61

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Plastics — Determination of burning behaviour of flexible vertical specimens in contact with a small-flame ignition source

Plastiques — Détermination du comportement au feu d'éprouvettes verticales souples au contact d'une petite flamme comme source d'allumage

Reference number
ISO 9773:1990(E)

Foreword

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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.

International Standard ISO 9773 was prepared by Technical Committee ISO/TC 61, *Plastics*.

Annex A of this International Standard is for information only.

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Plastics — Determination of burning behaviour of flexible vertical specimens in contact with a small-flame ignition source

1 Scope

1.1 This International Standard specifies a small-scale laboratory screening procedure for comparing the relative burning behaviour of vertically oriented thin and relatively flexible plastics specimens exposed to a low-energy-level flame ignition source. These specimens cannot be tested using method B of ISO 1210 since they distort or shrink away from the applied flame source without igniting.

1.2 This method of test determines the afterflame and afterglow times of specimens.

1.3 The classification system described in annex A is intended for quality control and the preselection of component materials for products. The classification established by this method of test is applicable only to the material used for the specimens.

NOTE 1 Test results are influenced by material components, e.g. pigments, fillers, fire-retardant concentrations.

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this International Standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

ISO 291:1977, *Plastics — Standard atmospheres for conditioning and testing.*

ISO 1043-1:1987, *Plastics — Symbols — Part 1: Basic polymers and their special characteristics.*

ISO 1210:—[1], *Plastics — Determination of the burning behaviour of horizontal and vertical specimens in contact with a small-flame ignition source.*

ISO 5725:1986, *Precision of test methods — Determination of repeatability and reproducibility for a standard test method by inter-laboratory tests.*

ISO 10093:—[2], *Plastics — Fire tests — Standard ignition sources.*

ASTM D 5025:1989, *Standard specifications for a laboratory burner used for small-scale burning tests on plastic materials.*

3 Definitions

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

3.1 afterflame: Persistence of flaming of a material, under specified test conditions, after the ignition source has been removed.

3.2 afterflame time: The length of time for which a material continues to flame, under specified test conditions, after the ignition source has been removed.

3.3 afterglow: Persistence of glowing of a material, under specified test conditions, after cessation of

1) To be published. (Revision of ISO 1210:1982)

2) To be published.

flaming or, if no flaming occurs, after removal of the ignition source.

3.4 afterglow time: The time during which a material continues to glow, under specified test conditions, after cessation of flaming or, if no flaming occurs, after the ignition source has been removed.

4 Principle

A test specimen having a nearly cylindrical form is supported vertically by one end and the free end is exposed to two successive applications of a specified gas flame. The burning behaviour of the specimen is assessed by measuring the afterflame and/or afterglow time.

5 Significance of test

5.1 Tests made on a material under the conditions specified in this standard can be of considerable value when comparing the relative burning behaviour of different materials, controlling manufacturing processes or assessing any change in burning characteristics prior to, or during, use. The results obtained from this method are dependent upon the shape, orientation and isolation of the specimen and the conditions of ignition. Correlation with performance under actual service conditions is not implied.

5.2 Results obtained in accordance with this International Standard shall not be used to describe or appraise the fire hazard presented by a particular material or particular shape under actual fire conditions. Assessment for fire hazard requires consideration of such factors as fuel contribution, intensity of burning (rate of heat release), products of combustion and environmental factors such as the intensity of the flame source, orientation of exposed material and ventilation conditions.

5.3 Burning behaviour as measured by this test method is affected by such factors as the density, colour and anisotropy of the material and the thickness of the specimen.

5.4 The effects on the burning behaviour of additives, deterioration and possible loss of volatile components are measurable using this method. Results obtained using this method may serve for comparing the relative performance of materials and can be helpful in material assessment.

5.5 The burning behaviour of some plastics materials may change with time. It is accordingly advisable to make tests before and after oven conditioning by an appropriate procedure that shall be described in the test report. The preferred oven conditioning conditions shall be 7 days at 70 °C. However, other oven conditioning times and temperatures may be used if agreeable to all parties.

6 Apparatus and materials

6.1 Laboratory fume hood (cupboard), having an internal volume of at least 0,5 m^3. The enclosure shall permit observation and shall be draught-free while permitting normal thermal circulation of air past the specimen during burning. For safety and convenience, it is desirable that this enclosure (which can be completely closed) be fitted with an evacuation device, such as an exhaust fan, to remove products of combustion, which may be toxic. However, it is important to be able to turn off the device during the actual test and to start it again immediately after the test to remove the products of combustion.

NOTE 2 The amount of oxygen available to support combustion is obviously important for the conduct of these flame tests. For tests conducted by this method when burning is vigorous, enclosure sizes less than 1 m^3 may not provide accurate results.

6.2 Laboratory burner, as specified in ASTM D 5025, or in ISO 10093 as ignition source P/PF2, having a barrel length of 100 mm ± 10 mm and an inside diameter of 9,5 mm ± 0,3 mm. The barrel shall not be equipped with an end-attachment, such as a stabilizer.

6.3 Ring stand, with clamps or the equivalent, adjustable for positioning of the specimen.

6.4 Timing device, accurate to 1 s.

6.5 Measuring scale, graduated in millimetres.

6.6 A supply of technical-grade methane gas, with regulator and meter for uniform gas flow.

NOTE 3 Other gas mixtures having a heat content of approx 37 MJ/m^3 have been found to provide similar results.

6.7 Desiccator, containing a suitable drying agent.

6.8 Conditioning room or chamber, capable of being maintained at 23 °C ± 2 °C and a relative humidity of (50 ± 5) % as specified in ISO 291.

6.9 Micrometer, capable of being read to 0,002 mm.

6.10 Specimen mandrel form, made from 12,7 mm ± 0,5 mm diameter rod.

6.11 Pressure-sensitive adhesive

6.12 Nichrome wire[3)]

6.13 Dry, absorbent surgical cotton

6.14 Air-circulating oven (minimum of five air changes per hour), capable of being maintained at 70 °C ± 1 °C.

7 Specimens

7.1 All specimens shall be cut from a representative sample of the material (sheets or end-products). After any cutting operation, care shall be taken to remove all dust and any particles from the surface; cut edges shall have a smooth finish.

7.2 Standard specimens shall be 200 mm ± 5 mm long, 50 mm ± 2 mm wide and a maximum of 0,1 mm thick. Measure the thickness of each to the nearest 0,002 mm, and note the measurements.

NOTE 4 Tests made on specimens of different thicknesses or density may not be comparable and tests made in different directions of anisotropy or on different colours may also not be comparable.

7.3 Specimens shall be prepared by marking a line across the width of the specimen 125 mm from one end (bottom) of the cut specimen. The longitudinal axis of the specimen shall be wrapped tightly around the longitudinal axis of the mandrel to form a lapped cylinder with the 125 mm line exposed. The overlapping portion of the specimen shall be secured within the upper 75 mm segment above the 125 mm mark and at the upper end of the tube with pressure-sensitive adhesive tape. The mandrel shall then be removed.

NOTE 5 For stiff specimens, the pressure-sensitive tape may be reinforced or replaced by Nichrome wire wound around the top 75 mm of the specimen (see figure 1).

3) Nichrome is an example of a suitable product available commercially. This information is given for the convenience of users of this International Standard and does not constitute an endorsement by ISO of this product.

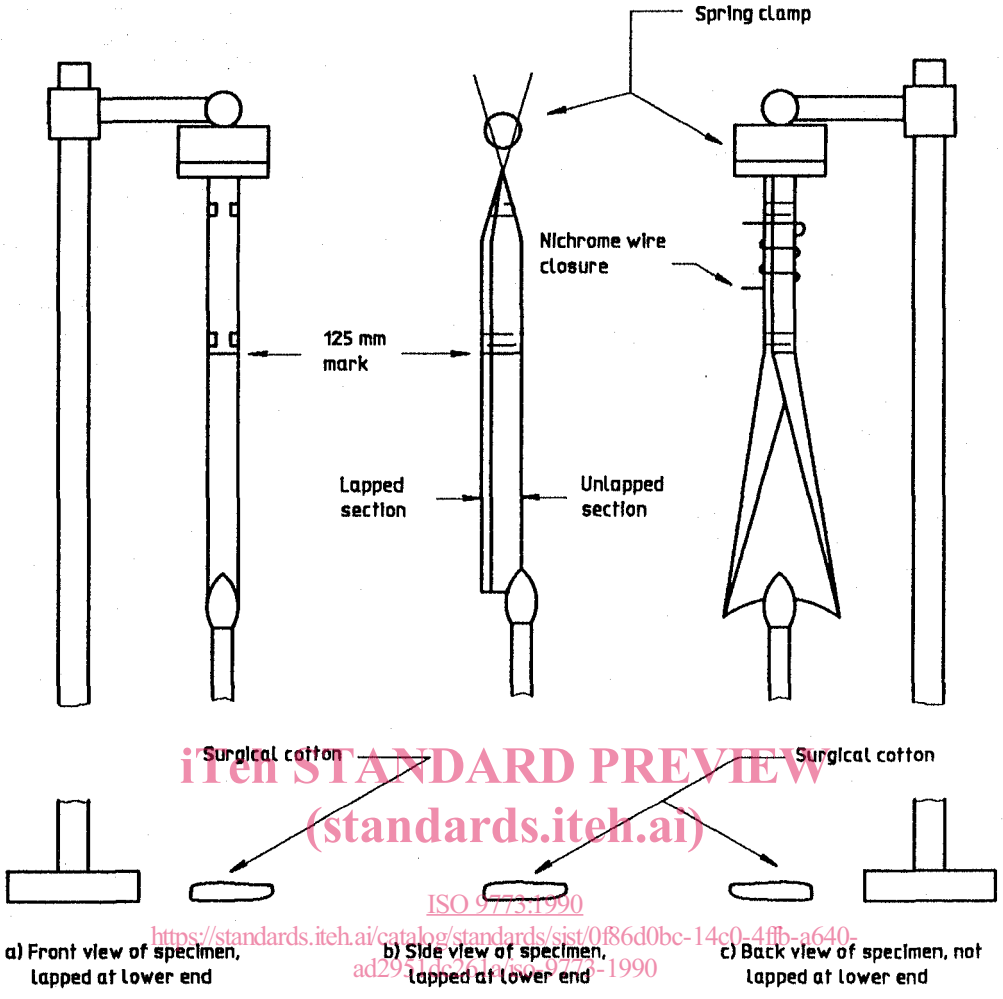

Figure 1 — Specimen orientation

7.4 A minimum of 20 specimens shall be prepared. It is advisable to prepare additional specimens for retest purposes if necessary.

8 Conditioning

Unless otherwise required by the material specifications, conditioning and testing shall be carried out under the following conditions:

8.1 Two sets of five specimens shall be preconditioned for at least 48 h at 23 °C ± 2 °C and (50 ± 5) % relative humidity.

8.2 Two sets of five specimens shall be preconditioned for 168 h at 70 °C ± 1 °C and then cooled in a desiccator for at least 4 h at room temperature.

8.3 All specimens shall be tested in a standard atmosphere at 23 °C ± 2 °C and (50 ± 5) % relative humidity in accordance with ISO 291.

9 Test procedures

9.1 Clamp a specimen from the upper 6 mm of its length, with the longitudinal axis vertical, by a heavy spring clamp or other device, so that the upper end of the tube is closed to prevent any chimney effects during the test. The lower end of the specimen shall be 300 mm above a horizontal layer of dry absorbent surgical cotton (50 mm × 50 mm) thinned to a maximum uncompressed thickness of 6 mm (see figure 2).

Dimensions in millimetres

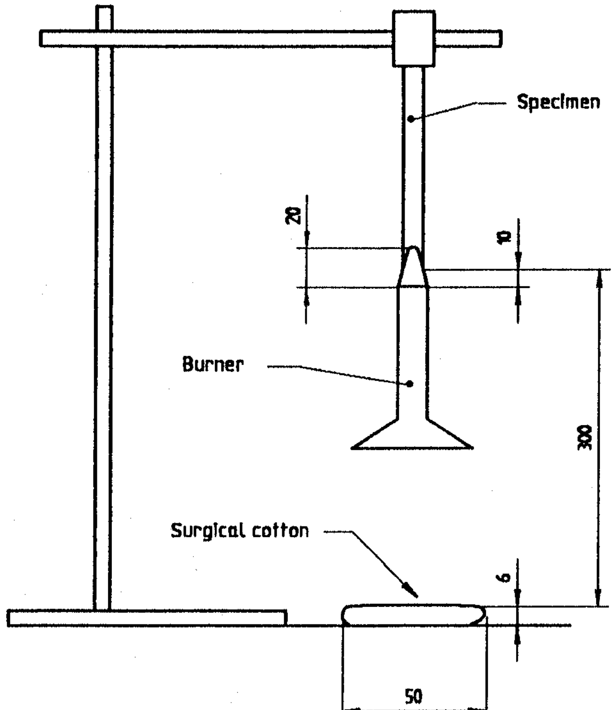

Figure 2 — Application of flame

9.2 Adjust the burner to produce a blue flame 20 mm ± 1 mm high. The flame is obtained by adjusting the supply and air ports of the burner until an approximately 20 mm yellow-tipped blue flame is produced. Increase the air supply until the yellow tip just disappears. The height of the flame shall be measured again and corrected if necessary.

9.3 Apply the flame of the burner centrally to the middle point of the bottom edge of the unlapped section (see note 6) of the specimen so that the top of the burner is 10 mm below that point of the lower end of the specimen, and maintain it at that distance for 3 s, moving the burner as necessary in response to any changes in the length or position of the specimen (see note 7). If the specimen drips molten or flaming material during the flame application, tilt the burner at an angle of up to 45° and withdraw it just sufficiently from beneath the specimen to prevent material from dropping into the barrel of the burner while maintaining the 10 mm spacing between the centre of the outlet of the burner and the remaining portion of the specimen, ignoring any strings of molten material. After the application of the flame to the specimen for 3 s, immediately withdraw the burner to a distance of at least 150 mm away from the specimen and simultaneously use the timing device to commence measurement, to the nearest second, of the afterflame time t_1. Note t_1.

NOTES

6 For specimens that flare and therefore are not lapped at their lower end when suspended from the pinched upper end, the longitudinal axis of the specimen material thus becomes the direction along which the flame is applied.

7 For specimens which move under the influence of the burner flame, the use of a small indicator rod attached to the burner (shown in figure 3) has been found to be helpful in maintaining 10 mm distance between the top of the burner and the major portion of the specimen.

Dimensions in millimetres

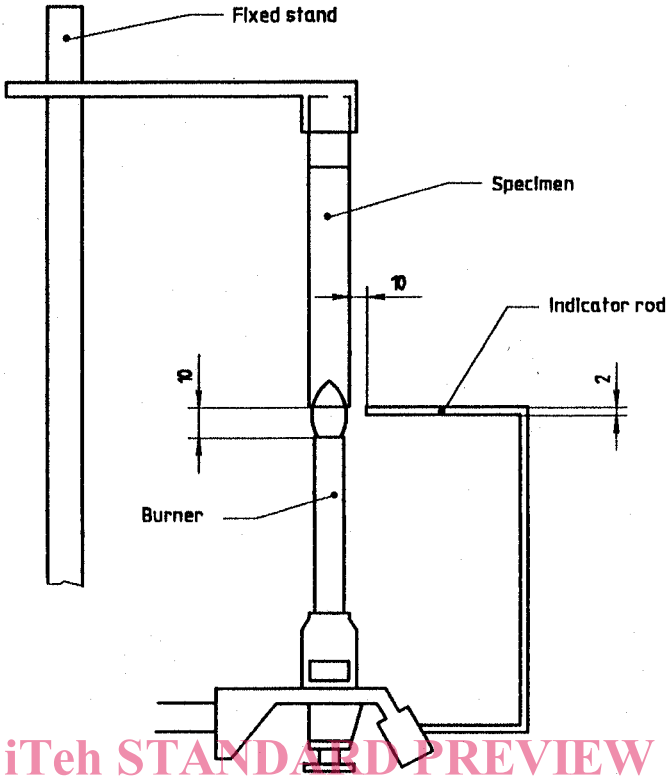

Figure 3 — Burner with optional flame distance indicator

9.4 When afterflaming of the specimen ceases, where immediately place the flame of the burner again under the specimen and maintain the burner at a distance of 10 mm from the remaining portion of the specimen for 3 s while moving the burner clear of dropping material as necessary as described in 9.3. After this application of the flame to the specimen for 3 s, immediately extinguish the burner or remove it to a distance of at least 150 mm from the specimen and simultaneously, using the timing device, commence measurement, to the nearest second, of the afterflame time t_2 and the afterglow time t_3 of the specimen. Note t_2 and t_3. Note also whether the afterflame or afterglow progresses up to the 125 mm mark and whether the cotton pad below the specimen is ignited by material dropping from the specimen.

9.5 Repeat the procedure of 9.1 to 9.4 until at least 5 specimens have been tested.

10 Expression of results

10.1 For each specimen, calculate the total afterflame time using the equation

$$t_{fi} = t_1 + t_2$$

where

t_{fi} is the total afterflame time for the ith specimen;

t_1 is the first afterflame time;

t_2 is the second afterflame time.

10.2 For each set of five specimens from both preconditioning treatments calculate the total set afterflame time t_{fs} using the equation

$$t_{fs} = \sum_{i=1}^{i=5} t_{fi}$$

where i and t_{fi} are as defined above.

11 Precision

11.1 The precision data were determined from an inter-laboratory experiment conducted in 1986 involving six laboratories, four materials and two replicates. Each replicate was determined by averaging the values of five measurements. The results were analyzed using ISO 5725 and are summarized in table 1.

Table 1 — Precision data

Stage	Parameter	Time (s)			
		FEP[1)]	PI[1)]	PET[1)]	PVF[1)]
After first flame application	Average	0	0,3	2,3	6,0
	Repeatability	0	1,2	1,8	12,3
	Reproducibility	0	1,8	2,5	12,2
After second flame application plus glowing	Average	0	0	2,1	7,2
	Repeatability	0	0	2,2	10,8
	Reproducibility	0	0	3,7	14,3

1) Symbols for plastics materials are defined in ISO 1043-1.

11.2 The difference between two averages determined from five specimens using identical test material by one analyst using the same apparatus within a short time-interval will exceed the repeatability shown in table 1 not more than once in 20 cases on average in the normal and correct operation of the method.

11.3 The difference between two independent averages determined from five specimens by two operators working in different laboratories on identical test material will exceed the reproducibility shown in table 1 not more than once in 20 cases on average in the normal and correct operation of the method.

11.4 The two averages determined from five specimens are to be considered suspect and not equivalent if they differ by more than the repeatability or reproducibility shown in table 1. Any judgment per sub-clause 11.2 or 11.3 would have an approximately 95 % (0,95) probability of being correct.

NOTE 8 Table 1 is only intended to present a meaningful way of considering the approximate precision of this test method for a range of materials. These data should not be rigorously applied to acceptance or rejection of material, as they are specific to the inter-laboratory test and may not be representative of other lots, conditions, materials or laboratories.

12 Test report

The test report shall include the following information:

a) a reference to this International Standard;

b) the direction of any anisotropy relative to the test specimen dimensions;

c) the conditioning treatment;

d) any prior treatment before testing, other than cutting, trimming and conditioning;

e) full identification of the tested product, including the manufacturer's name, number or code;

f) the gas used for the burner;

g) the name and location of the testing facilities;

h) the date of the test;

i) the individual test values, including:

1) specimen number (i),

2) specimen thickness,

3) first afterflame time (t_1),

4) second afterflame time (t_2),

5) total afterflame time (t_{fi}),

6) total set afterflame time (t_{fs}),

7) afterglow time after second flame application (t_3),

8) whether there was afterflame or afterglow up to the 125 mm mark,

9) whether the cotton indicator pad was ignited.