INTERNATIONAL STANDARD

ISO 834-2

First edition
2019-06

Fire-resistance tests — Elements of building construction —

Part 2: Requirements and recommendations for measuring furnace exposure on test samples

Reference number
ISO 834-2:2019(E)

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Published in Switzerland

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Foreword

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The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 92, *Fire safety*, Subcommittee SC 2, *Fire containment*.

This first edition cancels and replaces ISO/TR 834-2:2009, which has been technically revised.

A list of all parts in the ISO 834 series can be found on the ISO website.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

The purpose of this document is to describe 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 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: Requirements and recommendations for measuring furnace exposure on test samples

1 Scope

This document establishes general principles for measuring the uniformity of furnace exposure of samples tested in accordance with the requirements of ISO 834-1. This document 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 document does not include requirements for furnace performance. An intended use of data generated by the application of this document and the rational for the instrumentation described in this document are contained in the informative Annex A.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at http://www.electropedia.org/

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 15 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 15 mm thick on the side facing away from the furnace.

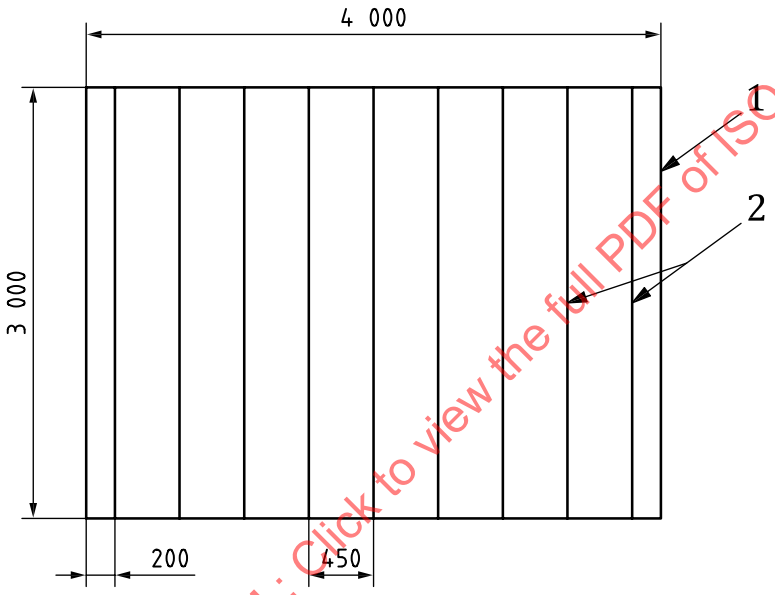
NOTE 1 Some examples of gypsum boards used in fire barrier assemblies include Type X by ASTM C1396, Type F by EN 520 and as described in JIS A 6901.

NOTE 2 Cement boards, gypsum boards, 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 to 6. Figures 1 to 3 apply to horizontal supporting constructions. Figures 4 to 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 for other furnace opening dimensions and allowances for compatibility with locally available materials and practices are acceptable.

Dimensions in millimetres



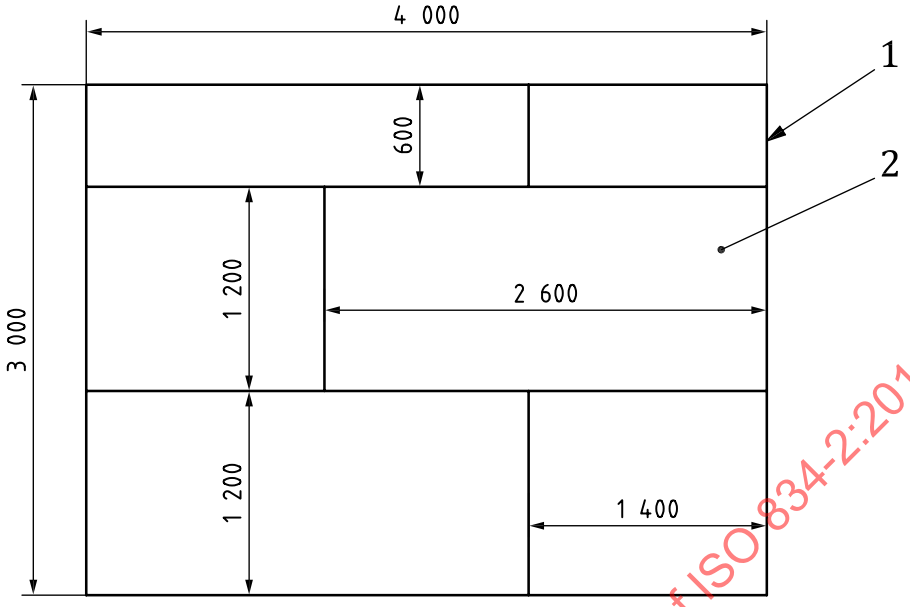
Key

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



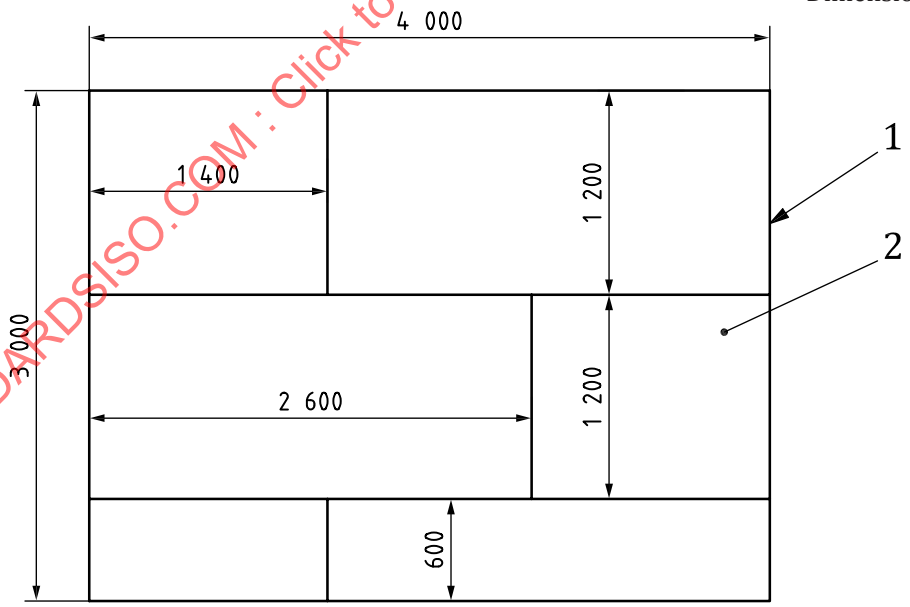
Key

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



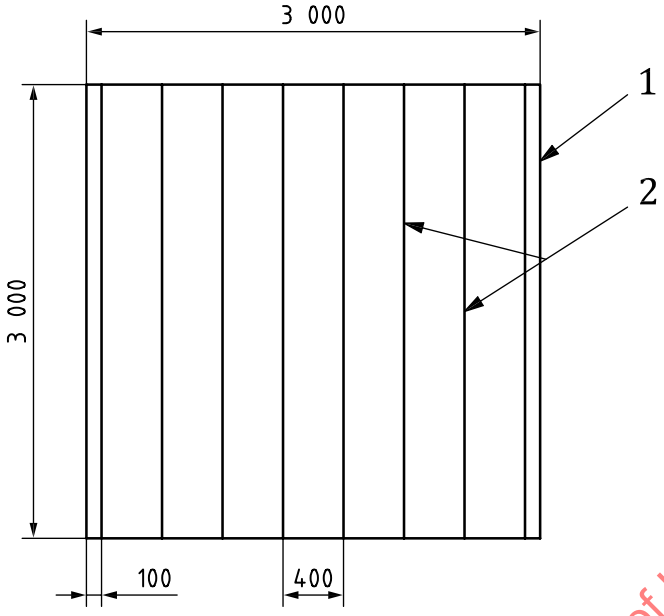
Key

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



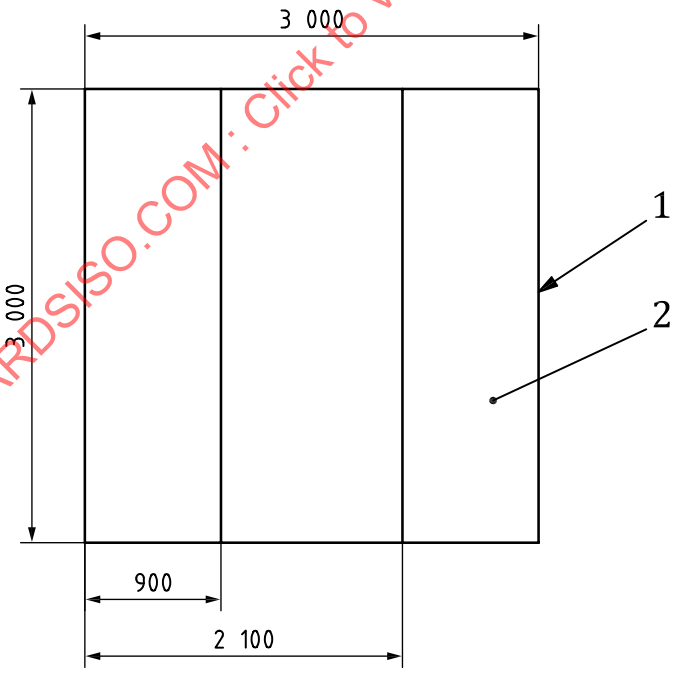
Key

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



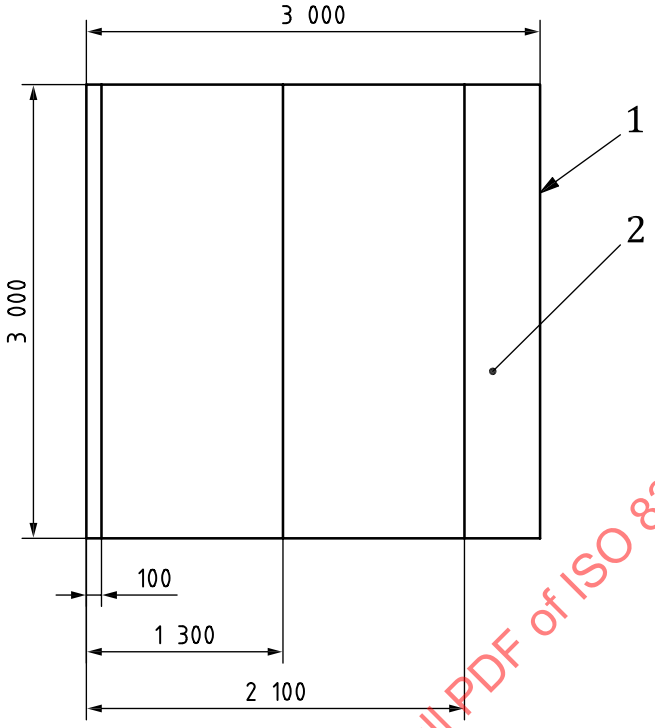
Key

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.

4.1.3.1 Modifications to dimensions for other furnace opening dimensions and allowances for compatibility with locally available materials and practices are acceptable.

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.

4.1.4.1 Modifications to dimensions for other furnace opening dimensions and allowances for compatibility with locally available materials and practices are acceptable.

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. It is permitted to use screws with different dimensions to accommodate local practices.

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.

4.1.8.1 Cement boards, gypsum boards, plywood and oriented strand boards are acceptable for use in vertical specimens.

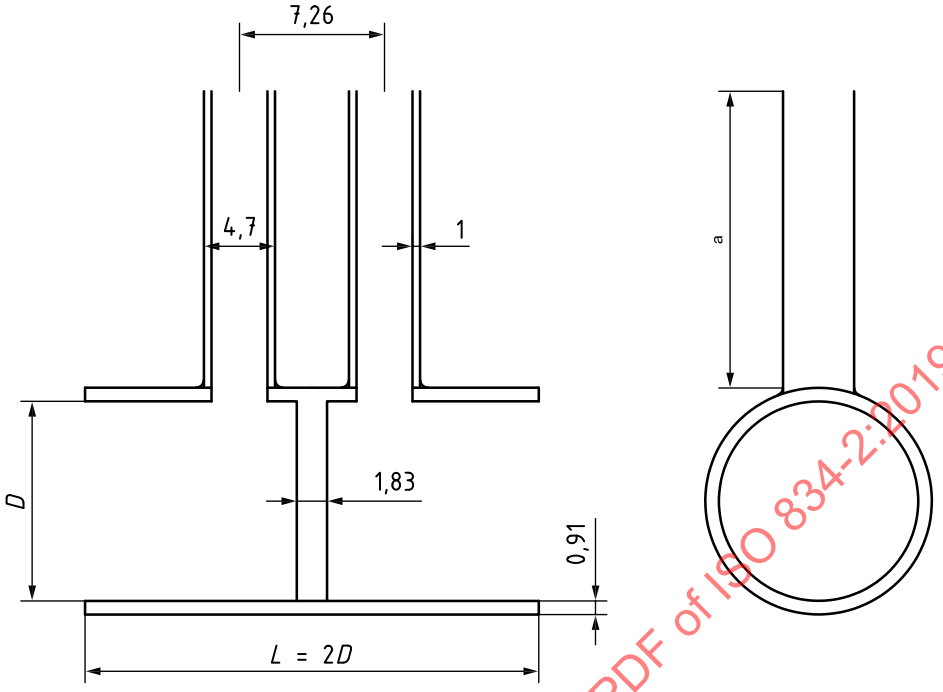
4.1.8.2 Cement boards, plywood and oriented strand boards are acceptable for use in horizontal specimens.

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 a nickel-chromium alloy (Unified Numbering System –USN N0660) 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 Formula (1):

$$V = 0{,}069\,8\sqrt{(PT)} \tag{1}$$

where

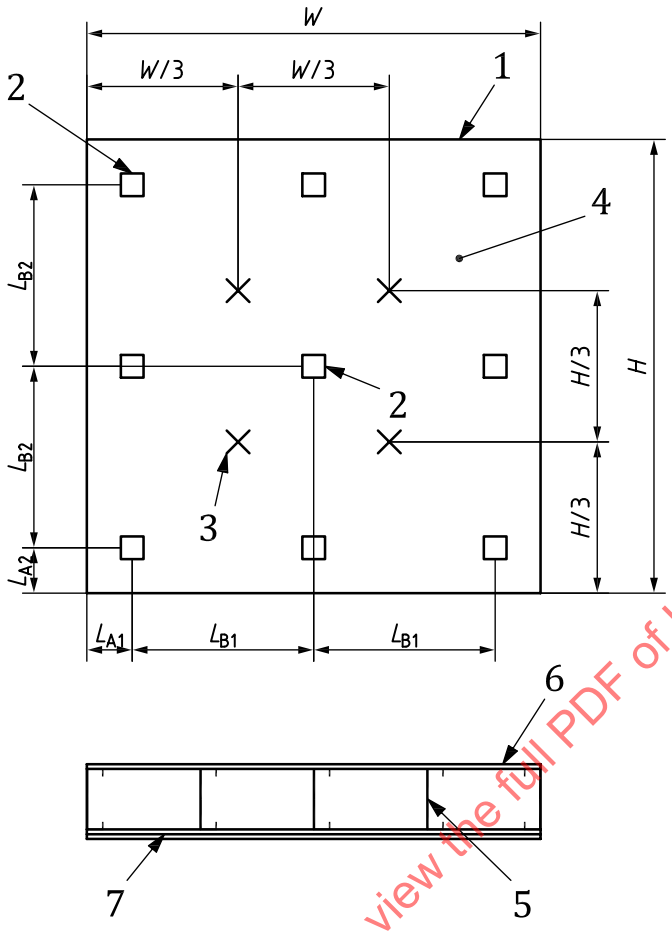
P is the pressure differential measured by bi-directional probe, expressed in pascals;

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.



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.

4.2.7.1 The dimensions L_{A1} and L_{A2}, as determined by the testing laboratory, reflect where the testing laboratory decides the furnace edge effects are insignificant.

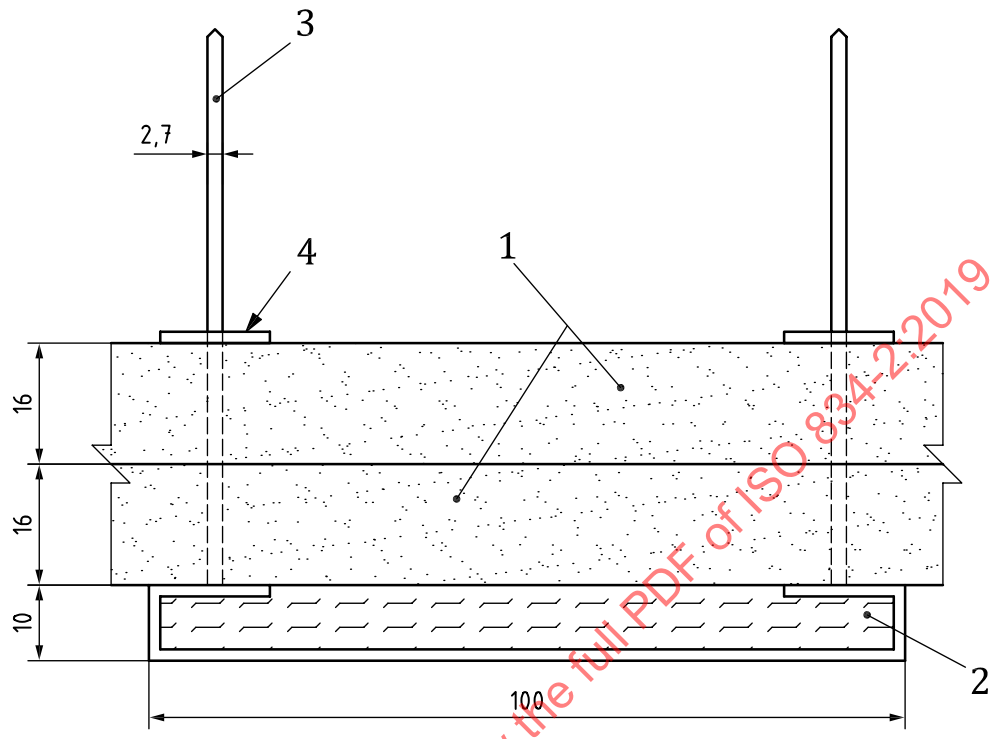
4.2.8 Dimensions L_{B1} and L_{B2} shall not be greater than 1 700 mm.

4.2.9 The effective area, A_{eff}, of the furnace shall be as given in Formula (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



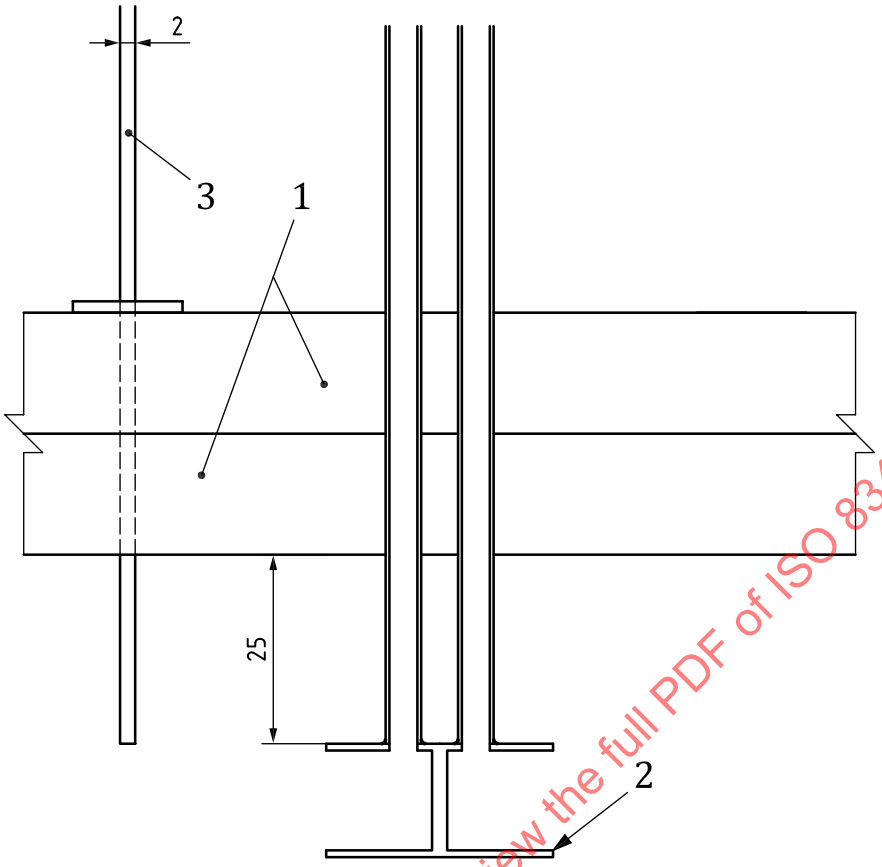
Key

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

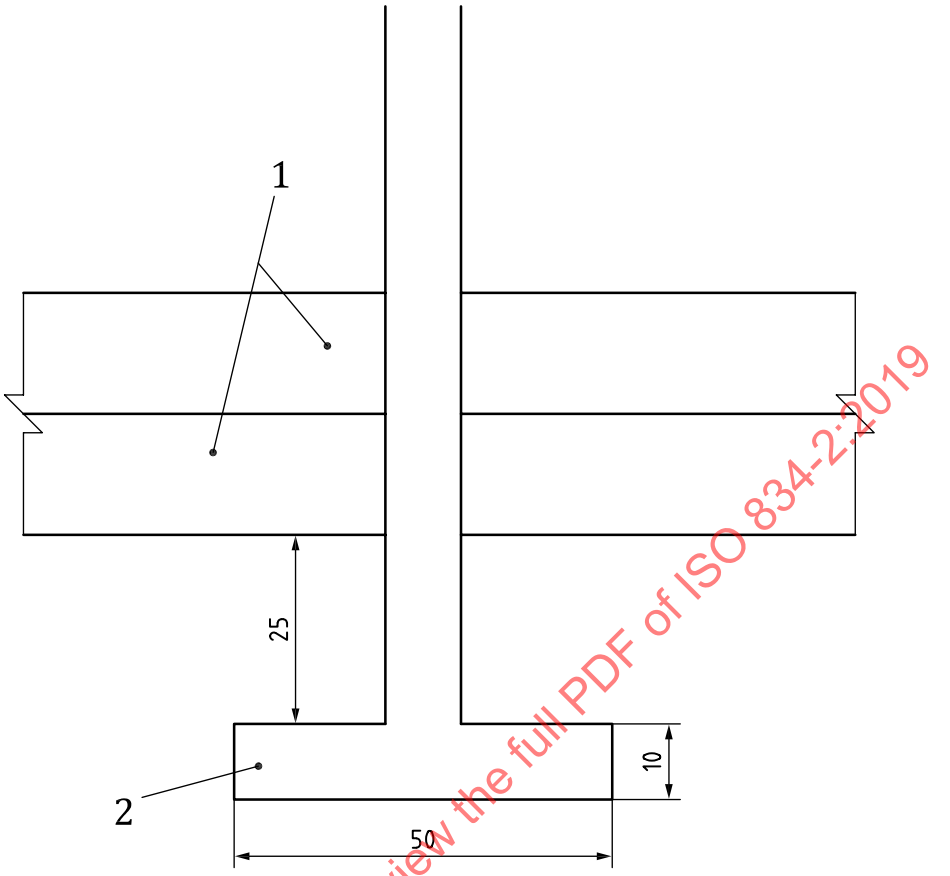
2 bi-directional probe (facing furnace exposure)

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;