IS 13286 (1992): Surface Spread of Flame for Thermal Insulation Materials - Methods of Test [CHD 27: Thermal Insulation]

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Indian Standard

SURFACE SPREAD OF FLAME FOR THERMAL INSULATION MATERIALS — METHODS OF TEST

UDC 662.998 — 405.8 : 536.468

BUREAU OF INDIAN STANDARDS
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI 110002

February 1992

Price Group 3

Thermal Insulation Materials Sectional Committee, CHD 027

FOREWORD

This Indian Standard was adopted by the Bureau of Indian Standards, after the draft finalized by the Thermal insulation Materials Sectional Committee had been approved by the Chemical Division Council.

In this method, specimens of the product (material, composite or assembly) are subjected to a specified heating and ignition regime. The test takes account of the combined effect of factors such as ignition characteristics and the extent to which the surface of the product spreads flame. The ifluence on these factors of any underlying materials in relation to their ability to influence the rate of fire growth is also taken into account. The test result is a function of distance of, and rate of, lateral spread of flame, and this is classified according to performances as classes 1 to 4.

Whilst this test has been designed to give information on the performance of a product in the early stages of a fire, it should not be considered or used by itself for describing or appraising the fire hazard of a material, composite or assembly under actual fire conditions. Neither should it be used as the sole source on which a valid assessment of hazard pertaining to surface spread of flame can be passed.

A small scale test procedure for assessing spread of flame characteristic, which might be useful for quality control work or research and development, has also been included in this standard.

For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test or analysis, shall be rounded off in accordance with IS 2 : 1960 'Rules for rounding off numerical values *(revised)'*. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

AMENDMENT NO. 1 JULY 2003
TO
IS 13286:1992 SURFACE SPREAD OF FLAME FOR THERMAL INSULATION MATERIALS — METHODS OF TEST

(*Page* 1, *clause* **4.2**, *line* 2) — Substitute '270 mm × 885 mm' *for* '230 mm × 900 mm'.

(*Page* 1, *clause* **4.3**, *last line*) — Substitute '50 ± 10 percent relative humidity' *for* '60-70 percent relative humidity'.

(CHD 27)

Reprography Unit, BIS, New Delhi, India

Indian Standard

SURFACE SPREAD OF FLAME FOR THERMAL INSULATION MATERIALS - METHODS OF TEST

1 SCOPE

1.1 This Indian Standard prescribes the methods of test for determining surface spread of flame for thermal insulation materials.

1.2 Two methods of tests have been prescribed for determining the tendency of thermal insulation materials to support the spread of flame across their surface, namely, a large-scale test for exposed surfaces of walls and ceilings and a small scale surface spread of flame test suitable for preliminary testing for development and quality control purposes.

NOTE — There is no direct correlation between these two tests.

2 REFERENCES

The following Indian Standard is the necessary adjunct to this standard:

IS No.	*Title*
3069 : 1965	Glossary of terms, symbols and units relating to thermal insulation materials

3 TERMINOLOGY

For the purpose of this standard, definitions given in IS 3069 : 1965 shall apply.

4 LARGE SCALE SURFACE SPREAD OF FLAME TEST AND METHOD OF CLASSIFICATION

4.1 General

This section specifies a large scale test for determining the tendency of materials to support the spread of flame across their surfaces. The test is intended for the classification of the exposed surfaces of walls and ceilings, according to the rate and distance of spread of flame across them.

4.1.1 The test should be performed on the assembly of materials on which information is required. Thin surfacings and coatings which have always to be applied to substrates should be tested with the appropriate substrate and where applicable the fixative to be used. The performance in the test applied to the thickness of the specimen and the combination of materials subjected to the test and may not be valid for other assemblies unless verified by a further test.

4.2 Size and Number of Specimens

A test sample of a material shall comprise six representative specimen, each 230 mm × 900 mm, and of their normal thickness where this does not exceed 50 mm. Where, however, the thickness of the material is greater, the material should be reduced to 50 mm and the test applied to be face that will be exposed in practice. The performance under the test may be assumed to apply to the thicker specimen.

4.3 Preparation and Conditioning of Specimens

Before test, paint the edges, together with a strip 40 mm wide from the edges on the unexposed face, with sodium silicate composition, the ingredients of which are specified in **4.4**, after which, condition the specimens to a moisture content in equilibrium with air at 27 ± 2°C and 60.70 per cent relative humidity.

4.3.1 Apply specimens of this surfacings and coatings to the appropriate substrates, using method normally recommended for their application.

4.4 Ingredients of Sodium Silicate Composition

The sodium silicate composition shall conform to the following proportions by weight:

Kaolin	1.50
Sodium silicate	1.12
Water	1.00

The sodium silicate shall be of a 'neutral' grade in the form of an aqueous syrup in which the ratio of soda to silica is between Na_2O : 3.2 SiO_2 and Na_2O:3.4 SiO_2 and which has a specific gravity between 1.41 and 1.43.

NOTE — This flame retardant composition is not suitable for use as a permanent paint for fire protection purposes.

4.5 Apparatus

The apparatus consists essentially of a vertically mounted radiation panel, approximately 900 mm square, provided with a refractory concrete surround projecting about 225 mm from the face of the panel. Any gaps between the surround and the panel should be tightly packed with a flexible non-combustible material.

4.5.1 On one side of the panel, at mid-height, is mounted a horizontal holder hinged to the side of the furnace or the surround. The holder

consists of a steel frame with asbestos insulation board horizontal guides to locate the specimen holder described in **4.6**. When the holder is moved to the testing position the face of the specimen is flush with the inner face of the refractory surround and its front edge is shielded.

4.5.2 On the opposite side to the holder a frame may be fixed with radiometers of the type described in **3.9** without a baseboard but with asbestos paper facings on both sides to act as a monitoring device. When the calibration of the radiating panel is undertaken the output of the monitoring radiometers, not less than five in number, is noted and used for control purposes for day-to-day operation of the apparatus.

4.5.3 A typical furnace installation is gas fired using town gas at an average rate of 480 m^3/h. The fuel is premixed in four venturi type injectors to which air is supplied under a pressure of 5 000 N/m^2 and the mixture fed to the burner elements. Each element consists of a number of turnel type burners where combustion takes place in the burner so that in operation no pronounced flaming should occur on the face of the panel.

4.6 Test Procedure

Fix the specimen to a wooden framework faced with asbestos millboard, secure in such a way that the face of the specimen may burn without obstruction from the supports, for example, by screws from the rear of the wooden framework. Mount the specimen with its long axis horizontal and its face vertical and bring, not longer than five seconds, from a position at room temperature to its test position virtually at right angles to the furnace. A slight angular adjustment is allowable, in order to achieve the specified pattern of incident radiation, since this is the primary requirement.

4.6.1 Immediately the specimen is exposed to the radiated heat apply a vertical luminous gas flame to its hotter end for one minute. This flame shall be 75 mm to 100 mm long and shall issue from a 9.5 mm diameter orifice. Locate the orifice not more than 6 mm in front of the surface of the specimen and at 6 mm above its lower edge. The room in which the test is made must be substantially free from draughts.

4.7 Observations During Testing

As soon as the igniting flame is in contact with the specimen, record the time of spread of the flame front for measured distances along a line drawn parallel to the long axis, 75 mm from the bottom edge of the specimen. Continue measurements for 10 min, unless the flame front reaches the far end of the specimen in a shorter time.

4.7.1 Observe any associated phenomenon, such as transitory flaming and production of flaming droplets, and include all supplementary observations in the report. Specimens which become detached from the substrate or melt during the first minute of exposure causing lack of flame impingement on the hot end shall be regarded as unclassifiable.

4.8 Classification of Surface Spread of Flame

Classify surfaces into one of the classes shown in Table 1 and in Fig. 2 according to their observed behaviour under test. For a full evaluation of a material having surfaces which differ, classify each face separately.

4.8.1 The flame spread on any specimen of the sample shall not exceed the limit assigned for the class with the proviso that for one specimen only in the sample, the flame spread may exceed this limit by the tolerance shown.

Table 1 Flame spread Classification

(*Clause* 4.8)

Classification	Flame Spread, at 1½ Min		Final Flame Spread	
	Limit	Tolerance for One Specimen in Sample	Limit	Tolerance for One Specimen in Sample
	mm	mm	mm	mm
(1)	(2)	(3)	(4)	(5)
Class 1	165	25	165	25
Class 2	215	25	455	45
Class 3	265	25	710	75
Class 4	← Exceeding Class 3 limits →			

4.9 Calibration of Apparatus, Specification for Panel and Radiometers

The panel to support the radiometers for measuring the intensity of radiant heat falling on a specimen consists of a base board 9 mm thick of asbestos board having a density of 1 200 kg/m^2 to 1 400 kg/m^3. Recesses are formed at 75 mm intervals and 3 mm deep at positions shown in Fig *2*. Radiometers are made by silver soldering chromel/constantan thermocouples, wire diameter not more than 0.71 mm, to one face of cleaned copper discs of 25 mm diameter and 0.20 mm thickness. An asbestos paper disc of 25 mm diameter and 0.25 mm thickness is applied to the same face of the copper disc as the thermocouple junction using the sodium silicate composition. When dry the assembly is fixed in the recess of the base board using the same adhesive. It is important to apply the sodium silicate composition sparingly as otherwise on heating it may bubble and cause malfunction of the radiometers.

4.9.1 The intensity of the radiated heat incident on the specimen shall vary with distance from the hotter end, so that when the calibrating panel is mounted in the place to be occupied by the specimen the e.m.f. output of the radiometers shall be as given in Table 2 within

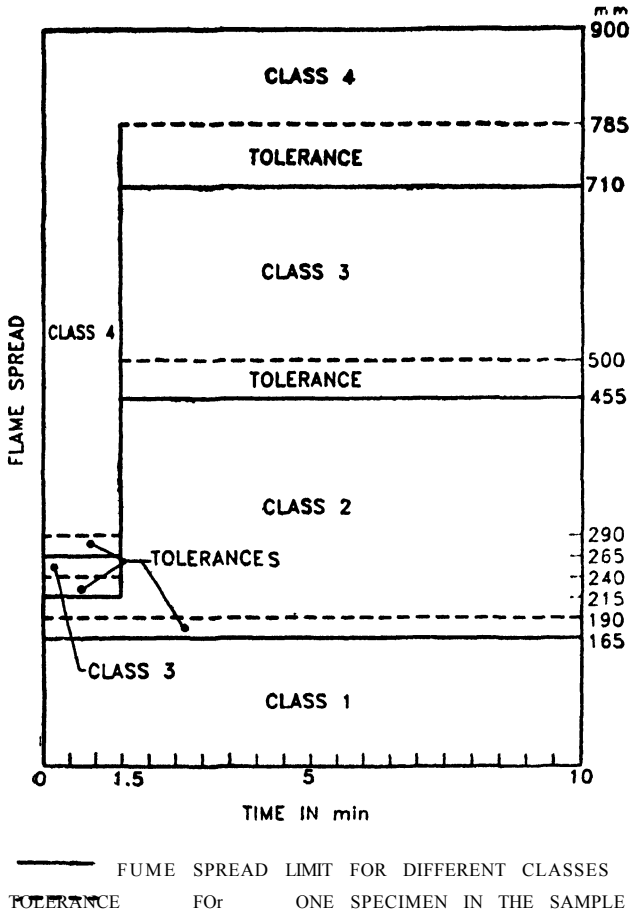


FIG. 1 CLASSIFICATION LIMITS FOR LARGE SCALE SPREAD OF FLAME TEST

± 1 mV with reference to a cold junction temperature for the radiometers of 0°C.

NOTE — The instruments used to measure e.m.f. should be of laboratory standard and calibrated and capable of making the measurements with the necessary accuracy.

Table 2 Output of Radiometers (Large Scale Test)

(Clause 4.9.1)

Distance from Hoter End of Specimen (mm)	Radiation Intensity (kW/m^2)	e.m.f. (mV)
(1)	(2)	(3)
75	37.0	31.5
150	31.0	28.5
225	25.5	26.0
300	21.0	23.5
375	18.4	21.5
450	15.1	19.5
525	13.4	18.0
600	11.7	16.5
675	10.5	15.5
750	8.8	13.5
825	7.5	12.0

4.10 Test Report

In the test report give a full description of the material, its construction and thickness, details of treatment, if any, the method of fixing, the face subjected to the test results including any supplementary observations and the classification.

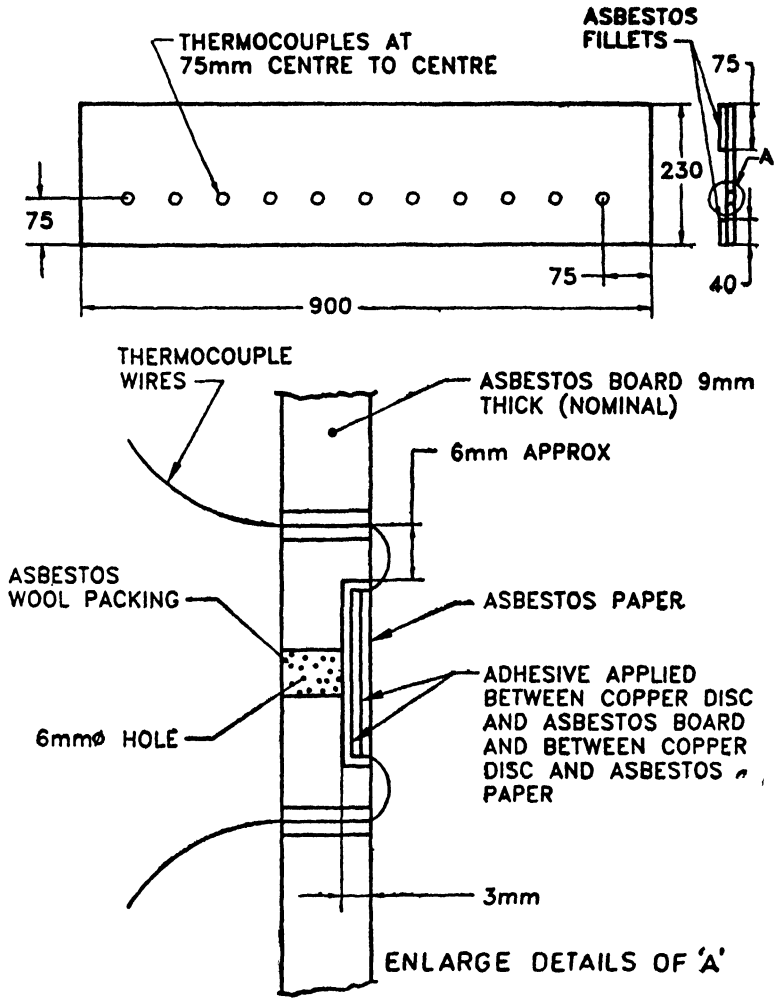
5 SMALL SCALE FURNACE SPREAD OF FLAME TEST

5.1 General

This section specifies a small scale surface spread of flame test. It also describes how the apparatus shall be calibrated and the test conducted.

5.1.1 The small scale surface spread of flame test can be used for all types of materials except those with corrugated or perforated surfaces which may be difficult to scale down to 1/3 size on the exposed face.

NOTE — It is not intended that this test should replace the standard large scale test and there is no direct correlation between the two. The small scale test is suitable for use at a preliminary test in the development of a product or for quality control.



All dimensions in millimetres.

FIG. 2 DETAILS OF PANEL FOR CALIBRATION OF RADIATION FURNACE

5.2 Size and Number of Specimens

A test sample of a materials shall comprise six representative specimens, each 95 mm × 300 mm and of the normal thickness where this does not exceed 25 mm. Where, however the thickness of the material is greater, the material should be reduced to 25 mm and the test applied to the face that will be exposed in practice. The performance under the test may be assumed to apply to the thicker specimen.

5.3 Conditioning of Specimens

Before testing, condition the specimens to a moisture content in equilibrium with air at 27±2°C and 60-70 percent relative humidity.

5.4 Apparatus

The apparatus for the small scale surface spread of flame test is one-third the linear size of the full scale apparatus.

5.4.1 The radiant panel shall be supplied with gas controlled by a sensitive gas valve (a 12 mm main and valve have been found suitable). A supply of air from a blower driven by an electric motor shall be mixed with the gas in a mixing chamber immediately behind the radiant panel. The mixture shall be burnt at the porous fire-brick surface of the panel, heating the later to the required temperature.

5.4.2 The specimen holder shall be constructed of asbestos board 12.5 mm thick, and shall be hinged centrally to a vertical side of the refractory concrete frame, so that in the test position it is perpendicular to the radiant panel. The face of the specimen under test, when the specimen is placed in the holder and the holder swung into test position, shall be flush with the inner surface of the refractory surround. The width of the specimen exposed to the furnace shall be 75 mm. The specimen shall be retained in position by a suitable backing board of asbestos board, which presses the specimen firmly against the inner face of the holder. The backing board itself shall be clamped by wedges to the holder, by springs or by retaining screws.

5.4.3 Provision shall be made for fixing a small bore gas pipe vertically up to the lower edge of the specimen, terminating in a 1.5 mm orifice. This pipe, which shall be located so that the orifice is close to the lower edge of the specimen, supplies gas for the pilot flame.

5.5 Calibration

The radiant panel shall be ignited and the gas supply shall be adjusted so that the radiant intensity to which the surface of the specimen is subjected in its test position shall have the values given in Table 3. Thus the e.m.f. output of an asbestos-faced copper disc radiometer of the type described in 4.9 of the large scale surface spread of flame test, when mounted with a backing in the plane to be occupied by the specimen and along its centre line shall be as in Table 3 within ± 1 mV with reference to a cold junction for the radiometers of 0°C.

Table 3 Output of Radiometers (Small Scale Test)

(*Clause* 5.5)

Distance from Hoter End of Specimen (mm) (1)	Radiation Intensiy (kW/m^2) (2)	e.m.f. (mV) (3)
50	31.0	28.5
100	21.0	23.5
150	15.1	19.5
200	11.7	16.5
250	8.8	13.5

5.6 Furnace Control

The temperature of the radiation panel corresponding to the setting giving the calibration described in **5.5** shall be measured in one of two ways for monitoring for day-to-day operation.

5.6.1 In the first method, use a total radiation pyrometer placed at such a distance from the panel, dependent upon the constants of the instrument, that the 300 mm square radiant panel fills the cone of vision of the receiving tube but does not include any of the surround.

5.6.2 In the second method, use the standard disc radiometer with asbestos paper facing on both sides supported between two steel rods and stretching the thermocouple wires between them, the rods being fixed rigidly to a suitable support. Use the refractory surround for this purpose.

5.6.3 Locate the disc facing the plane of the radiant panel 125 mm from it at a point 75 mm above its lower edge and on its vertical centre line. Having adjusted the gas supply to the furnace to give the required radiant intensities along the face of the specimen, allow the disc to achieve its equilibrium temperature and record its e.m.f. A dead-beat instrument is desirable for this measurement as there may be rapid fluctuations in the temperature of the disc about its mean value, due to turbulent draughts from the hot face of the panel. Use the method of construction of the asbestoes-faced copper disc thermocouple as described in **4.9** of the large scale surface spread of flame test.

NOTE — With the radiant panel operating correetly its surface temperature is about 875°C and the monitoring radiometer shows an e.m.f, of about 80 mV.

5.7 Test Procedure

Light the pilot flame and adjust its height to 50-60 mm. Swing the test specimen in its holder immediately from its position, at room temperature, into a position with its long axis horizontal and its face vertical and virtually at right angles to the surface of the radiant panel. As soon as the specimen is in position, apply the gas flame to the hotter end for one minute. The room in which the test is made must be substantially free from draughts.

5.8 Observations During Testing

As soon as the igniting flame is in contact with the specimen, record the time of spread of the flame front along the longitudinal centre-line of the specimen. Continue measurements for 10 min, unless the flame front reaches the far end of the specimen in a shorter time.

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