



BSI Standards Publication

Fire-resistance tests — Elements of building construction

Part 1: General requirements

National foreword

This British Standard is the UK implementation of ISO 834-1:2025.

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A list of organizations represented on this committee can be obtained on request to its committee manager.

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**International
Standard**

ISO 834-1

**Fire-resistance tests — Elements of
building construction —**

**Part 1:
General requirements**

*Essai de résistance au feu — Éléments de construction —
Partie 1: Exigences générales*

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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.

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

This second edition cancels and replaces the first edition of ISO 834-1:1999 and the second edition of ISO/TR 834-3:2012, which have both been technically revised. It also incorporates the Amendment(s) ISO 834-1:1999/Amd 1:2012 and ISO 834-1:1999/Amd 2:2021.

The main changes are as follows:

- the content has been aligned with EN 1363-1: additional time-temperature curves have been added and changes have been made with respect to the criteria for load bearing capacity.

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 main changes made in this document with respect to ISO 834-1:1999/Amd2:2021 have been to align with EN 1363-1. In that respect, additional time-temperature curves have been added, and changes have been made to the criteria for load bearing capacity. ISO/TC 92/SC 2 appreciates that such criteria are in essence a contemporary compromise between state of the art science on structural behaviour in fire, and considerations reflecting the practical implication for use in fire laboratories, respecting the safety of staff and protecting the test equipment. EN 1363-1 was revised in 2019 (published officially in 2020), not directly based on scientific evidence but leaning more on practical considerations, with a view to judge different structures on a fair and equal basis, regardless of their failure mode in fire. Over the past couple of years, the revised EN 1363-1 has been used satisfactorily in Europe. Taking good notice of this, and after good discussion, ISO/TC 92/SC 2, decided to adopt the EN 1363-1:2020 changes.

Fire-resistance tests — Elements of building construction —

Part 1: General requirements

1 Scope

This document specifies a test method for determining the fire resistance of various elements of construction when subjected to fire exposure conditions, represented with standardized time-temperature curves. The test data thus obtained will permit subsequent classification on the basis of the duration for which the performance of the tested elements under these conditions satisfies specified criteria.

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 834-2, *Fire-resistance tests — Elements of building construction — Part 2: Requirements and recommendations for measuring furnace exposure on test samples*

ISO 13943, *Fire safety — Vocabulary*

IEC 60584-1, *Thermocouples — Part 1: EMF specifications and tolerances*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 13943 and the following apply.

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

- ISO Online browsing platform: available at <https://www.iso.org/obp>
- IEC Electropedia: available at <https://www.electropedia.org/>

3.1

actual material properties

properties of a material determined from representative samples taken from the specimen for the fire test according to the requirements of the concerned product standard

3.2

calibration test

procedure to assess the test conditions experimentally

3.3

deformation

any change in dimension or shape of an element of construction due to structural and/or thermal actions

Note 1 to entry: This includes deflection, expansion or contraction of elements.

3.4

element of building construction

defined construction component, such as a wall, partition, floor, roof, beam or column

3.5

insulation

ability of a separating element of building construction when exposed to fire on one side, to restrict the temperature rise of the unexposed face to below specified levels

3.6

integrity

ability of a separating element of building construction, when exposed to fire on one side, to prevent the passage through it of flames and hot gases or the occurrence of flames on the unexposed side

3.7

loadbearing capacity

ability of a specimen of a loadbearing element to support its test load, where appropriate, without exceeding specified criteria with respect to both the extent of, and rate of, deformation

3.8

loadbearing element

element that is intended for use in supporting an external load in a building and maintaining this support in the event of a fire

3.9

neutral pressure plane

elevation at which the pressure is equal inside and outside the furnace

3.10

notional floor level

assumed floor level relative to the position of the building element in service

3.11

restraint

constraint to expansion or rotation (induced by thermal and/or mechanical actions) afforded by the conditions at the ends, edges or supports of a test specimen

Note 1 to entry: Examples of different types of restraint are longitudinal, rotational and lateral.

3.12

separating element

element that is intended for use in maintaining separation between two adjacent areas of a building in the event of a fire

3.13

supporting construction

construction that can be necessary for the testing of some building elements into which the test specimen is assembled, such as the wall into which a door is fitted

3.14

test construction

complete assembly of the test specimen together with its supporting construction

3.15

test specimen

element (or part) of a building construction provided for the purpose of determining either its fire resistance or its contribution to the fire resistance of another building element

4 Symbols

Symbol	Description	Unit
A	area under the actual average furnace time/temperature curve	°C·min
A_s	area under the relevant furnace time/temperature curve	°C·min
C	axial contraction measured from the start of testing	mm
C_l	limiting vertical contraction (negative elongation)	mm
$C(t)$	axial contraction at time t during the test	mm
$\frac{\Delta C}{\Delta t}$	rate of axial contraction, defines as: $\frac{C(t_2) - C(t_1)}{(t_2 - t_1)}$	mm/min
$\left(\frac{\Delta C}{\Delta t}\right)_l$	limiting rate of axial contraction	mm/min
d	distance from the extreme fibre of the design compression zone to the extreme fibre of the design tensile zone of the structural section of a flexural test specimen	mm
$D(t)$	deflection at time t during the test	mm
D_l	limiting deflection	mm
$\frac{\Delta D}{\Delta t}$	rate of deflection, defines as: $\frac{D(t_2) - D(t_1)}{(t_2 - t_1)}$	mm/min
$\left(\frac{\Delta D}{\Delta t}\right)_l$	limiting rate of deflection	mm/min
d_e	percent deviation (see 6.1.2)	%
h	initial height of axially loaded specimen	mm
L	length of the clear span of the specimen	mm
T	average temperature within the test furnace	°C
t	time from the commencement of heating	min

5 Test equipment

5.1 General

Equipment employed in the conduct of the test consists essentially of the following:

- a specially designed furnace to subject the test specimen to the test conditions specified in the appropriate clause;
- control equipment to enable the temperature of the furnace to be regulated as specified in 6.1;
- equipment to control and monitor the pressure of the hot gases within the furnace as specified in 6.2;
- a frame in which the test specimen can be erected and which can be positioned in conjunction with the furnace so that appropriate heating, pressure and support conditions can be developed;
- arrangement for loading and restraint of the test specimen as appropriate, including control and monitoring of loads;
- equipment for measuring temperature in the furnace and on the unheated face of the test specimen, and where needed within the test specimen construction;
- equipment for measuring the deformation of the test specimen where specified in the appropriate clauses;
- equipment for evaluating test specimen integrity and for establishing conformity with the performance criteria described in Clause 10;

- i) equipment for establishing the elapsed time;
- j) equipment for measuring the oxygen concentration of furnace gases.

More guidance on test equipment is given in [Annex A](#).

5.2 Furnace

The test furnaces shall be designed to employ liquid or gaseous fuels and shall be capable of:

- a) heating of vertical or horizontal separating elements on one face; or
- b) heating of columns on all sides; or
- c) heating of walls on more than one side; or
- d) heating of beams on three or four sides, as appropriate.

NOTE Furnaces can be designed so that assemblies of more than one element can be tested simultaneously, provided all the requirements for each individual element can be conformed to.

The furnace linings shall consist of materials with densities less than 1 000 kg/m³. Such lining materials shall have a minimum thickness of 50 mm and shall constitute at least 70 % of the internally exposed surface of the furnace.

5.3 Loading equipment

The loading equipment shall be capable of subjecting test specimens to the level of loading determined according to [6.3](#). The load may be applied hydraulically, mechanically or by the use of weights.

The loading equipment shall be able to simulate conditions of uniform loading, point loading, concentric loading or eccentric loading, as appropriate for the test construction. The loading equipment shall also be capable of maintaining the test load at a constant value (to within ± 5 % of the required value) without changing its distribution for the duration of the loadbearing capacity period. The equipment shall be capable of following the maximum deformation and the rate of deformation of the test specimen for the duration of the test.

The loading equipment shall not significantly influence the heat transfer through the specimen nor impede the use of the thermocouple insulating pads. It shall not interfere with the measurement of surface temperature and/or deformation and shall permit general observation of the unexposed face. The total area of the contact points between the loading equipment and the test specimen surface shall not exceed 10 % of the total area of the surface of a horizontal test specimen.

Where loading has to be maintained after the end of heating, provision shall be made for such maintenance.

5.4 Restraint and support frames

Special frames or other means shall be used to reproduce the boundary and support conditions appropriate for the test specimens as specified in [6.4](#).

5.5 Instrumentation

5.5.1 Temperature

5.5.1.1 Furnace temperature

The furnace temperature shall be measured with plate thermometers which comprise an assembly of a folded nickel alloy plate, the thermocouple fixed to it and insulation material.

The folded metal plate shall be constructed from a strip of austenitic nickel-based superalloy for high temperature oxidation resistance measuring (150 ± 1) mm long by (100 ± 1) mm wide by $(0,7 \pm 0,1)$ mm folded to the design as shown in [Figure 1](#).

Face A is facing towards the furnace lining. Face B is facing the test specimen.

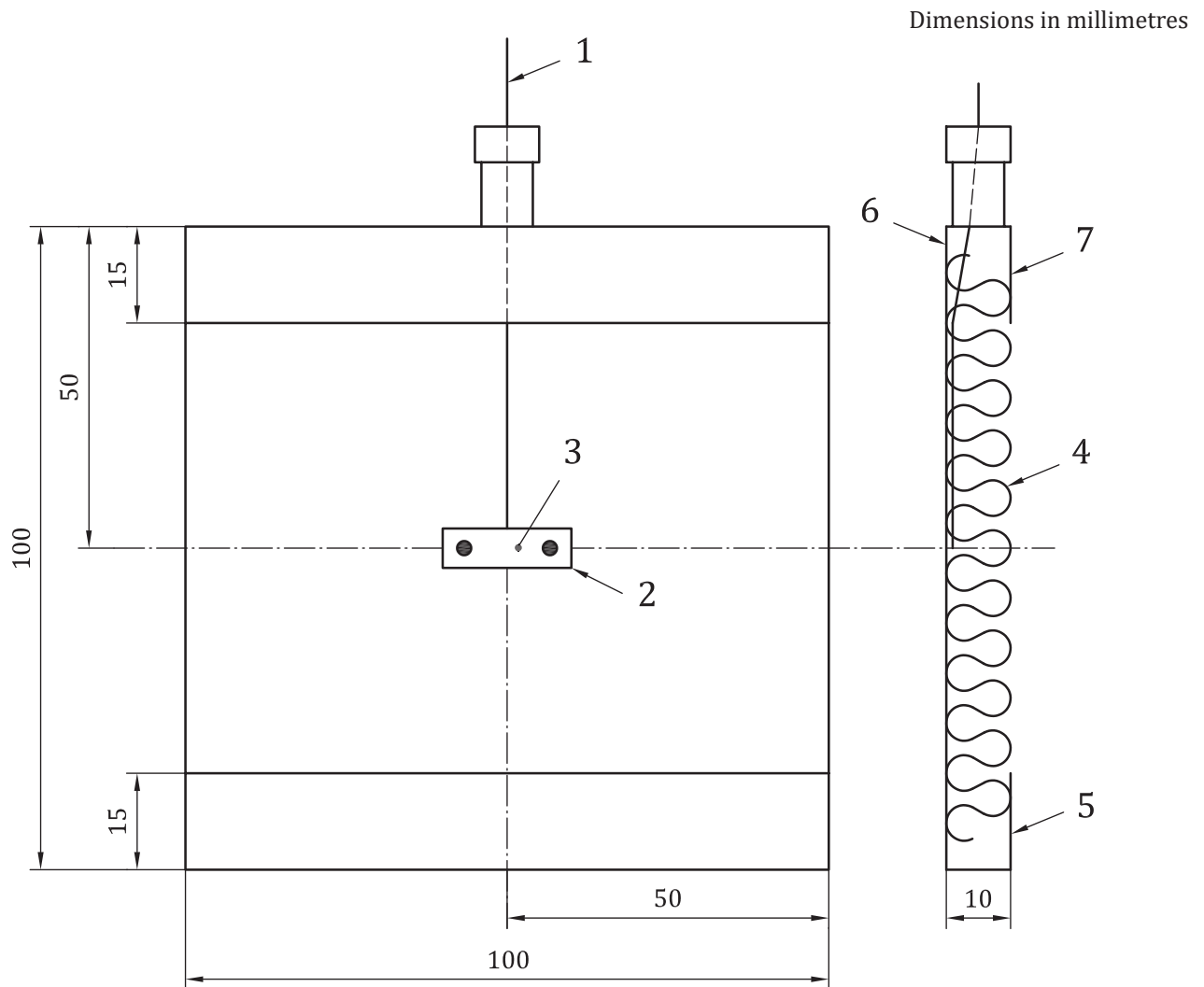
The measuring junction shall consist of nickel chromium/nickel aluminium (type K) wire in accordance with IEC 60584-1, contained within mineral insulation in a heat-resisting steel alloy sheath of nominal diameter 1 mm to 3 mm, the hot junctions being electrically insulated from the sheath. The thermocouple hot junction shall be fixed to the geometric centre of the plate in the position shown in [Figure 1](#) by a small steel strip made from the same material as the plate. The steel strip can be welded to the plate or may be screwed to it to facilitate replacement of the thermocouple. The strip shall be approximately 18 mm by 6 mm if it is spot welded to the plate, and nominally 25 mm by 6 mm if it is to be screwed to the plate. The screw shall be 2 mm in diameter.

The assembly of plate and thermocouple shall be fitted with a pad of inorganic insulation material nominally (97 ± 1) mm by (97 ± 1) mm by (10 ± 1) mm thick, density (280 ± 30) kg/m³.

Before the plate thermometers are first used, the complete plate thermometer shall be aged by immersing in a pre-heated oven at 1 000 °C for 1 h.

NOTE Exposure in a fire resistance furnace for 90 min under the standard temperature/time curve is considered to be an acceptable alternative to using an oven.

When a plate thermometer is used more than once, a log of its use shall be maintained indicating, for each use, the checks made and duration of use. The thermocouple and the insulation pad shall be replaced after 50 h exposure in the furnace.

**Key**

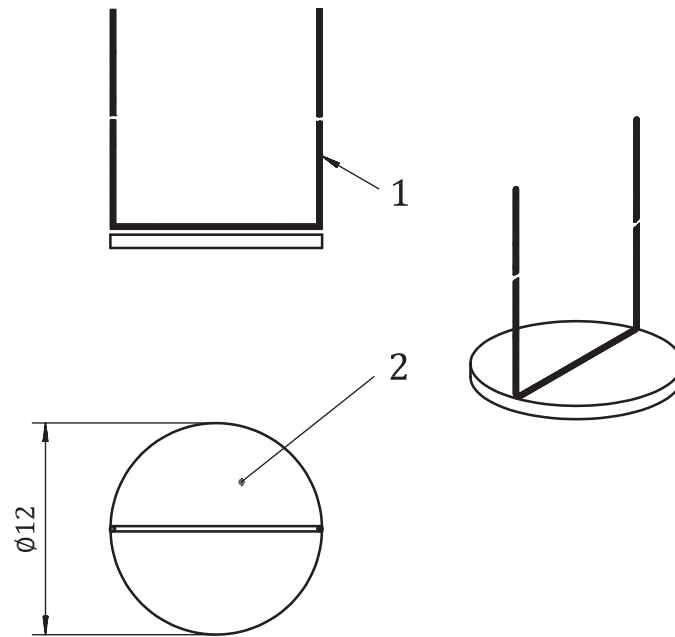
- 1 sheathed thermocouple with insulated hot junction
- 2 spot-welded or screwed steel strip
- 3 hot junction of thermocouple
- 4 insulation material
- 5 nickel alloy strip ($0,7 \pm 0,1$) mm thick
- 6 face A, facing furnace
- 7 face B, facing test specimen

Figure 1 — Illustration of plate thermometer

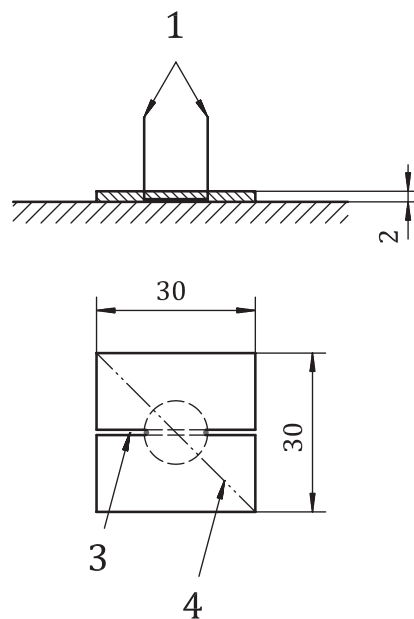
5.5.1.2 Unexposed surface temperature

The temperature of the unexposed surface of the test specimen shall be measured by means of disc thermocouples of the type shown in [Figure 2](#). In order to provide a good thermal contact, thermocouple wires, 0,5 mm in diameter, shall be soldered or welded to a 0,2 mm thick by 12 mm diameter copper disc. Each thermocouple shall be covered with a 30 mm × 30 mm × 2,0 mm ± 0,5 mm thick inorganic insulating pad, unless specified otherwise in the standards for specific elements. The pad material shall have a density of $900 \text{ kg/m}^3 \pm 100 \text{ kg/m}^3$. The measuring and recording equipment shall be capable of operating within the limits specified in [5.6](#).

The insulating pad shall be bonded to the surface of the test specimen, with no adhesive between the copper disc and the specimen surface or between the copper disc and the insulating pad.



a) Copper disc measuring junction



b) Copper disc and insulating pad

Key

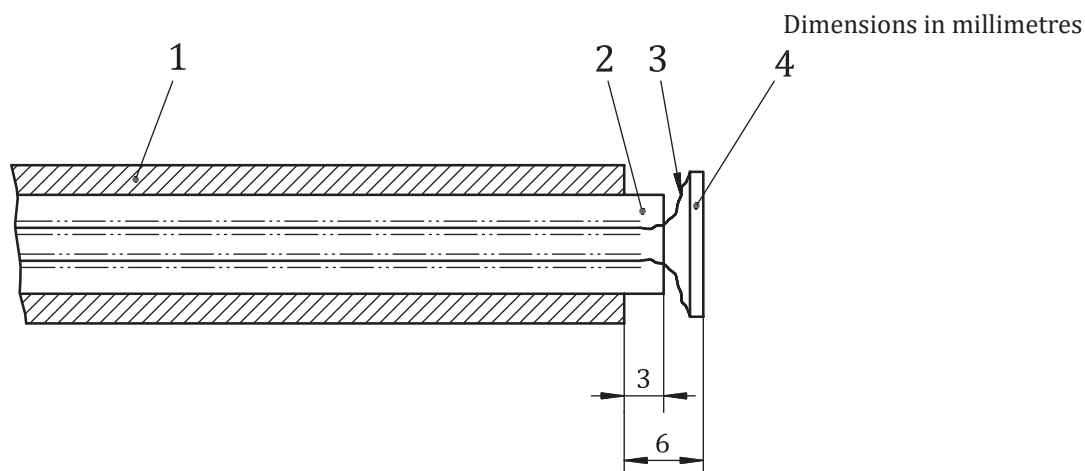
- 1 thermocouple wire of 0,5 mm diameter
- 2 copper disc, 0,2 mm thick
- 3 cuts to allow pad to be positioned over copper disc
- 4 alternative cut location

Figure 2 — Unexposed surface thermocouple and insulating pad

5.5.1.3 Roving thermocouples

One or more roving thermocouples of the design shown in [figure 3](#) or alternative temperature-measuring devices which can be shown to have at least the accuracy and a response time equal to or less than the

design illustrated by [Figure 3](#) shall be available to measure the unexposed surface temperature during a test in positions where higher temperatures are suspected. The measuring junction of the thermocouple consists of 1,0 mm diameter thermocouple wires soldered or welded to a 12 mm diameter, 0,5 mm thick copper disc. The thermocouple assembly shall be provided with a handle so that it can be applied over any point on the unexposed surface of the test specimen.



Key

- 1 heat-resistant steel support tube, of 13 mm diameter
- 2 twin-bore ceramic insulator, of 8 mm diameter
- 3 thermocouple wire, of 1,0 mm diameter
- 4 copper disc, 12 mm in diameter, 0,5 mm thick

Figure 3 — Roving thermocouple assembly

5.5.1.4 Internal temperature

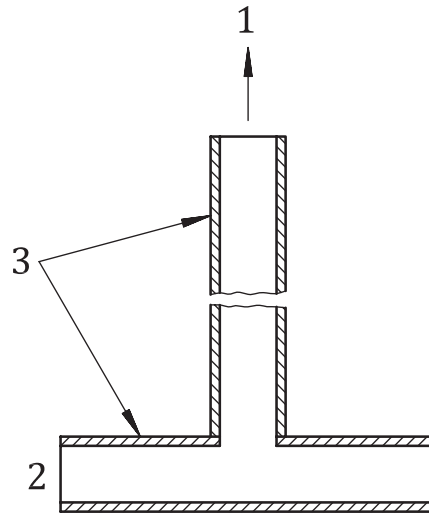
When information concerning the internal temperature of a test specimen or particular component is required, it shall be obtained by means of thermocouples having characteristics appropriate to the range of temperatures to be measured as well as being suitable for the type of materials in the test specimen.

5.5.1.5 Ambient-temperature

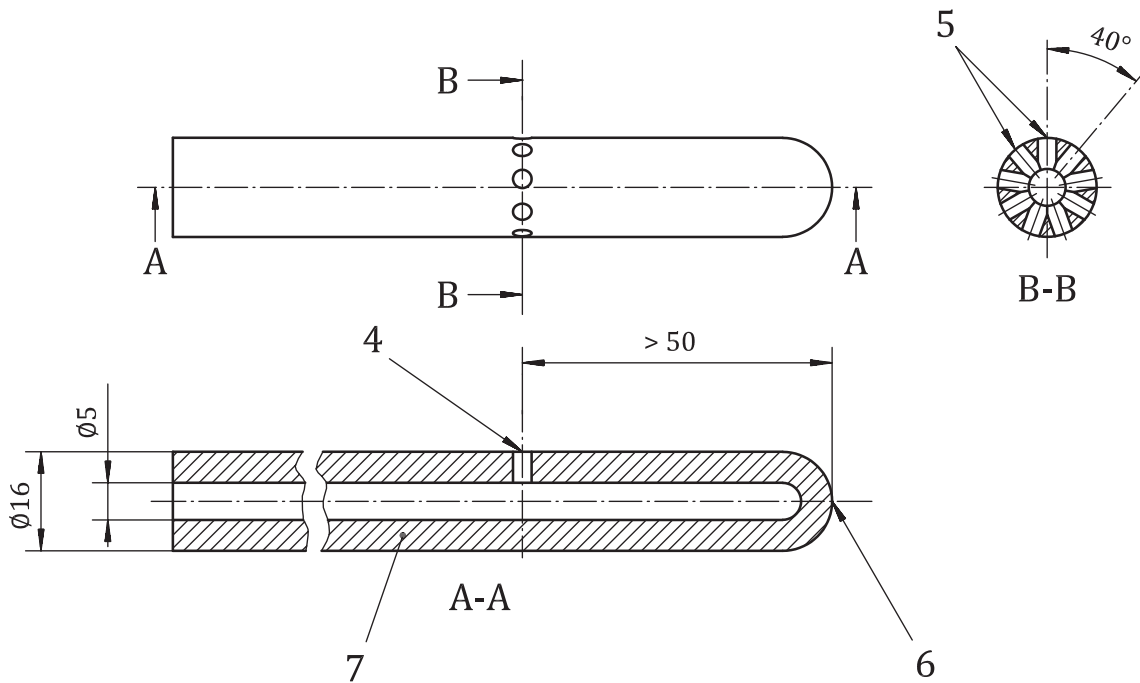
The ambient temperature within the laboratory shall be measured with a thermocouple in the vicinity of the test specimen both prior to and during the test period. The thermocouple shall be nominally of 3 mm diameter, mineral insulated, stainless-steel sheathed type K, in accordance with IEC 60584-1. The measuring junction shall be protected from radiated heat and draughts.

5.5.2 Pressure

The pressure in the furnace shall be measured by means of one of the designs of sensors shown in [Figure 4](#). The measuring and recording equipment shall be capable of operating within the limits specified in [5.6](#).



a) Type 1 - "T" shaped sensor



b) Type 2 - Tube sensor

Key

- 1 to pressure transducer
- 2 open
- 3 stainless-steel tube (inside diameter 5 mm to 10 mm)
- 4 holes, of 3,0 mm diameter
- 5 holes, of 3,0 mm diameter, spaced 40° apart around the pipe
- 6 welded end
- 7 stainless-steel pipe

Figure 4 — Pressure-sensing heads

5.5.3 Load

When using weights, no further measurement of load in a test is needed. The loads applied by hydraulic loading systems shall be measured by means of a load cell or other relevant equipment having the same accuracy or by monitoring the hydraulic pressure at an appropriate point. The measuring and recording equipment shall be capable of operating within the limits specified in [5.6](#).

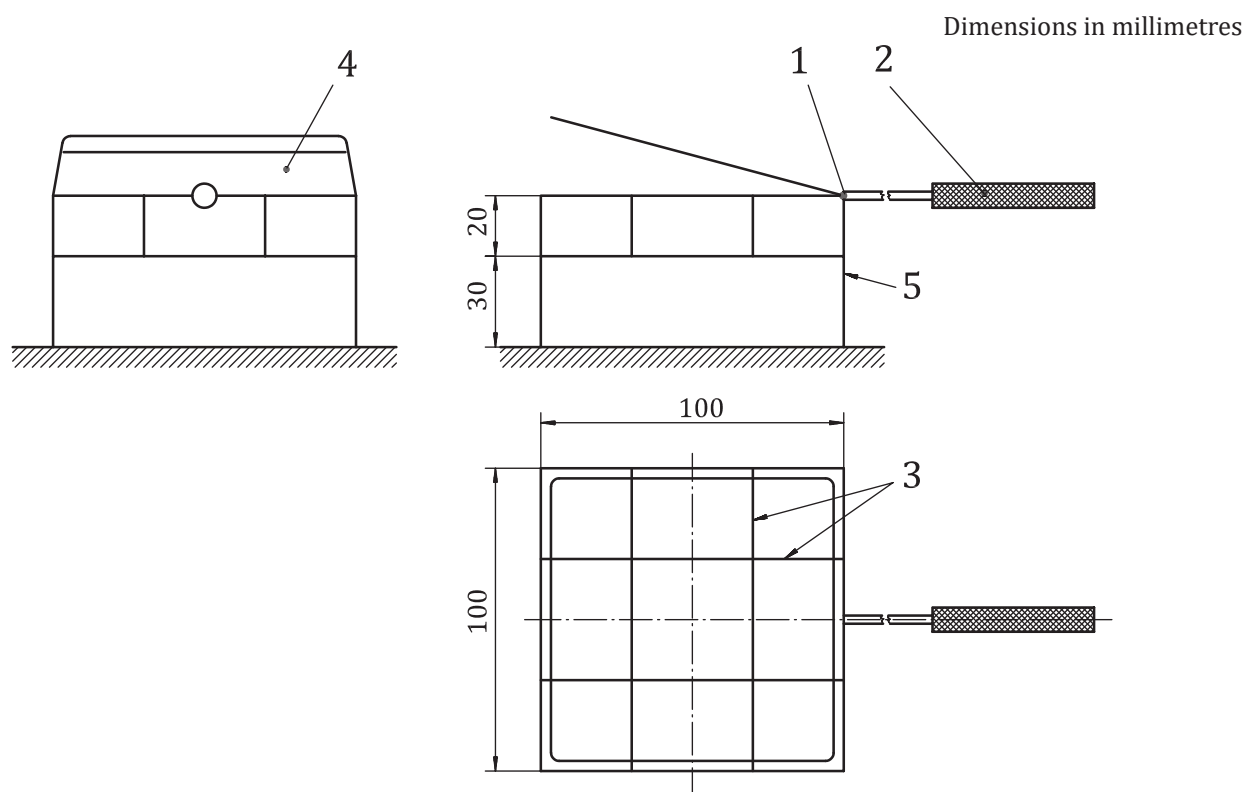
5.5.4 Deformation

Deformation measurements can be made by using equipment employing mechanical, optical or electrical techniques. Where such equipment is used in relation to performance criteria (e.g. measurements of deflection or contraction), it shall be capable of operating at a frequency of at least one reading per minute. All necessary precautions shall be taken to prevent any drift in the sensor readings due to heating.

5.5.5 Integrity

5.5.5.1 Cotton pad

Unless specified otherwise in the standards for specific elements, the cotton pad used in the measurement of integrity shall consist of new, undyed and soft cotton fibres without other added fibres, 20 mm thick 3 100 mm square, and shall weigh between 3 g and 4 g. It shall be conditioned prior to use by drying in an oven at $100\text{ }^{\circ}\text{C} \pm 5\text{ }^{\circ}\text{C}$ for at least 30 min. After drying it may be stored in a desiccator or other moisture-proof container until use. For use, it shall be mounted in a wire frame, as shown in [Figure 5](#), provided with a handle.



Key

- 1 hinge
- 2 handle of suitable length
- 3 supporting steel wire of 0,5 mm diameter
- 4 hinged lid with latch
- 5 framework of steel wire of 1,5 mm diameter

Figure 5 — Cotton pad holder