TECHNICAL REPORT

ISO/TR 834-2

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2009-07-01

Fire-resistance tests — Elements of building construction —

Part 2: Guidance on measuring uniformity of furnace exposure on test samples

Essais de résistance au feu — Éléments de construction —

Partie 2: Lignes directrices pour la mesure de l'uniformité de l'exposition au feu des échantillons pour essai

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ISO copyright office
Case postale 56 • CH-1211 Geneva 20
Tel. + 41 22 749 01 11
Fax + 41 22 749 09 47
E-mail copyright@iso.org
Web www.iso.org

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. 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.

In exceptional circumstances, when a technical committee has collected data of a different kind from that which is normally published as an International Standard ("state of the art", for example), it may decide by a simple majority vote of its participating members to publish a Technical Report. A Technical Report is entirely informative in nature and does not have to be reviewed until the data it provides are considered to be no longer valid or useful.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO/TR 834-2 was prepared by Technical Committee ISO/TC 92, *Fire safety*, Subcommittee SC 2, *Fire containment*.

ISO 834 consists of the following parts, under the general title *Fire-resistance tests — Elements of building construction*:

— *Part 1: General requirements*

— *Part 2: Guidance on measuring uniformity of furnace exposure on test samples* [Technical report]

— *Part 3: Commentary on test method and test data application* [Technical report]

— *Part 4: Specific requirements for loadbearing vertical separating elements*

— *Part 5: Specific requirements for loadbearing horizontal separating elements*

— *Part 6: Specific requirements for beams*

— *Part 7: Specific requirements for columns*

— *Part 8: Specific requirements for non-loadbearing vertical separating elements*

— *Part 9: Specific requirements for non-loadbearing ceiling elements*

Introduction

The purpose of this Technical Report is to recommend a procedure to measure the exposure of a test sample to a furnace during a test conducted in accordance with ISO 834 (all parts). The furnace exposure is determined by measuring temperature, air velocity and oxygen concentration at various locations. The recommended procedure includes the use of low-cost, readily available, lightweight materials to represent the test sample. The recommended materials minimize the influence of variable moisture content among samples.

Fire-resistance tests — Elements of building construction —

Part 2:
Guidance on measuring uniformity of furnace exposure on test samples

1 Scope

This Technical Report establishes general principles for measuring the uniformity of furnace exposure of samples tested in accordance with the requirements of ISO 834-1. This Technical Report specifies the type and location of instrumentation used to measure the temperature, velocity and oxygen content near the surface of simulated test samples. The surface of the simulated sample facing the furnace is gypsum board secured to cold-formed steel supports.

This Technical Report does not include requirements for furnace performance.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 834-1, *Fire resistance tests — Elements of building construction — Part 1: General requirements*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1
effective area of furnace opening
furnace opening within the boundaries of the monitoring instrumentation

4 Test equipment

4.1 Supporting construction

4.1.1 The supporting construction shall consist of cold-formed steel supports faced with two layers of gypsum board a minimum of 16 mm thick intended for use in fire-barrier assemblies on the side facing the furnace and with a single-layer structural panel a minimum of 18 mm thick on the side facing away from the furnace.

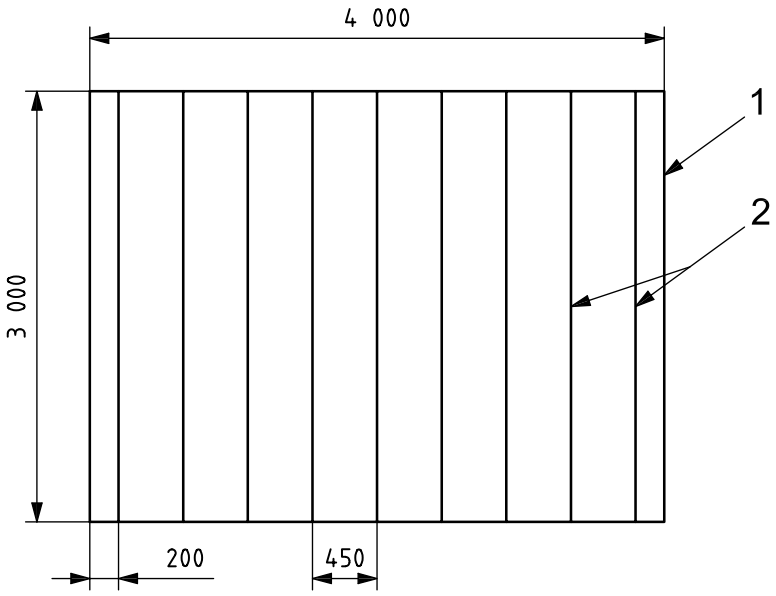
NOTE 1 Gypsum boards used in fire barrier assemblies are identified as Type X by ASTM C1396 and as Type F by EN 520.

NOTE 2 Plywood and oriented strand boards are considered typical structural panels.

4.1.2 Construction details with respect to the location of the support channels, gypsum board and the structural panels are shown in Figures 1 through 6. Figures 1 through 3 apply to horizontal supporting constructions. Figures 4 through 6 apply to vertical supporting constructions.

4.1.2.1 The construction details assume a horizontal furnace opening of 3 m by 4 m and a vertical furnace opening of 3 m by 3 m. Modifications to dimensions are necessary for other furnace opening dimensions.

Dimensions in millimetres



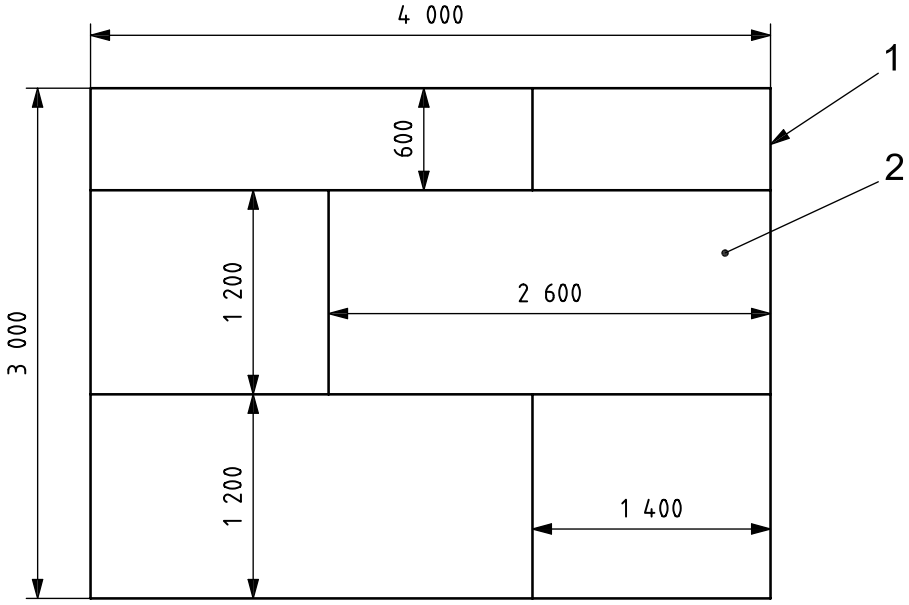
Key

1 perimeter of supporting construction

2 support channels, nine, spaced 450 mm on centre

Figure 1 — Details of horizontal supporting construction — Layout of support channels

Dimensions in millimetres



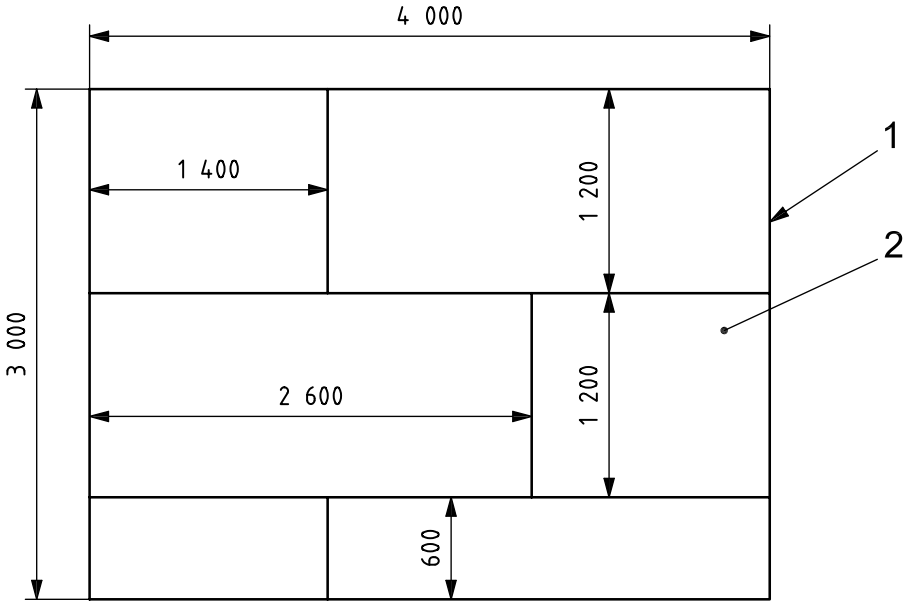
Key

1 perimeter of supporting construction

2 inner (first) layer of gypsum board or structural panels on unexposed surface

Figure 2 — Details of horizontal supporting construction — Layout of inner layer of gypsum board and structural panels

Dimensions in millimetres



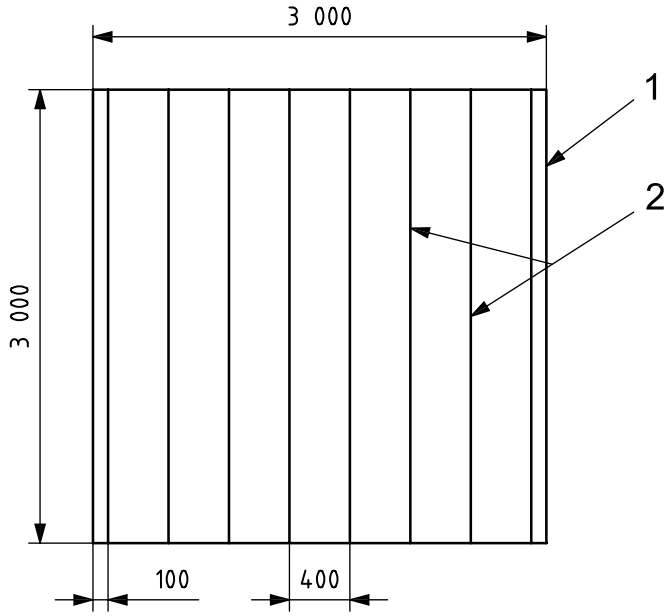
Key

1 perimeter of supporting construction

2 outer (second) layer of gypsum board

Figure 3 — Details of horizontal supporting construction — Layout of outer layer of gypsum board

Dimensions in millimetres



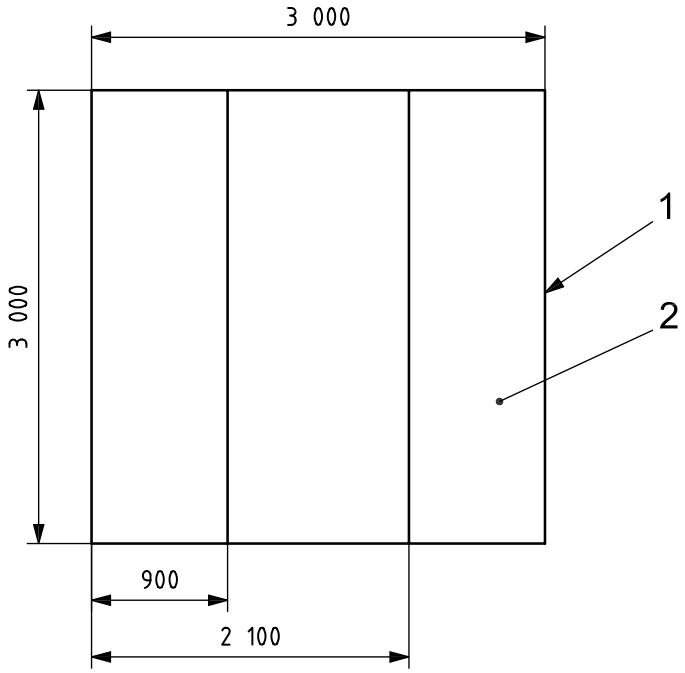
Key

1 perimeter of supporting construction

2 support channels, eight, spaced 400 mm on centre

Figure 4 — Details of vertical supporting construction — Layout of support channels

Dimensions in millimetres



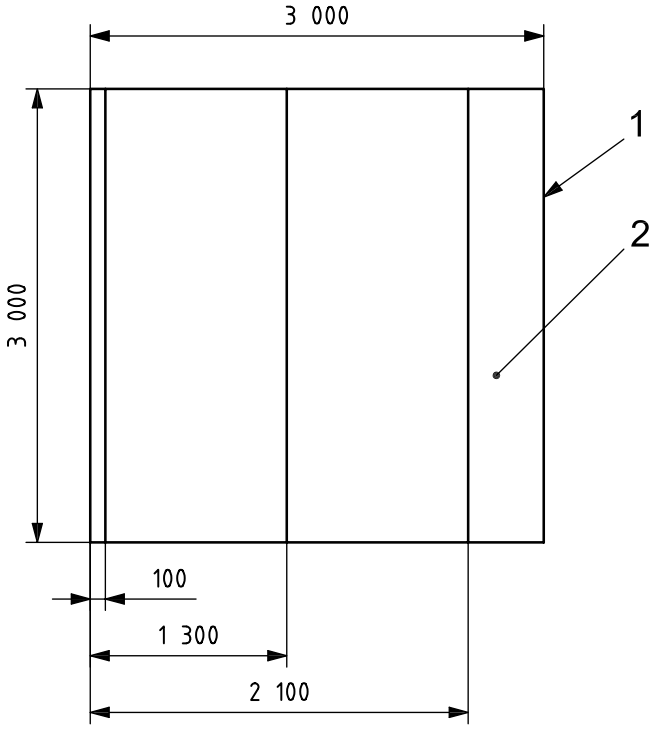
Key

1 perimeter of supporting construction

2 inner (first) layer of gypsum board or structural panels on unexposed surface

Figure 5 — Details of vertical supporting construction — Layout of inner layer of gypsum board and structural panels

Dimensions in millimetres



Key

1 perimeter of supporting construction

2 outer layer of gypsum board

Figure 6 — Details of vertical supporting construction — Layout of outer layer of gypsum board

4.1.3 The cold-formed steel support channels for horizontal supporting construction shall be fabricated from steel a minimum 1,4 mm thick. The channels shall be C-shaped with a minimum depth of 240 mm, a minimum flange width of 40 mm and a minimum return flange of 12 mm.

The horizontal support channels shall be attached to rim channels. Rim channels are located along the perimeter of the horizontal supporting construction and run perpendicular to the direction of the support channels. The dimensions of the rim channels shall be compatible with the support channels. The support channels shall be attached to the rim channels with steel screws.

NOTE Attachment of the support channel to the rim channel can require the use of a steel clip angle.

4.1.4 The cold-formed steel support channels for vertical supporting construction shall be fabricated from steel a minimum of 0,9 mm thick. The channels shall be C-shaped with a minimum depth of 90 mm, a minimum flange width of 30 mm and a minimum return flange of 5 mm.

The vertical support channels shall be attached to rim channels. The rim channels are located along the top and bottom of the vertical supporting construction. The dimensions of the rim channels shall be compatible with the support channels. The support channels shall be attached to the rim channels with steel screws.

NOTE Attachment of the support channel to the rim channel can require the use of a steel clip angle.

4.1.5 The support channels shall be spaced 300 mm to 450 mm on centre.

4.1.6 The inner layer of gypsum board shall be attached to the support channels with steel screws designed for the attachment of gypsum board to steel supports. Typical screws have a thread diameter of 5 mm, a head diameter of 8 mm and a length of 25 mm. The screws shall be spaced a maximum of 200 mm on centre along each support channel. A distance of 10 mm to 15mm shall be provided between the screws and the edges of the gypsum board.

NOTE The inner layer, or base layer, is in contact with the support channels.

4.1.7 The exposed layer of gypsum board shall be attached to the support channels with steel screws designed for the attachment of gypsum board to steel supports. Typical screws have a thread diameter of 5 mm, a head diameter of 8 mm and a length of 40 mm. The screws shall be spaced a maximum of 200 mm on centre along each support channel and spaced 100 mm from the screws used to attach the inner layer. A distance of 10 mm to 15 mm shall be provided between the screws and the edges of the gypsum board.

NOTE The exposed layer, or outside layer, is in contact with the inner layer of gypsum board.

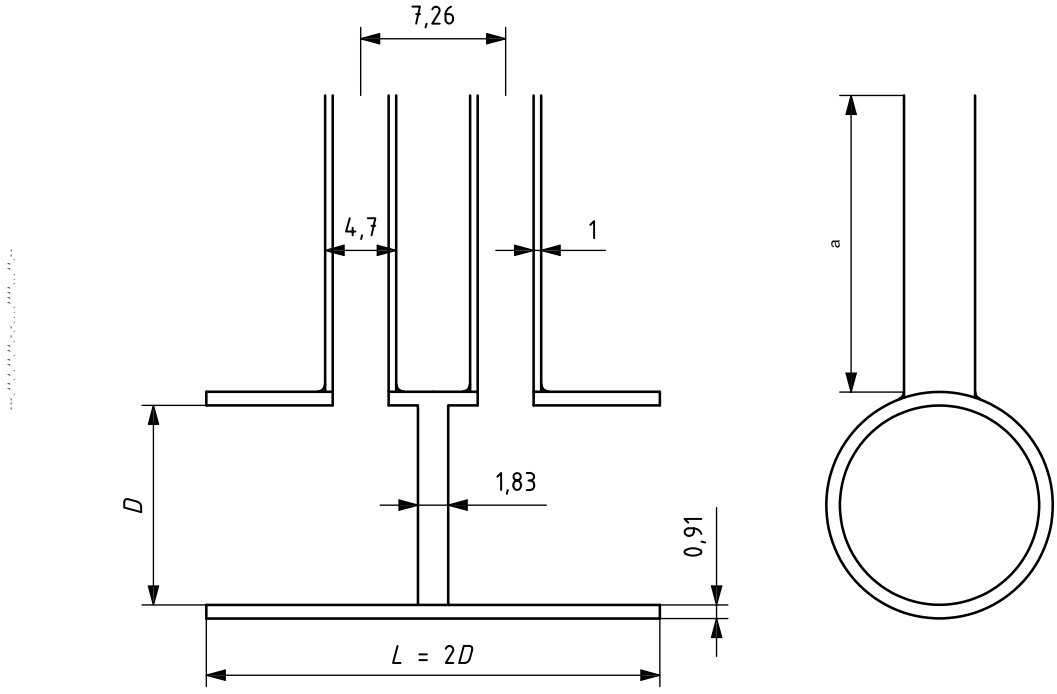
4.1.8 The structural panels shall be attached to the support channels with steel screws designed for the attachment of panels to steel supports. The screws shall be spaced a maximum of 150 mm on centre along each support channel. A distance of 10 mm to 15 mm shall be provided between the screws and the edges of the structural panels.

4.2 Instrumentation

4.2.1 Plate thermometers shall be constructed in accordance with ISO 834-1.

4.2.2 A bi-directional, low-velocity probe shall be constructed as shown in Figure 7.

Dimensions in millimetres



[a] This dimension varies.

Figure 7 — Bi-directional low velocity probe

4.2.3 The type K (chromel – alumel) ungrounded junction thermocouple used with the bi-directional probe shall be sheathed with Inconel[1)] and have a maximum outside diameter of 1,5 mm.

4.2.4 The gas velocity, V, expressed in metres per second, shall be calculated from Equation (1):

$$V = 0{,}805\sqrt{(133P)(T)} \tag{1}$$

where

P is the pressure differential measured by bi-directional probe, expressed in pascals;

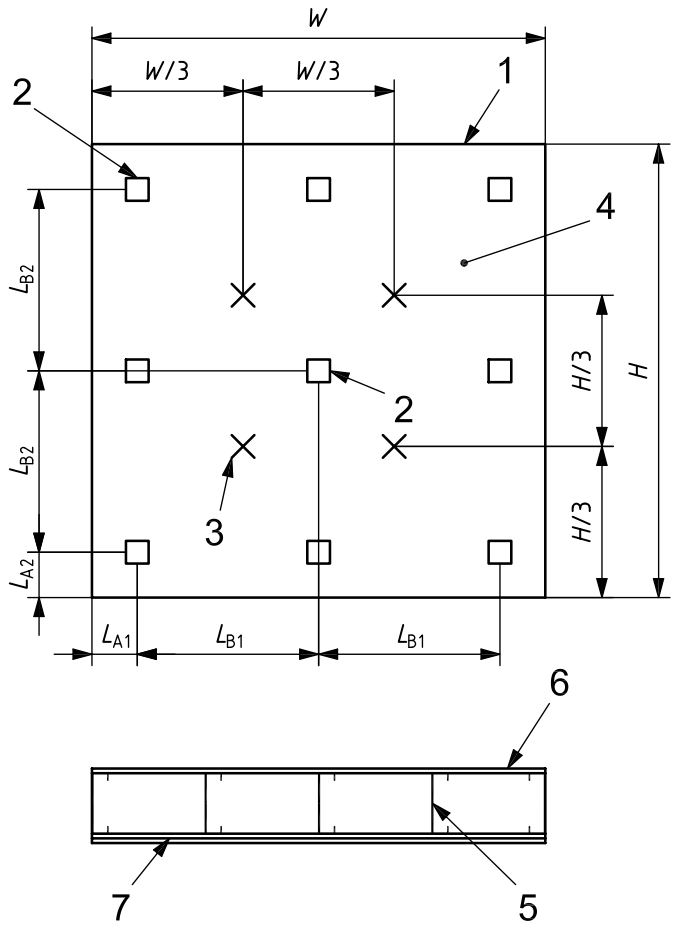
T is the temperature measured by the fast-response thermocouple, expressed in kelvin.

4.2.5 The probe for obtaining the air sample in the furnace chamber to determine the oxygen content shall be in conformance with the requirements for the T probe specified in ISO 834-1 used to measure furnace pressure.

4.2.6 The plate thermometers; bi-directional, low-velocity probes; and probe to measure oxygen content shall be located as shown in Figure 8. A minimum of five plate thermometers shall be used.

NOTE For furnaces having an opening of 1 700 mm by 1 700 mm or less, a plate thermometer is located at each corner of the effective area of the furnace and an additional plate thermometer is located at the centre of the effective area of the furnace.

1) Inconel™ is an example of a suitable product available commercially. This information is given for the convenience of users of this part of ISO 834 and does not constitute an endorsement by ISO of this product.



Key

1 perimeter of supporting construction

2 plate thermometer

3 bi-directional probes and fast response thermocouples

4 T probe, located within the rectangle formed by the fast response thermocouples, for measurement of the oxygen content

5 cold-formed steel supports

6 structural panels

7 gypsum board

Figure 8 — Location of instrumentation

4.2.7 Dimensions L_{A1} and L_{A2} shall be determined by the testing laboratory.

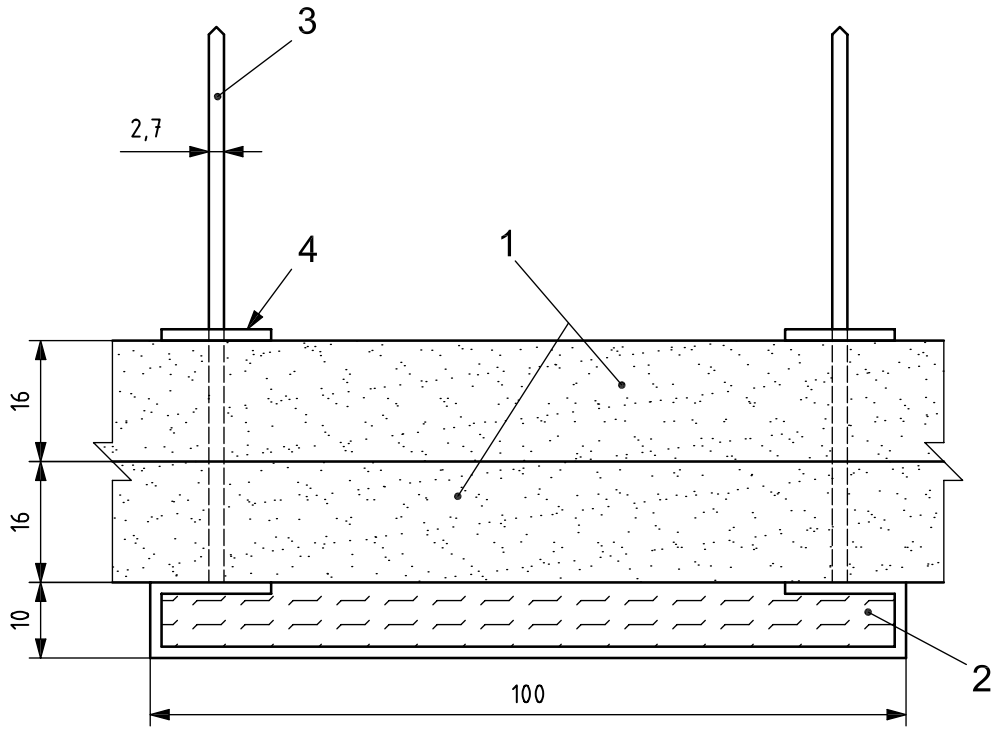
4.2.8 Dimensions L_{B1} and L_{B2} shall not be greater than 1 700 mm.

4.2.9 The effective area, A_{eff}, of the furnace shall be as given in Equation (2):

$$A_{eff} = (W - 2L_{A1})(H - 2L_{A2}) \quad (2)$$

4.2.10 The plate thermometers shall be positioned on the exposed surface of the gypsum board as shown in Figure 9.

Dimensions in millimetres



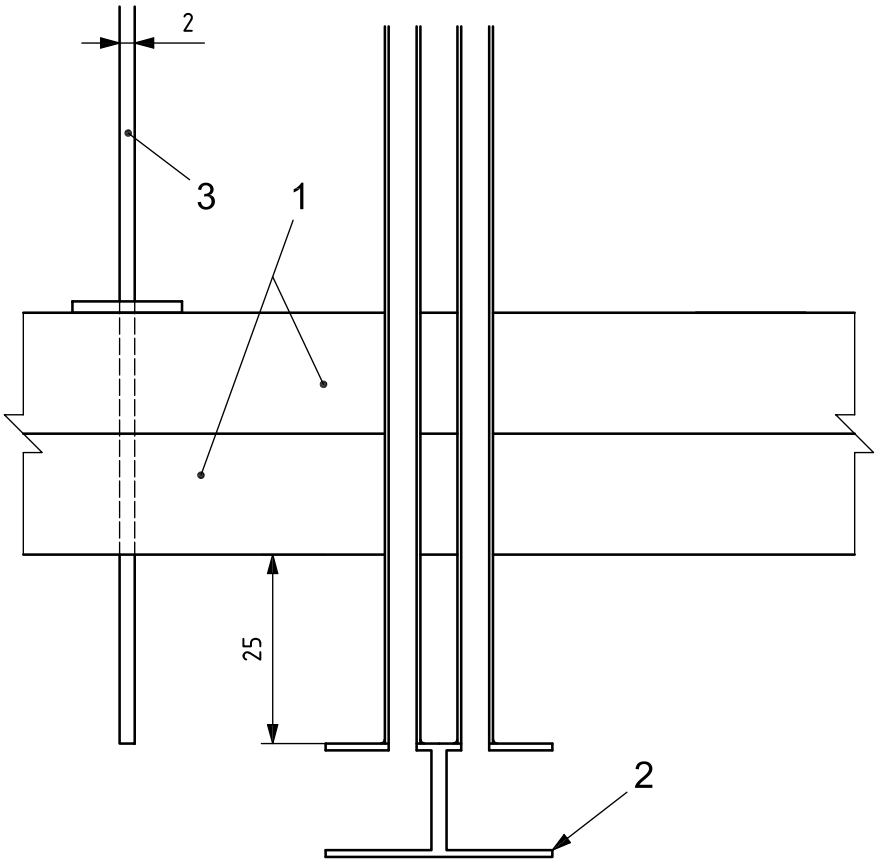
Key

1 gypsum board
2 plate thermometer (facing furnace exposure)
3 copper pin welded to plate thermometer at each corner
4 clinch shield

Figure 9 — Placement of plate thermometer on surface of supporting construction

4.2.11 The bi-directional probes and the fast-response thermocouples shall be positioned on the exposed surface of the gypsum board as shown in Figure 10. The orientation of adjacent probes shall be rotated 90°. The distance between the probe and the thermocouple shall be between 50 mm and 150 mm.

Dimensions in millimetres



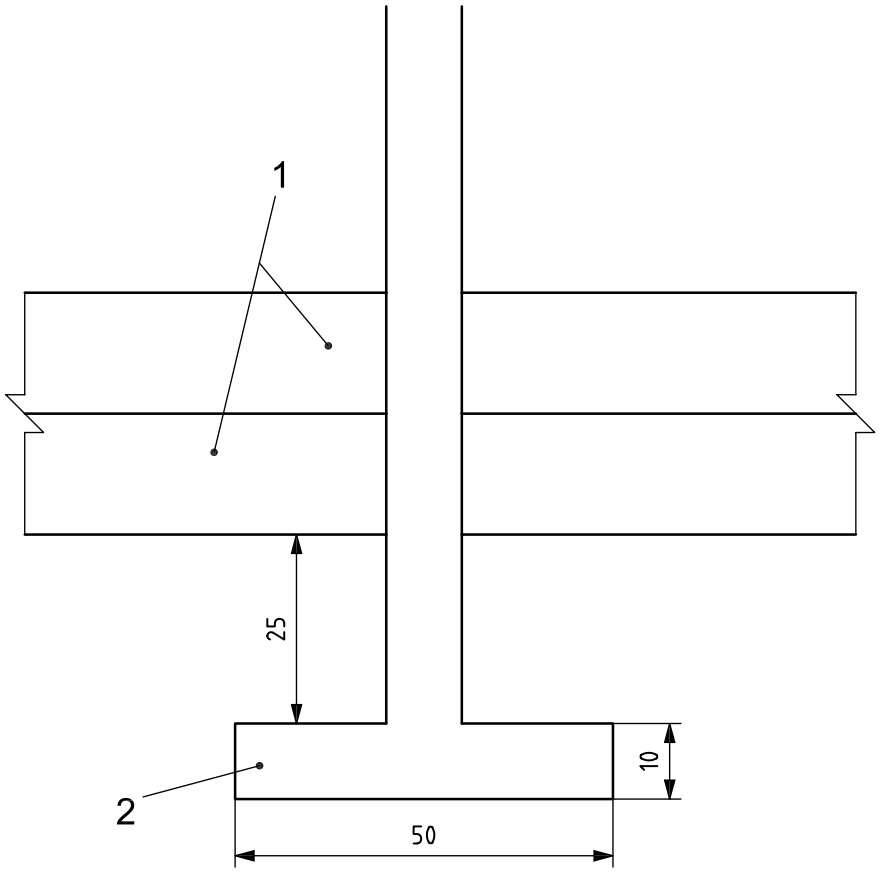
Key

1 gypsum board
2 bi-directional probe (facing furnace exposure)
3 type K (chromel – alumel) ungrounded junction thermocouple (facing furnace exposure)

Figure 10 — Placement of bi-directional probe and fast-response thermocouple on the surface of the supporting construction

4.2.12 The probe for oxygen content measurement shall be positioned on the exposed surface of the gypsum board as shown in Figure 11.

Dimensions in millimetres



Key

1 gypsum board

2 T probe (facing furnace exposure) for measurement of the oxygen content

Figure 11 — Placement of probe for oxygen content measurement on the surface of the supporting construction

5 Test method

5.1 The furnace shall be operated in accordance with the requirements contained in ISO 834-1.

5.2 The test duration shall be a minimum of 45 min.

5.3 All data shall be recorded at minimum of 1 min intervals.

6 Report

The test report shall include all important information relevant to the test specimen and the fire test, including the following specific items:

a) name and address of the testing laboratory, any unique reference number and the test date;

b) assembly procedure and constructional details of the test specimen, with drawings including the dimensions of components and, where possible, photographs;

c) temperatures within the furnace as specified in ISO 834-1 at a minimum of 1 min intervals;

d) pressures within the furnace as specified in ISO 834-1 at a minimum of 1 min intervals;

e) effective area of the furnace;

f) average temperature recorded by the plate thermometers mounted on the supporting construction at a minimum of 1 min intervals;

g) difference between the maximum temperature and the minimum temperature recorded on the supporting construction by the plate thermometers at a minimum of 1 min intervals;

h) velocities calculated from the data obtained from the bi-directional, low-velocity probes and fast-response thermocouples at a minimum of 1 min intervals;

i) oxygen content at a minimum of 1 min intervals.

Annex A
(informative)

Commentary

This Technical Report describes a procedure whereby the fire exposure characteristics within furnaces complying with the requirements of ISO 834-1 can be measured and recorded for a standard test specimen constructed of readily available, inexpensive construction materials and instrumentation commonly found in a fire-test laboratory.

Data obtained during this procedure are intended to provide a basis to demonstrate compliance with ISO/IEC 17025:2005, 5.9, for assuring the quality of test and calibration results. Recorded data include temperatures measured by plate thermometers mounted on the supporting construction, temperatures measured by Inconel®-sheathed thermocouples with an outside diameter of 1,5 mm, velocities across the face of the standard test specimen and the oxygen content within the furnace chamber.

The plate thermometers are positioned on the supporting construction to define the perimeter of the effective area associated with the furnace. Additional plate thermometers are evenly distributed within the effective area. These plate thermometers are intended to document the temporal and geometric uniformity and/or variation of the heat flux imposed by the furnace on the test specimen. In addition to the plate thermometers, rapid-response thermocouples measure the gas temperatures that are used with the pressure differentials measured by the bi-directional probes to calculate air velocities across the face of the sample. The velocity measurement is intended to provide an indication of air turbulence within the furnace and the shear force across the face of the test specimen. The oxygen content of the atmosphere within the furnace is intended to provide an indication of the propensity of combustible materials to ignite during a fire test.

Bibliography

[1] MC CAFFREY, B.J. and HESKESTAD, G.A., Robust Bi-directional Low-Velocity Probe for Flame and Fire Application*, Combustion and Flam*e, Vol. **26**, No. 1, pp. 125-127, February 1976

[2] ASTM C1396/C1396M, *Standard Specification for Gypsum Board*[2)]

[3] EN 520, *Gypsum plasterboards — Definitions, requirements and test methods*[3)]

[4] ISO/ISO 17025:2005, *General requirements for the competence of testing and calibration laboratories*

[5] ISO 13943, *Fire safety — Vocabulary*

2) ASTM International, West Conshohocken, PA, USA.

3) European Committee for Standardization, Brussels, Belgium.

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