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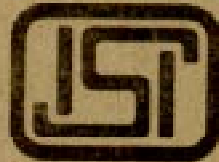


*Indian Standard*

**METHODS OF TEST FOR RIGID CELLULAR  
THERMAL INSULATION MATERIALS**

**PART 8 FLAME HEIGHT, TIME OF BURNING AND  
LOSS OF MASS**

UDC 678.077.405.8 : 536.46 : 662.998



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**INDIAN STANDARDS INSTITUTION**  
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG  
NEW DELHI 110002

# Indian Standard

## METHODS OF TEST FOR RIGID CELLULAR THERMAL INSULATION MATERIALS

### PART 8 FLAME HEIGHT, TIME OF BURNING AND LOSS OF MASS

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*Indian Standard***METHODS OF TEST FOR RIGID CELLULAR  
THERMAL INSULATION MATERIALS****PART 8 FLAME HEIGHT, TIME OF BURNING AND  
LOSS OF MASS****0. FOREWORD**

**0.1** This Indian Standard was adopted by the Indian Standards Institution on 25 March 1985, after the draft finalised by the Thermal Insulation Materials Sectional Committee had been approved by the Chemical Division Council.

**0.2** In the preparation of this standard, considerable assistance has been drawn from ASTM D 3014-76 'Test for flame height, time of burning and loss of weight of rigid cellular plastics in a vertical position', issued by American Society for Testing and Materials.

**0.3** In reporting the result of a test made in accordance with this standard, if the final value, observed or calculated, is to be rounded off, it shall be done in accordance with IS : 2 - 1960\*.

**1. SCOPE**

**1.1** This standard prescribes a small-scale laboratory screening method for comparing relative extent and time of burning and loss of mass of rigid cellular thermal insulation materials.

**2. TERMINOLOGY**

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

**3. PRINCIPLE**

**3.1** The specimen is mounted in a vertical chimney with a glass front and ignited with a bunsen burner for ten seconds. The height and duration of flame and the mass percent retained by the specimen are recorded.

NOTE — This method, which is only a small-scale procedure, should not be a criterion for fire hazard.

\*Rules for rounding off numerical values ( revised ).

†Glossary of terms, symbols and units relating to thermal insulation materials.

#### 4. CONDITIONING

**4.1** The test specimens shall be conditioned at  $27 \pm 2^{\circ}\text{C}$  and  $65 \pm 5$  percent relative humidity for at least 16 hours.

#### 5. APPARATUS

**5.1 Test Chimney** — Conforming to the dimensions in Fig. 1, 2 and 3. The body of the chimney may be either galvanized or stainless steel. In it an insert made of 0.025 mm aluminium foil is fastened. The insert is held in place by a stainless steel channel which carries three pins to support the specimen. A heat-resistant glass panel forms the front wall of the chimney. A scale, reading in millimetres, graduated at 10 mm intervals shall be provided at one side of the glass panel for determining flame height ( *see* Fig. 1 and 4 ). The scale begins 50 mm above the bottom of the chimney.

**5.2 Timer** — Capable of measuring to the nearest 0.1 s for determining the duration of burning.

**5.3 Burner** — A standard gas burner with 9.5 mm inside diameter barrel capable of producing a flame with an inner cone of  $960^{\circ}\text{C}$  is required to ignite the specimens.

**5.4 Balance** — Capable of weighing to the nearest 0.01 g for weighing the specimen.

**5.5 Aluminium Weighing Dishes** — Disposable, 50 mm in diameter are required to collect dripping polymer.

**5.6 Test Chamber** — A relatively draught-free laboratory hood. The fan should be turned off during the test and should be turned on immediately following the test to remove products of combustion, which in some cases may be toxic.

#### 6. TEST SPECIMEN

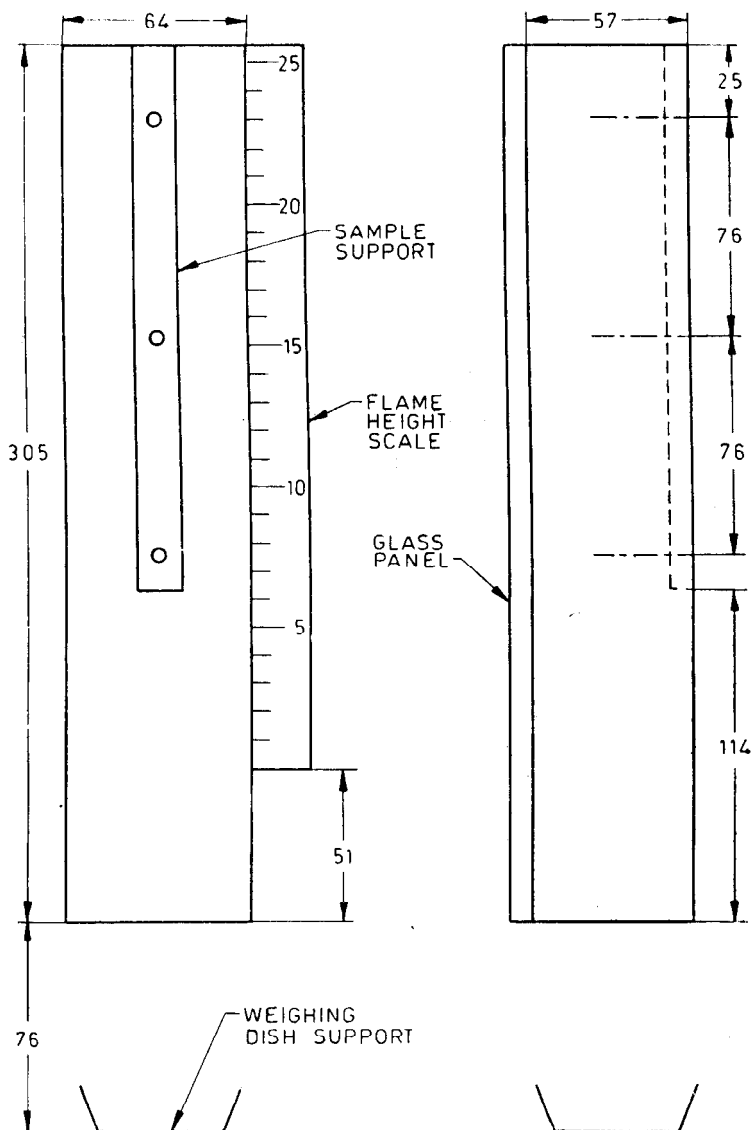
**6.1** Six specimens of size  $250 \times 20 \times 20$  mm shall be obtained by sawing without deformation of the cellular structure. If any specimen varies by more than 5 percent from the average density of the six, the sample should be considered unacceptable for testing by this method.

#### 7. PROCEDURE

**7.1** Determine the density of each specimen in accordance with IS : 11239 ( Part 2 ) 1985\*.

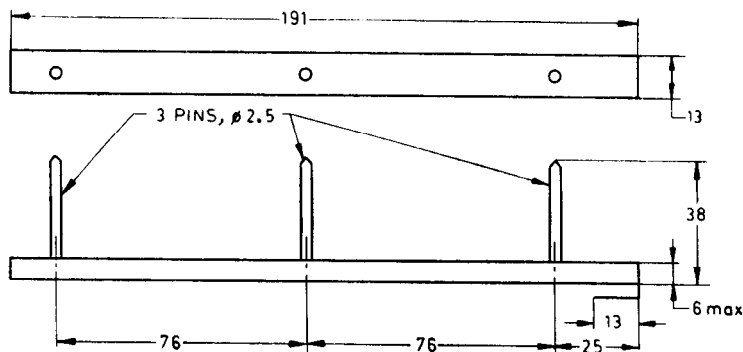
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\*Methods of test for rigid cellular thermal insulation materials: Part 2 Apparent density.



All dimensions in millimetres.

FIG. 1 CRITICAL DIMENSIONS OF CHIMNEY



All dimensions in millimetres.

FIG. 2 CRITICAL DIMENSIONS OF SPECIMEN SUPPORT

**7.2** Weigh and record the mass ( $W$ ) of each specimen to the nearest 0.01 g.

**7.3** Weigh and record the mass ( $S$ ) of the specimen support to the nearest 0.01 g.

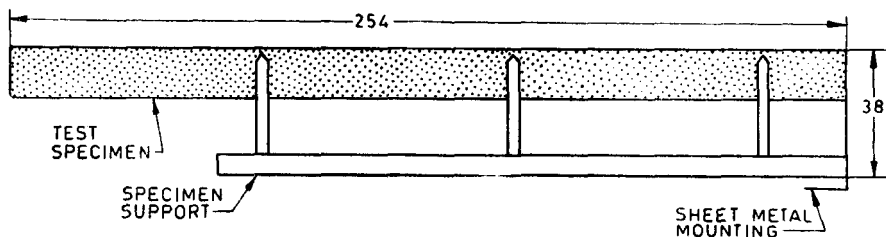
**7.4** Weigh and record the mass ( $D$ ) of disposable weighing dish for each specimen to the nearest 0.01 g.

**7.5** Ignite and adjust the burner so that the inner blue cone is 25 to 35 mm high. Further adjust the burner until the temperature at the top of the inner cone is  $960 \pm 10^\circ\text{C}$ .

NOTE — To obtain  $960^\circ\text{C}$ , it may be necessary to use a propane burner with propane gas, or a natural gas burner with natural gas. In order to minimize the time and frequency required for temperature calibration, it is necessary to maintain steady supply of gas. Thermocouples have been found useful to make this temperature measurement.

**7.6** Impale the specimen on the three pins of the specimen support, with the top of the specimen even with the top of the specimen support as shown in Fig. 3. Higher density cellular plastics may require that holes be drilled in the specimen to allow insertion of the pins. When required, the holes should be drilled at the time of specimen preparation (if holes are drilled the specimen shall be weighed after drilling holes).

**7.7** Line the chimney with aluminium foil so that it is against the sides and back of the chimney and flush with the bottom. Place the shining side of the aluminium foil towards the test specimen. A new liner should be installed for each specimen.



All dimensions in millimetres.

FIG. 3 TEST SPECIMEN INPOLED ON SPECIMEN SUPPORT (SIDE VIEW)

**7.8** Place the specimen support in the chimney so that the top of the specimen is even with the top of the chimney as shown in Fig. 4.

**7.9** Place the disposable weighing dish on a support centred 75 mm below the chimney as shown in Fig. 4.

**7.10** Put the glass front in place and ignite the specimen by placing the inner cone of the burner flame under the centre of the specimen for 10 seconds. Simultaneously with placing the flame under the specimen, start the timer to determine the time to extinguishment ( $T$ ). Keep the burner at an angle of about  $15^\circ$  from the vertical as shown in Fig. 4.

NOTE — Accurate positioning of the burner is facilitated by use of a cradle to hold the burner at the proper angle and distance from the specimen.

**7.11** Measure the maximum flame height ( $H$ ), during combustion of the specimen, to the nearest 10 mm with the flame height scale on the front of the chimney and record. If the flame rises above the top of the scale, record as 250 + mm.

**7.12** Stop the timer when combustion of the specimen ceases and record as time to extinguishment ( $T$ ) to the nearest second. If the time of extinguishment is less than 10 seconds note the time but continue to apply the flame for full 10 seconds. If droppings burn, after specimen extinguishes,  $T$  shall be taken when the drops extinguish.

**7.13** After cooling remove the specimen support and specimen and weigh, without removing the specimen, to the nearest 0.01 g and record ( $S$ ). Weigh the disposable weighing dish containing the droppings and record ( $D$ ). If droppings accumulate in the burner, they must be removed and included in the weight.

**7.14** Clean the specimen support and repeat the procedure given in 7.6 to 7.13 until all specimens have been ignited.

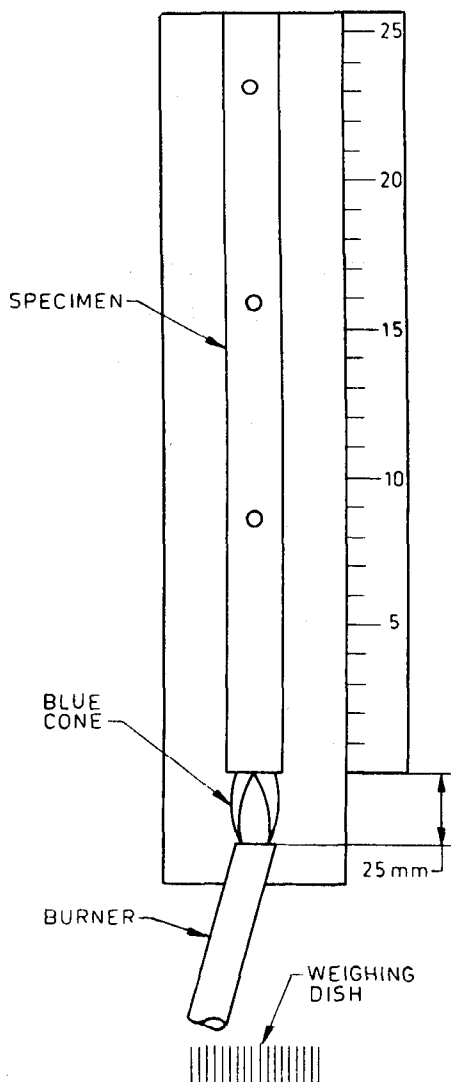


FIG. 4 BURNER POSITION UNDER SPECIMEN IN CHIMNEY  
( FRONT VIEW )

## 8. CALCULATIONS

**8.1** Calculate the mass percent of the specimen retained after ignition by the equation

$$PWR = \frac{(S_2 - S_1) - (D_2 - D_1)}{W} \times 100$$

where

*PWR* = percent mass retained by entire specimen, including drips;

*S*<sub>2</sub> = mass of specimen and specimen support after ignition, g;

*S*<sub>1</sub> = mass of the specimen support, g;

*D*<sub>2</sub> = mass of disposable weighing dish with droppings after ignition, g;

*D*<sub>1</sub> = mass of the disposable weighing dish, g; and

*W* = mass of the specimen, g.

## 9. REPORT

**9.1** The report shall include the following:

- a) Reference to this standard;
- b) Description and identity of the material;
- c) Average density;
- d) Average time to extinguishment for the six specimens to the nearest second;
- e) Number of specimens that produced flaming drops;
- f) Average mass percent retained for the six specimens;
- g) Average flame height for the six specimens to the nearest 25 mm;
- h) Temperature and relative humidity of air during storage prior to conditioning and storage time; and
- i) Temperature and relative humidity of air during flame testing.

# INTERNATIONAL SYSTEM OF UNITS ( SI UNITS )

## Base Units

<i>Quantity</i>	<i>Unit</i>	<i>Symbol</i>
Length	metre	m
Mass	kilogram	kg
Time	second	s
Electric current	ampere	A
Thermodynamic temperature	kelvin	K
Luminous intensity	candela	cd
Amount of substance	mole	mol

## Supplementary Units

<i>Quantity</i>	<i>Unit</i>	<i>Symbol</i>
Plane angle	radian	rad
Solid angle	steradian	cr

## Derived Units

<i>Quantity</i>	<i>Unit</i>	<i>Symbol</i>	<i>Definition</i>
Force	newton	N	1 N = 1 kg.m/s <sup>2</sup>
Energy	joule	J	1 J = 1 N.m
Power	watt	W	1 W = 1 J/s
Flux	weber	Wb	1 Wb = 1 V.s
Flux density	tesla	T	1 T = 1 Wb/m <sup>2</sup>
Frequency	hertz	Hz	1 Hz = 1 c/s (s <sup>-1</sup> )
Electric conductance	siemens	S	1 S = 1 A/V
Electromotive force	volt	V	1 V = 1 W/A
Pressure, stress	pascal	Pa	1 Pa = 1 N/m <sup>2</sup>