošno	Plastics in general

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DRAFT INTERNATIONAL STANDARD

ISO/DIS 4589-3

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Plastics — Determination of burning behaviour by oxygen index —

Part 3:
Elevated-temperature test

Plastiques — Détermination du comportement au feu au moyen de l'indice d'oxygène —

Partie 3: Essai à haute température

ICS: 13.220.40; 83.080.01

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ISO/CEN PARALLEL PROCESSING

This draft has been developed within the International Organization for Standardization (ISO), and processed under the **ISO lead** mode of collaboration as defined in the Vienna Agreement.

This draft is hereby submitted to the ISO member bodies and to the CEN member bodies for a parallel five month enquiry.

Should this draft be accepted, a final draft, established on the basis of comments received, will be submitted to a parallel two-month approval vote in ISO and formal vote in CEN.

To expedite distribution, this document is circulated as received from the committee secretariat. ISO Central Secretariat work of editing and text composition will be undertaken at publication stage.

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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 4589-3 was prepared by Technical Committee ISO/TC 61, *Plastics*, Subcommittee SC 4, *Burning behaviour*.

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This second edition cancels and replaces the first edition (ISO 4589-3:1996), which has been technically revised.

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ISO 4589 consists of the following parts, under the general title *Plastics — Determination of burning behaviour by oxygen index*:

— *Part 1: Guidance:*

— *Part 2: Ambient-temperature test*

— *Part 3: Elevated-temperature test*

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Introduction

This part of ISO 4589 has been prepared to extend the methods available for the determination of flammability by oxygen index (see ISO 4589-2) to typical elevated temperatures to which a plastic material can be exposed in a service situation. It also provides a method for determining the temperature at which combustion of a small bar of material is just supported in air under certain test conditions; the resulting temperature is termed the flammability temperature.

This part of ISO 4589 is intended to be used in conjunction with ISO 4589-2 which describes the basic oxygen index test method.

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Plastics — Determination of burning behaviour by oxygen index — Part 3: Elevated-temperature test

1 Scope

This part of ISO 4589 specifies methods for determining the minimum volume fraction of oxygen, in a mixture with nitrogen, that will support combustion of small vertical test specimens under specified test conditions over a range of temperatures between 25 °C and 150 °C. The range of temperatures is typically between 40 °C and 150 °C. The results are defined as temperature index values at the test temperature, which is typical of the practical temperature that a plastic material may experience in an overheated service situation.

Methods are provided for testing materials that are self-supporting at the test temperature in the form of vertical bars or sheet up to 10,5 mm thick. However, they are not applicable to form V which requires supporting frame as defined in Table 2 of Part 2. These methods are suitable for solid, laminated or cellular materials characterized by an apparent density 100 kg/m^3 or greater. The methods may also be applicable to some cellular materials having an apparent density of less than 100 kg/m^3. A method is provided for testing flexible sheet or film materials while supported vertically.

This part of ISO 4589 also includes a method (see Annex A) for determining the temperature at which the oxygen index of small vertical test specimens in air is 20,9 % under specified test conditions. The temperature at which this occurs is defined as the flammability temperature (FT) and the method is limited to the determination of temperatures less than 400 °C. The method is not applicable to materials having an oxygen index of < 20,9 %.

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Results obtained in accordance with this part of ISO 4589 is not applicable to describe or appraise the fire hazard presented by a particular material or shape under actual fire conditions, unless used as one element of a fire risk assessment which takes into account all of the factors which are pertinent to the assessment of the fire hazard of a particular application for the material.

NOTE 1 It may not be possible to apply these methods satisfactorily to materials that exhibit high levels of shrinkage when heated, e.g. highly oriented thin film.

NOTE 2 For assessing the flame propagation properties of cellular materials of density < 100 kg/m^3, attention is drawn to the method of ISO 3582:2000, *Flexible cellular polymeric materials — Laboratory assessment of horizontal burning characteristics of small specimens subjected to a small flame*.

2 Normative reference

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 4589-1, *Plastics — Determination of burning behaviour by oxygen index — Part 1: Guidance.*

ISO 4589-2, *Plastics — Determination of burning behaviour by oxygen index — Part 2: Ambient-temperature test.*

ISO 13943, *Fire safety — Vocabulary.*

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3 Definitions

For the purposes of this part of ISO 4589, the following definitions apply, as well as those from ISO 13943, two of which are reproduced below for the convenience of the reader.

3.1
flammability temperature
FT
The temperature at which flaming combustion of a material is supported in air that has a volume fraction of oxygen of 20,9 %.

3.2
temperature index
TI
The minimum volume fraction of oxygen, in a mixture of oxygen and nitrogen, at an agreed test temperature that will just support flaming combustion of a material under specified test conditions.

NOTE The agreed test temperature will typically be between 40 °C and 150 °C.

3.3
oxygen index
OI
limiting oxygen index
LOI
minimum volume fraction of oxygen in a mixture of oxygen and nitrogen, at 23 °C ± 2 °C, that just supports flaming combustion of a material under specified test conditions

NOTE It is usually expressed as a percentage.

[SOURCE: ISO 13943:2008, 4.248]

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3.4
ignition
sustained ignition (deprecated)
⟨flaming combustion⟩ initiation of sustained flame

[SOURCE: ISO 13943:2008, 4.188]

4 Principle

A small test specimen is supported vertically in a mixture of oxygen and nitrogen flowing upwards through a transparent heated chimney. The upper end of the specimen is ignited and the subsequent burning behaviour of the specimen is observed to compare the period for which burning continues, or the length of specimen burnt, with specified limits for such burning. By testing a series of specimens in different volume fractions of oxygen, the minimum volume fraction of oxygen is estimated. Guidance cocerning the apparatus and test method is given in ISO 4589-1.

5 Apparatus

5.1 Arrangement

The apparatus specified in 5.2 to 5.6 shall be arranged as indicated by the diagrams in figures 1 to 3, as appropriate.

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5.2 Test chimney

The test chimney shall consist of two concentric heat-resistant glass tubes supported vertically between an insulating top plate and a base through which oxygen-containing gas mixtures can be introduced. The chimney is provided with a heating element suitable for use, in conjunction with a preheater for heating the incoming gas mixture, to maintain the test atmosphere within the inner tube in the vicinity of the test specimen at within ± 3 °C of any specific test temperature up to and including 125 °C and at within ± 5 °C of any higher test temperature at which the equipment is intended to be used. The heating element shall not impede adequate observation of a test specimen under test. If the same performance can be achieved, a chimney of other structure can also be used.

The preferred dimensions of the inner tube are 450-500 mm minimum height and 75 mm to 100 mm diameter cylindrical bore. The upper outlet should preferably be restricted as necessary by an overhead cap having an outlet small enough to produce an exhaust velocity of at least 90 mm/s at 23 °C ± 2 °C from a flow rate within the chimney of 40 mm/s at 23 °C ± 2 °C (see NOTE). The height of the outer tube should be similar to that of the inner tube and the radial clearance between the inner and outer tubes should be between 5 mm and 10 mm. Chimneys of other dimensions, with or without restricted outlets, may be used, if shown to give equivalent results.

The bottom of the chimney, or the base upon which the chimney is supported, shall incorporate a means for distributing evenly the gas mixture entering the inner tube. A satisfactory means comprises beads of diameter between 3 mm and 5 mm, in a layer between 80 mm and 100 mm deep. Other devices, such as radial manifolds, may be used, if shown to give equivalent results.

A porous screen may be mounted below the level of the test piece holder, to prevent falling combustion debris from fouling the gas entry and distribution paths.

The chimney support may incorporate a levelling device and indicator, to facilitate vertical alignment of the chimney and a test piece supported therein. A dark background may be provided, to facilitate observation of flames within the chimney.

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NOTE For inner tubes of diameter 75 mm to 100 mm, a cap converging to an outlet of diameter 40 mm at a level at least 10 mm above the top of the cylindrical chimney has been found satisfactory. For such tubes also, an electrical-resistance heating element dissipating up to about 1 000 W and helically wound about the outer surface of the tube with a graded distribution of winding pitch (the windings wrap the windings so that the temperature is evenly distributed) has been found suitable in conjunction with a preheater comprising a cylindrical ceramic body with longitudinal holes and containing a heating element dissipating up to about 1 000 W with regulating controls which can be operated separately from those of the heater windings on the chimney tube. If the target test condition is 150 °C or less, a preheater is not necessary, Apparatus of more simple structure can be used.

5.3 Test specimen holder

The test specimen holder specified in clause 5.2 of ISO 4589-2 shall be used.

The holder may have a complementary tool of any suitable shape (see Figure 4) for moving a specimen or loaded specimen holder into or out of the test chimney.

5.4 Gas supplies

The gas supplies specified in clause 5.3 of ISO 4589-2 shall be used.

NOTE 1 Because damage may occur to the chimney heater and preheater if energized while no gas flows through them, it is recommended that a gas-flow or pressure-sensing device is incorporated in the gas supply lines and is coupled to the heater power-control circuits.

NOTE 2 To economize purified oxygen and nitrogen, it is recommended that an air pump is provided to supply air instead of oxygen and/or nitrogen, at the appropriate flow rate, during periods when specimens are not being tested.

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5.5 Gas control devices

The gas supplies specified in clause 5.4 of ISO 4589-2 shall be used, except that the flow rate shall be 40 mm/s ± 0,8 mm/s at 23 °C.

Means shall be provided for checking or ensuring that the temperature of the gas mixture in the chimney is in accordance with 5.2. If this involves an internal probe, its position and profile shall be designed to minimize induction of turbulence within the chimney.

NOTE Systems of measurement and control that have proved satisfactory are listed in 5.4 of ISO 4589-2.

5.6 Oxygen analyser

The oxygen analyser specified in clause 5.5 of ISO 4589-2 shall be used.

5.7 Flame igniter

The flame igniter specified in clause 5.6 of ISO 4589-2 shall be used.

5.8 Timing device

The timing device specified in clause 5.7 of ISO 4589-2 shall be used.

5.9 Fume extraction system

The fume extraction system specified in clause 5.8 of ISO 4589-2 shall be used.

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6 Calibration and maintenance of equipment

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Calibrate and maintain the equipment periodically in accordance with the instructions given in Annex A of ISO 4589-2 so that the maximum interval between recalibration and use conforms to the periods stated in Table 1 of ISO 4589-2, except that the accuracy of checking the flow rate shall be ± 0,8 mm/s.

7 Preparation of test specimens

7.1 Sampling

Sampling shall be in accordance with 7.1 of ISO 4589-2.

For the flammability temperature procedure (see Annex A), at least 10 test specimens shall be provided. If a test specimen is not self-supporting at the temperature of the test, it shall be provided with external support by the use of 0,55 mm ± 0,05 mm diameter nickel-chromium alloy wire with a maximum working temperature of 1100 °C and secured by ties of copper wire of 0,20 mm ± 0,02 mm diameter. These shall be positioned as shown in Figure 5. See Annex B for round-robin analysis of the effects of variation of the test specimen holder.

Another practice is to support the test piece between two capillary glass tubes, the assembly being lightly bound together with a single tie of fine nichrome or stainless-steel wire (nominally 200 µm gauge) and held in a small standard clamp. This non-standard practice should be used carefully and recorded in the test report.

7.2 Test specimen dimensions and preparation

With the exception of form V, test specimen dimensions shall conform to, and specimen preparation shall be in accordance with, 7.2 of ISO 4589-2.

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