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IS : 12458 - 1988

Indian Standard
METHOD OF
FIRE RESISTANCE TEST OF FIRESTOPS

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Indian Standard

METHOD OF FIRE RESISTANCE TEST OF FIRESTOPS

0. FOREWORD

0.1 The Indian Standard was adopted by the Bureau of Indian Standards on 14 October 1988, after the draft finalized by the Fire Safety Sectional Committee had been approved by the Civil Engineering Division Council.

0.2 The method of fire resistance test of various structures of buildings is covered in IS : 3809-1979*. The method of fire resistance test of firestops intended for use in openings in fire resistance wall and/or floor-ceiling assemblies as

horizontal and/or vertical stops for fire resistance requires different procedure in view of its importance and hence the same has been covered in this standard.

0.3 In reporting the results of a test or analysis 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*.

*Fire resistance test of structures (*first revision*).

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

1. SCOPE

1.1 This standard specifies method of fire resistance test of firestops that are required for use in openings in fire resistive walls or floor-ceiling assemblies.

1.2 The test provides for the determination of fire rating of firestops on the basis of the length of time the firestops resist fire before the first development of through openings or flaming and transmission of heat on the unexposed surface and performance under the application of the hose stream.

2. APPARATUS

2.1 Furnace — It shall be capable of subjecting a full size specimen individually or in combination with others in a fire rated horizontal or vertical structural element with fire resistance not less than that of the specimen to be evaluated. The furnace shall also be capable of reproducing standard conditions of heating and pressure.

2.2 Thermocouples — Appropriate thermocouples shall be provided for measuring the internal furnace temperature and unexposed surface temperature of the firestop assembly in conformity with the requirements of 3.1.2 and 3.1.3.

2.3 Pressure Measuring Equipment — Pressure measuring equipment coupled with the furnace shall be provided in conformity with the requirement of 3.2.1 and 3.2.2.

2.4 Hose Stream Equipment — The equipment with appropriate technique shall be pro-

vided to apply hose stream immediately after the fire exposure in conformity with the requirement of 5.1.2.

3. STANDARD HEATING AND PRESSURE CONDITIONS

3.1 Standard Heating Conditions

3.1.1 Temperature Rise — The temperature rise within the furnace shall be controlled so as to vary with time within the limits specified in 5.1.3 according to the following relationship:

$$T - T_0 = 345 \log_{10} (8t + 1)$$

where

T = furnace temperature at time t , expressed in degrees Celsius;

T_0 = initial furnace temperature, expressed in degrees Celsius; and

t = time, expressed in minutes.

The curve representing this function, known as the 'Standard time-temperature rise curve' is shown in Fig. 1. The relationship expressed, gives the values shown' in Table 1.

3.1.2 Measurement of Furnace Temperature

3.1.2.1 The furnace temperature is deemed to be the average of the temperature recorded by thermocouples arranged within the furnace to give an approximation to its average temperature.

3.1.2.2 These thermocouples shall not be fewer than one for each 1.5 m² of surface area of walls and floors of the furnace, in which the test specimen of through cable fire penetrations firestops are installed.

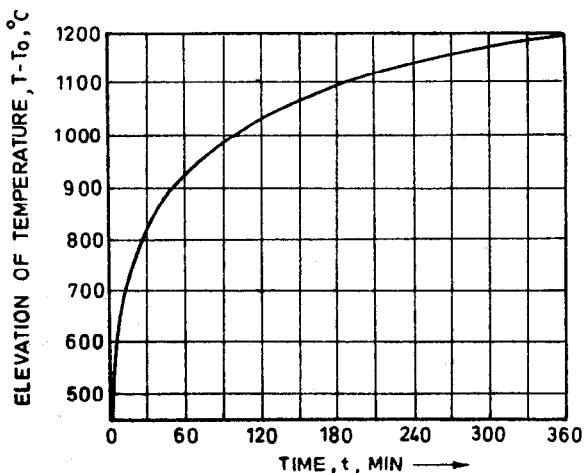


FIG. 1 STANDARD TIME TEMPERATURE RISE CURVE

TABLE 1 TEMPERATURE RISE AS A FUNCTION OF TIME

(Clause 3.1.1)

TIME, t	ELEVATION OF FURNACE TEMPERATURE, T - T₀, °C
min	
5	556
10	659
15	718
30	821
60	925
90	986
120	1029
180	1090
240	1133
360	1193

In any case, the number of thermocouples shall be not less than five.

3.1.2.3 Bare wire thermocouples of wire diameter not less than 0.75 mm and not more than 1.5 mm shall be arranged so that the hot junction is 100 mm from the nearest point of the vertical separation point. This distance shall be kept constant as far as possible during the test.

3.1.2.4 Sheathed thermocouples may be used provided that they have a sensitivity not less than and time-constant not greater than those of the bare wire thermocouples.

3.1.2.5 The wires of the thermocouples shall be placed in open tubes of heat-resistant material, for example, porcelain, within approximately 25 mm from the hot junction.

3.1.3 Tolerances

3.1.3.1 For mean deviation of furnace temperature

rise — The mean deviation of furnace temperature rise is given as a percentage by the following expression:

$$\frac{A - B}{B} \times 100$$

where

A = integral value of the average furnace temperature as a function of time, and

B = integral value of T - T₀ from the equation defined in 5.1.1.

The tolerances on mean deviations shall satisfy the following conditions:

- a) ±15 percent during the first 10 minutes of test,
- b) ±10 percent during the first 30 minutes of test, and
- c) ±5 percent after the first 30 minutes of test.

3.1.3.2 For temperature distribution within the furnace — At any time after the first 10 minutes of test, the temperature recorded by any thermocouple, shall not differ from the corresponding temperature of the standard time-temperature curve by more than ±100°C. For specimens incorporating a significant amount of combustible material, the deviation of any one thermocouple shall not exceed 200°C.

3.1.4 Measurement of Temperature of Test Specimens — Surface temperature of test specimens shall be measured by means of thermocouples with a wire diameter of not more than 0.7 mm.

3.1.4.1 Each thermocouple junction shall be attached to the centre of the face of a copper disc 12 mm in diameter and 0.2 mm thick which is secured to the surface of the specimen at the required position.

3.1.4.2 The discs shall be covered with oven-dry square asbestos pads 30 × 30 mm and 2 mm thick. The asbestos material shall have a density of 100 kg/m².

3.1.4.3 The disc and the pad may be fixed to the surface of the specimen by pins, tape or a suitable adhesive, depending on the nature of the material forming the side of the specimen.

3.1.4.4 Temperatures on the penetrating items should be measured with thermocouples located 25 mm from the unexposed surface of the firestop material; the thermocouple head is to be held firmly against the penetrating items. The thermocouple leads are not to be larger than 0.32 mm² and are to be electrically insulated with heat and moisture resistance coverings. The pads are to be held firmly against

the penetrating items and are to be fitted closely above the thermocouples. The temperature shall be measured:

- a) at a minimum of one point on the through-penetration firestop material surface at the periphery of the test sample.
- b) at least three points on the through-penetration firestop material surface approximately equidistant from a penetrating item or group of penetrating items in the field of the firestop and the periphery.
- c) at a point on any frame installed around the perimeter of the opening.
- d) at a point on the unexposed surface of the wall or floor assembly at least 30 mm from any opening.
- e) at one point on each type of through-penetrating item.

3.1.5 The temperatures are to be measured at intervals of 5 minutes or less until a reading exceeding 100°C has been obtained at any one point. Thereafter, the readings would be taken at intervals not less than 5 minutes.

3.2 Pressure Conditions

3.2.1 An overall pressure difference of 25 ± 5 Pa (2.5 ± 0.5 mm H₂O) shall exist in the furnace during the evaluation period from 15 min onwards.

3.2.2 The overall pressure shall be measured and monitored at 100 mm from the underneath surface for the horizontal specimen and at a point located approximately at three-quarters of the height of test specimen.

3.3 Testing Conditions — The testing equipment and test sample assembly are to be protected from abnormal condition of wind and weather. The ambient temperature at the beginning of the test shall lie within the range of 20 to 40°C.

4. TEST SPECIMENS

4.1 Each type of firestop as described by the construction drawing types of material used shall be tested in a higher rating fire resisting wall or floor. The periphery of firestop shall be not closer than 300 mm to the furnace edge. The penetrating items of the test sample should be such that they extend 300 ± 25 mm from the exposed side and 900 ± 25 mm from the unexposed side. The individual ends of these items shall be covered. The two sizes (as defined by openings) given in 4.1.1 will cover all ranges up to 1 m².

4.1.1 The size 450 × 560 mm will cover all sizes up to and including 450 × 560 mm (and

area 0.25 m²) and dimensions of components of lesser sizes should not be less than those provided in 450 × 560 mm. Similarly, size 800 × 1250 mm covers all sizes up to and including 800 × 1250 mm (1 m² area) provided dimensions of components are not less than those provided in 800 × 1250 mm.

4.2 Conditioning — The test specimen shall be conditioned for a week.

4.2.1 The drying of the test specimen may be by natural or artificial means and a temperature of 60°C should not be exceeded.

5. PROCEDURE AND RATING

5.1 The firestop shall comply with the following criteria for the specified rating period.

5.1.1 The sample shall be tested for the rating period and shall withstand fire test without permitting the passage of flame on sustained flaming for a duration of not more than 10 seconds on the unexposed side of the test sample; the transmission of heat to raise temperature measured by any thermocouple on the unexposed surfaces of firestop by not more than 163°C above its initial temperature. At the end of this test, the same sample shall be subjected to hose stream test within 10 minutes according to the procedure given in 5.1.2 and shall not develop any opening that would permit a projection of water from the stream beyond unexposed side.

NOTE — The passage of flame is characterized by ignition of cotton, fibres pad (100 mm² × 20 mm thick of mass 3-4 g conditioned at 100°C for half-an-hour) at a distance of 25 mm, *Max*.

5.1.2 The stream is to be delivered through a 63 mm hose and discharged through a stand pipe (see IS : 903-1984*) with water pressure and duration of application as given in Table 2. The nozzle orifice is to be 6 m from the centre of the exposed surface of the test specimen and stream shall be directed first at the middle and then at all other parts of the exposed face with all changes in directions being made slowly.

**TABLE 2 PRESSURE AND DURATION—
HOSE STREAM TEST**

PERIOD OF FIRE TEST	WATER PRESSURE AT BASE OF NOZZLE kPa	DURATION OF APPLICATION s PER m ² EX- POSED AREA
min		
> 240 ≤ 480	310	32
> 120 ≤ 240	210	16
> 90 ≤ 120	210	9.7
≤ 90	210	6.5

*Specification for fire hose delivery couplings branch pipe, nozzles and nozzle spanner (third revision).

6. REPORT

6.1 The test report shall include the following information:

a) A description of the assembly including fixing arrangement of firestop and drawings showing the exact size of the component and the location of firestops

within the test assembly,

- b) Rating of each firestop,
- c) Name of the manufacturer and the trade-name, and
- d) Observation made during the test and after furnace fire is extinguished.

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