BRITISH STANDARD

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Laboratory method of test for

Assessment of the horizontal burning characteristics of specimens no larger than 150 mm x 50 mm x 13 mm (nominal) of cellular plastics and cellular rubber materials when subjected to a small flame

UDC 678.01 - 405.8:536.468

Co-operating organizations

The Plastics and Rubber Industry Standards Committees, under whose supervision this British Standard was prepared, consist of representatives from the following Government departments and scientific and industrial organizations:

British Association of Synthetic Rubber Manufacturers
British Plastics Federation
British Resin Manufacturers' Association
British Rubber Manufacturers' Association*
Chemical Industries Association
Department of the Environment
Department of Trade and Industry*
Electrical and Electronic Insulation Association
Electrical Installation Equipment Manufacturers' Association
Electrical Research Association
Engineering Equipment Users' Association
Malaysian Rubber Producers' Research Association
Ministry of Defence, Army Department
Ministry of Defence, Navy Department
Ministry of Defence, Procurement Executive
Plastics Institute
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Royal Institute of British Architects
Royal Institute of Public Health and Hygiene
Rubber and Plastics Research Association of Great Britain*
Rubber Growers' Association
Society of Motor Manufacturers and Traders Limited*

The organizations marked with an asterisk in the above list, together with the following, were directly represented on the committee entrusted with the preparation of this British Standard:

British Furniture Manufacturers' Federated Association
British Railways Board
British Rigid Urethane Foam Manufacturers' Association
Department of Employment
Expanded Polystyrene Products Manufacturers' Association
Ministry of Defence
National Bedding Federation
Safety in Mines Research Establishment
The Society of British Aerospace Companies Limited

This British Standard, having been approved by the Plastics and Rubber Industry Standards Committees, was published under the authority of the Executive Board on 30 September 1974

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The following BSI references relate to the work on this standard:
Committee references PLC/RUC/-/1 and PLC/RUC/-/1/1
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Amendments issued since publication

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7687	July 1993	Indicated by a sideline in the margin

Contents

Foreword

This British Standard was first published in 1971 under the authority of the Plastics and Rubber Industry Standards Committees. This revision is in line with a Draft International Standard under consideration by ISO/TC 45 — Rubber and Rubber Products, and ISO/TC 61 — Plastics, of the International Organization for Standardization (ISO).

In this revision greater emphasis is placed on the intended purpose of the test method and the strengthening of the warnings against misusing the test results to predict behaviour under the complex conditions existing in an actual fire. In line with the ISO draft and so as to emphasize the limited interpretation that can be put on the test results, the classification system given in the first edition has been omitted and the test results are now only reported as simple numerical values. The principle of classification in relation to small-scale tests is being reviewed as a matter of policy, both in BSI and in ISO.

In this revision the title of the standard has been altered to emphasize the limited nature of the test.

Technical changes from the first edition are the use of thinner test specimens to align with international agreement, modifications to the design of the test chamber to ensure an adequate oxygen supply, and conditioning of the test specimens at 23 °C, 50 % r.h., in line with international agreements for the conditioning of plastics and rubbers.

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Summary of pages

This document comprises a front cover, an inside front cover, pages i and ii, pages 1 to 8, an inside back cover and a back cover.

This standard has been updated (see copyright date) and may have had amendments incorporated. This will be indicated in the amendment table on the inside front cover.

1 Scope

This British Standard describes a small-scale laboratory procedure for comparing the relative horizontal burning characteristics of cellular plastics and cellular rubber materials, as such, exposed to a low energy source of heat. It has no relevance to the environmental conditions under which cellular plastics and cellular rubber materials may be used either singly or in conjunction with other materials.

This test method is not intended to be used to assess potential fire hazard in use (see 3.1).

2 Reference

The title of the publications referred to is given on the inside back cover.

3 General

3.1 Tests made on specimens of material under the conditions described in this standard can be of value in controlling manufacturing processes to ensure consistency of production. There is no known evidence of correlation between the results of such tests and burning under actual use conditions. Therefore conclusions cannot and shall not be drawn from such results regarding burning behaviour under actual use conditions. If it is desired to measure and compare fire hazards for a finished product containing cellular plastics or cellular rubber materials, another test method which simulates as nearly as possible the actual conditions of use has to be used.

3.2 Horizontal burning characteristics under the action of a small flame as measured by this test procedure are affected by such factors as density and anisotropy of the cellular material and the thickness of the specimen.

3.3 Some test specimens of certain materials may shrink from the applied flame without igniting. In this event test results are not valid and additional test specimens may be required to obtain the ten sets of data required.

3.4 Test specimens of certain materials may show burning only along the upper surfaces. In such cases measurement of percentage mass loss may be made and reported if required.

3.5 Inter-laboratory trials have shown that many variables influence the reproducibility of the results of this type of test. For this reason the procedure laid down shall be adhered to in all respects, especially as regards the use and construction of the test chamber and the use and location of the support gauzes and gauze holder.

NOTE Since, with some materials, the horizontal burning characteristics of test specimens may change with time, it is advisable that a series of tests should be carried out both before and after an appropriate ageing procedure, details of which should be given in the test report.

4 Apparatus

4.1 Test chamber. A test chamber shall be used, constructed of non-combustible (non-asbestos) insulating board, having inside dimensions of 600 ± 5 mm length, 300 ± 5 mm width and 760 ± 5 mm height, and being otherwise as depicted in Figure 1. To allow easy access between tests the chamber may be designed so that the front panel containing the window is removable, but if so constructed then provision shall be made for ensuring that a draught-proof seal is obtained when the panel is in position. The chamber shall be used in a fume cupboard.

The air in the chamber shall be draught-free, yet permit normal thermal circulation of air past the specimen during burning.

4.2 Fuel supply. Propane gas of at least 93 % purity and complying with the requirements of BS 4250, supplied through pressure-regulating and on/off valves, shall be used.

4.3 Burner. A burner of internal barrel diameter 9.5 ± 0.5 mm and jet size 0.3 ± 0.1 mm shall be used. The jet shall be such that the propane pressure to obtain the flame as shown in Figure 2 is less than 7 kN/m2.

4.4 Wing top. A wing top having an opening of internal length 48 ± 1 mm and internal width 3.0 ±0.2 mm shall be fitted to the burner.

4.5 Specimen support gauze. The support shall be 215 mm long, 75 mm wide and shall have 13 mm of its length bent to form a right angle as indicated in Figure 3. It shall consist of 6.4 mm mesh gauze constructed from 0.8 mm diameter steel wire. A minimum of four supports shall be available.

4.6 Gauze holder. The gauze holder shall be constructed from mild steel and shall be as depicted in Figure 4, so that

a) the gauze is maintained with its long axis horizontal to within ± 1°, and parallel to the 600 mm dimension of the test chamber;

b) the nearest end of the specimen is 13 ± 1 mm above the burner wing top (see Figure 2);

c) the space both above and below the specimen is unobstructed;

d) a means is provided for clamping the burner in the correct position relative to the specimen;

e) the gauze is equidistant from front and back, and from the sides of the test chamber, and is 175 ± 25 mm above the base of the test chamber.

4.7 Timing device. A timing device accurate to within ± 1 s shall be used.

4.8 Measuring scale. A measuring scale graduated in millimetres shall be used.

5 Size, number and marking of test specimens

5.1 Ten specimens shall be cut from a representative sample of the material. Care shall be taken to remove all dust and any particles from the surfaces.

5.2 The standard specimen shall be 150 ± 1 mm long x 50 ± 1 mm wide. Materials supplied in thicknesses over 14 mm shall be cut to 13 ± 1 mm thickness, any skin having been removed. Materials supplied in thicknesses of 14 mm or less shall be tested at the thickness supplied provided that this is not less than 5 mm, and in this case skins need not be removed.

5.3 Each test specimen shall be weighed, if required (see **3.4**) and shall be marked across its width by a line 25 mm from one end, referred to hereafter as the gauge mark. For samples which have a skin on one side only, which is normally the exterior surface of the material, the gauge mark shall be placed on the surface with the skin.

6 Conditioning of specimens

The material shall be tested not less than 72 h after manufacture. Prior to the test, the test specimens shall be stored for at least 16 h in the following atmospheric conditions:

23 ± 2 °C, 50 ± 5 % r.h.

This period may form the latter part of the 72 h following manufacture.

7 Test procedure

7.1 Adjustment of flame

7.1.1 Ensure that the chamber lid is closed and that the fume cupboard fan is off.

7.1.2 Adjust the burner and gas pressure to provide a blue flame whose visible portion is 38 ± 1 mm high, with a clearly defined inner cone 6 ± 1 mm high, using, for example, preset calipers.

7.1.3 Turn off the gas.

7.2 Adjustment of specimen support

7.2.1 Place a clean specimen support gauze in the holder so that the lower surface of the specimen will be 13 ± 1 mm above the tip of the burner wing top as shown in Figure 2. The relative positions of burner and holder shall be such that when the specimen is in position one edge of the flame is in line with the end of the specimen and the other edge of the flame extends into the specimen as shown in Figure 2. The centre of the wing top shall be directly under the centre line of the specimen when positioned. Ensure that the front panel of the test chamber is sealed.

7.3 Positioning of specimen

7.3.1 Open the glass sliding door and place a test specimen on the support in such a manner that

a) the surface on which the gauge mark has been made is uppermost;

b) the end farthest away from the gauge mark is touching the 13 mm bent up portion of the support gauze;

c) its longitudinal axis is parallel to that of the support gauze.

7.4 Conduct of test

7.4.1 Turn on and ignite the gas and simultaneously start the timing device.

7.4.2 Immediately close the glass sliding door of the test chamber and close the door of the fume cupboard.

7.4.3 Note and record the severity of the burning characteristics of the specimen, i.e. warping, charring, melting, dripping, and whether any drips continue to burn on reaching the floor of the chamber.

7.4.4 Turn off the gas after 60 s.

7.4.5 Record the time in seconds when the specimen flame reaches the gauge mark.

7.4.6 If the whole of the upper surface has not been consumed record the time when the specimen flame extinguishes, i.e. the time when the yellow or other characteristic flame in contact with the main body of the specimen disappears.

In some cases the specimen flame may extinguish within the propane flame. In these cases the extinction time shall be taken as the time when the discoloration imparted to the propane flame disappears.

NOTE Drips falling into the burner should be ignored unless a visible change occurs in the flame. In this case the test on that specimen should be abandoned and after cleaning the burner and wing top a new specimen should be substituted.

7.5 Measurement of extent burnt

7.5.1 Switch on the fume cupboard fan, open the test chamber lid and the glass sliding door and remove the specimen and the specimen support.

7.5.2 Measure and record the extent burnt, which is equal to 150 mm minus the distance from the unburned end to the nearest evidence (such as charring) of the flame front along the upper surface of the specimen. If the whole of the upper surface is affected record the extent burnt as 150 mm.

7.5.3 If measurement of percentage mass loss is required, reweigh the test specimen not including anything which has fallen from the test specimen.

7.6 Preparation for next test

7.6.1 Burn and clean off any residues remaining on the specimen support. Use at least four supports in strict rotation to allow each to cool to room temperature before re-use.

7.6.2 Examine the burner, wing top and glass sliding door for cleanliness, and clean if necessary.

7.6.3 Check the flame size at least after every five tests.

7.6.4 Close the test chamber lid, switch off the fume cupboard fan, and repeat the test from 7.2 for the other specimens.

8 Calculations

8.1 If the flame front passes the gauge mark, then

$$\text{burning rate of the specimen (mm/s)} = \frac{125}{t_b}$$

where

t_b is the time (s) at which the flame reaches the gauge mark.

8.2 If the flame front does not reach the gauge mark, then

$$\text{burning rate of the specimen (mm/s)} = \frac{\text{extent burnt}}{t_e}$$

where

t_e is the time (s) when the flame is extinguished.

8.3 Calculate the mean extent burnt, the mean extinction time and the mean burning rate and, if required, the mean percentage mass loss for the test specimens.

9 Test report

The test report shall include the following:

a) *The statement:*

The following test results relate only to the behaviour of the test specimens under the particular conditions of test; they shall not be used as a means of assessing the potential fire hazard of the material in use.

b) A description of the material tested, including

1) the nominal apparent density of the material;

2) the thickness to the nearest millimetre of the test specimens;

3) presence or absence of skins;

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

5) the direction of any anisotropy.

c) A description of the burning characteristics of the test specimens, i.e. warping, charring, melting, dripping, and whether any drips continue to burn on reaching the floor of the chamber.

d) The mean extent burnt for the test specimens (see Note).

e) The mean extinction time t_e for the test specimens (see Note).

f) The mean burning rate for the test specimens (see Note).

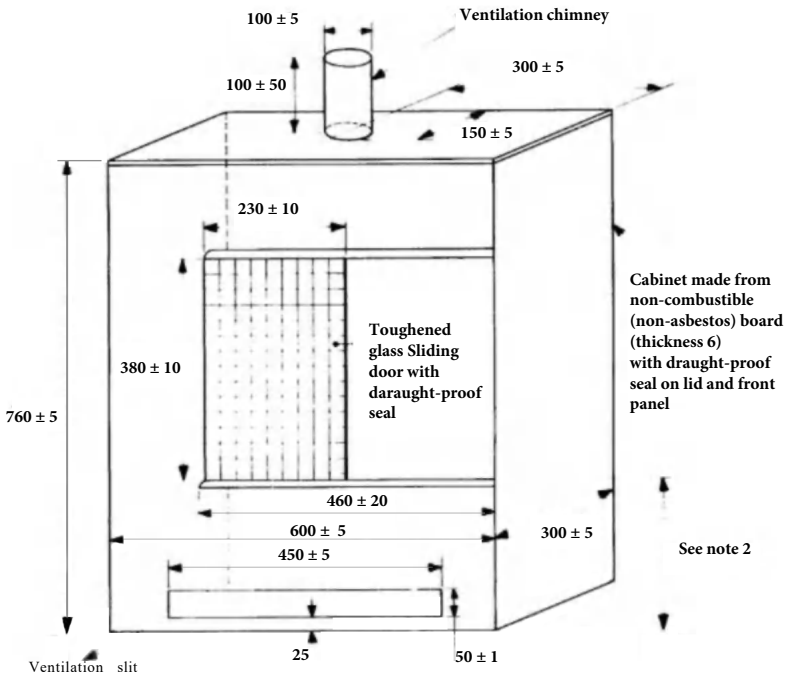
g) The mean mass loss, expressed as a percentage, if required.

NOTE Experience has shown that for both discrimination and reproducibility the mean extent burnt is the preferred test criterion. Inter-laboratory tests on specimens from four materials gave 95 % confidence limits on measurements of extent burnt as follows:

Mean extent burnt of test specimens	95 % confidence limits including inter-laboratory and testing errors
mm	mm
17	± 8
18	± 10
29	± 12
41	± 18

In view of the reproducibility of the test method as indicated by the confidence limits stated above, it is recommended that results for mean extent burnt should be reported to the nearest 25 mm.

Results for mean extinction time and mean burning rate should preferably be reported to the nearest 5 s and 0.5 mm/s respectively.

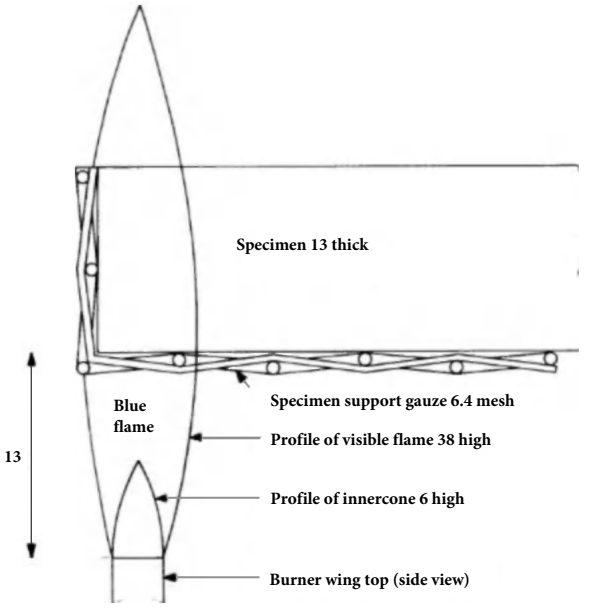


All dimensions are in millimetres

NOTE 1 The dimensions shown for the test chamber are internal

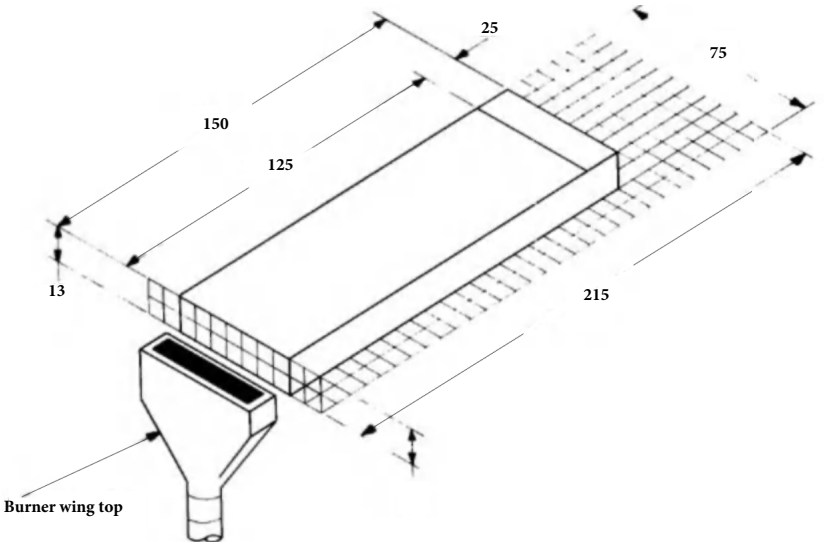
NOTE 2 It is recommended that the bottom of the window be approximately 25 mm below the normal position of the gauze during the test (see **Figure 4**)

Figure 1 — Test chamber



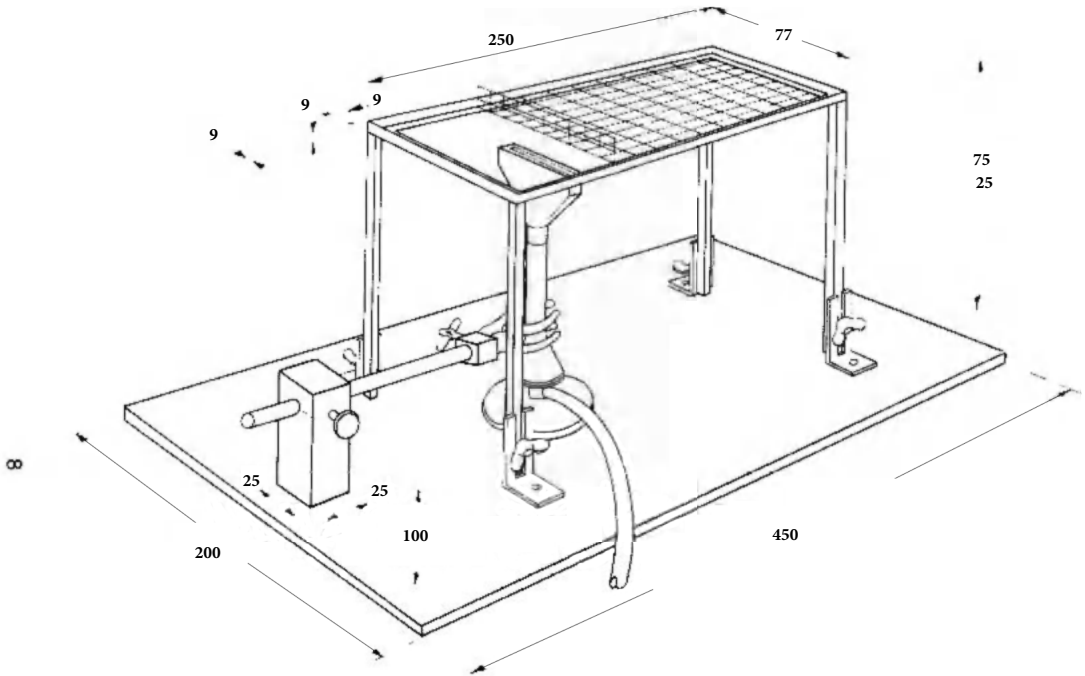
All dimensions are in millimetres

Figure 2 — Details of flame and relative positions of burner wing top, specimen and specimen support



All dimensions are in millimetres

Figure 3 — Dimensions of specimen and specimen support



All dimensions are in millimetres

Figure 4 — Gauze holder

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Publication referred to

This standard makes reference to the following British Standard:
BS 4250, *Commercial butane and propane.*

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