INTERNATIONAL STANDARD

ISO 834-1

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Fire-resistance tests — Elements of building construction —

Part 1:
General requirements

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

Reference number
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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.

Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as International Standard requires approval by at least two-thirds of the Member Bodies casting a vote.

International Standard ISO 834-1 was prepared by Technical Committee ISO/TC 92, *Fire safety*, Subcommittee SC 2, *Fire resistance.*

This first edition of ISO 834-1 cancels and replaces ISO 834:1975, together with Amendment 1:1979 and Amendment 2:1980, of which it constitutes a technical revision. The revision has been made because of the need for more accuracy and reproducibility in the test method. Its provisions are supplemented by the commentary material contained in part 3.

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

— *Part 1: General requirements*
— *Part 3: Commentary on test method and test data application*
— *Part 4: Specific requirements for loadbearing vertical separating elements*
— *Part 5: Specific requirements for loadbearing horizontal separating elements*
— *Part 6: Specific requirements for loadbearing beams*
— *Part 7: Specific requirements for loadbearing columns*
— *Part 8: Specific requirements for non-loadbearing vertical separating elements*
— *Part 9: Specific requirements for non-loadbearing horizontal separating elements*
— *Part 10: Method to determine the contribution of applied protection materials to structural metallic elements*
— *Part 11: Method to assess the contribution of applied protection materials to structural metallic elements*

Introduction

Significant changes with respect to ISO 834:1975 are requirements for the following:

– accuracy of measuring equipment;

– tolerances applied to the deviation of the curve of the average furnace temperature with respect to the standard heating curve;

– pressure conditions for vertical and horizontal elements;

– specification of test load;

– conditioning;

– application of instrumentation;

– criteria respecting loadbearing capacity.

In general, the revision reflects the objective of Working Group WG 1 in providing a standard that is arranged in logical sequence and providing for increased precision in the development and application of the test data, as well as repeatability of the results using the same and different equipment. It is planned to enhance the repeatability aspect by the development, in the near future, of a precision calibration routine which will address parameters such as temperature uniformity, pressure gradients, oxygen concentration, furnace lining materials, and others.

Fire-resistance tests – Elements of building construction –

Part 1:
General requirements

1 Scope

This part of ISO 834 specifies a test method for determining the fire resistance of various elements of construction when subjected to standard fire exposure conditions. 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 standards contain provisions which, through reference in this text, constitute provisions of this part of ISO 834 . At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this part of ISO 834 are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

ISO 13943:—[1)], *Fire safety — Vocabulary.*

IEC 60584-1:1995, *Thermocouples — Part 1: Reference tables*.

3 Definitions

For the purposes of this part of ISO 834, the definitions given in ISO 13943 and the following definitions apply.

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. This includes deflection, expansion or contraction of elements.

1) To be published.

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: An 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: The 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 — Examples of different types of restraint are longitudinal, rotational and lateral.

3.12 separating element: An 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: That construction that may be required 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 standard time/temperature curve	°C·min
C	axial contraction measured from the start of heating	mm
$C(t)$	axial contraction at time t during the test	mm
$\frac{dC}{dt}$	rate of axial contraction, defined as: $\frac{C(t_2) - C(t_1)}{(t_2 - t_1)}$	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	deflection measured from the commencement of heating	mm
$D(t)$	deflection at time t during the test	mm
$\frac{dD}{dt}$	rate of deflection, defined as: $\frac{D(t_2) - D(t_1)}{(t_2 - t_1)}$	mm/min
h	initial height of axially loaded specimen	mm
L	length of the clear span of the specimen	mm
d_e	percent deviation (see 6.1.2)	%
t	time from the commencement of heating	min
T	temperature within the test furnace	°C

5 Test equipment

5.1 General

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

a) a specially designed furnace to subject the test specimen to the test conditions specified in the appropriate clause;

b) control equipment to enable the temperature of the furnace to be regulated as specified in 6.1;

c) equipment to control and monitor the pressure of the hot gases within furnace as specified in 6.2;

d) 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;

e) arrangement for loading and restraint of the test specimen as appropriate, including control and monitoring of loads;

f) equipment for measuring temperature in the furnace and on the unheated face of the test specimen, and where needed within the test specimen construction;

g) equipment for measuring the deformation of the test specimen where specified in the appropriate clauses;

h) equipment for evaluating test specimen integrity and for establishing compliance with the performance criteria described in clause 10 and for establishing the elapsed time.

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 may be designed so that assemblies of more than one element can be tested simultaneously, provided all the requirements for each individual element can be complied with.

The furnace linings shall consist of materials with densities less than 1 000 kg/m^3. 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 6.4. 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 6.5.

5.5 Instrumentation

5.5.1 Temperature

5.5.1.1 Furnace thermocouples

The furnace thermocouples shall be plate thermometers which comprise an assembly of a folded steel plate, the thermocouple fixed to it and containing insulation material. The measuring and recording equipment shall be capable of operating within the limits specified in 5.6.

The plate part shall be constructed from (150 ± 1) mm long by (100 ± 1) mm wide by (0,7 ± 0,1) mm thick nickel alloy sheet strips folded to the design as shown in figure 1.

The measuring junction shall consist of nickel chromium/nickel aluminium (type K) wire as defined in IEC 60584-1, contained within mineral insulation in a heat-resisting steel alloy sheath of nominal diameter 1 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/m^3.

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.

5.5.1.2 Unexposed surface thermocouples

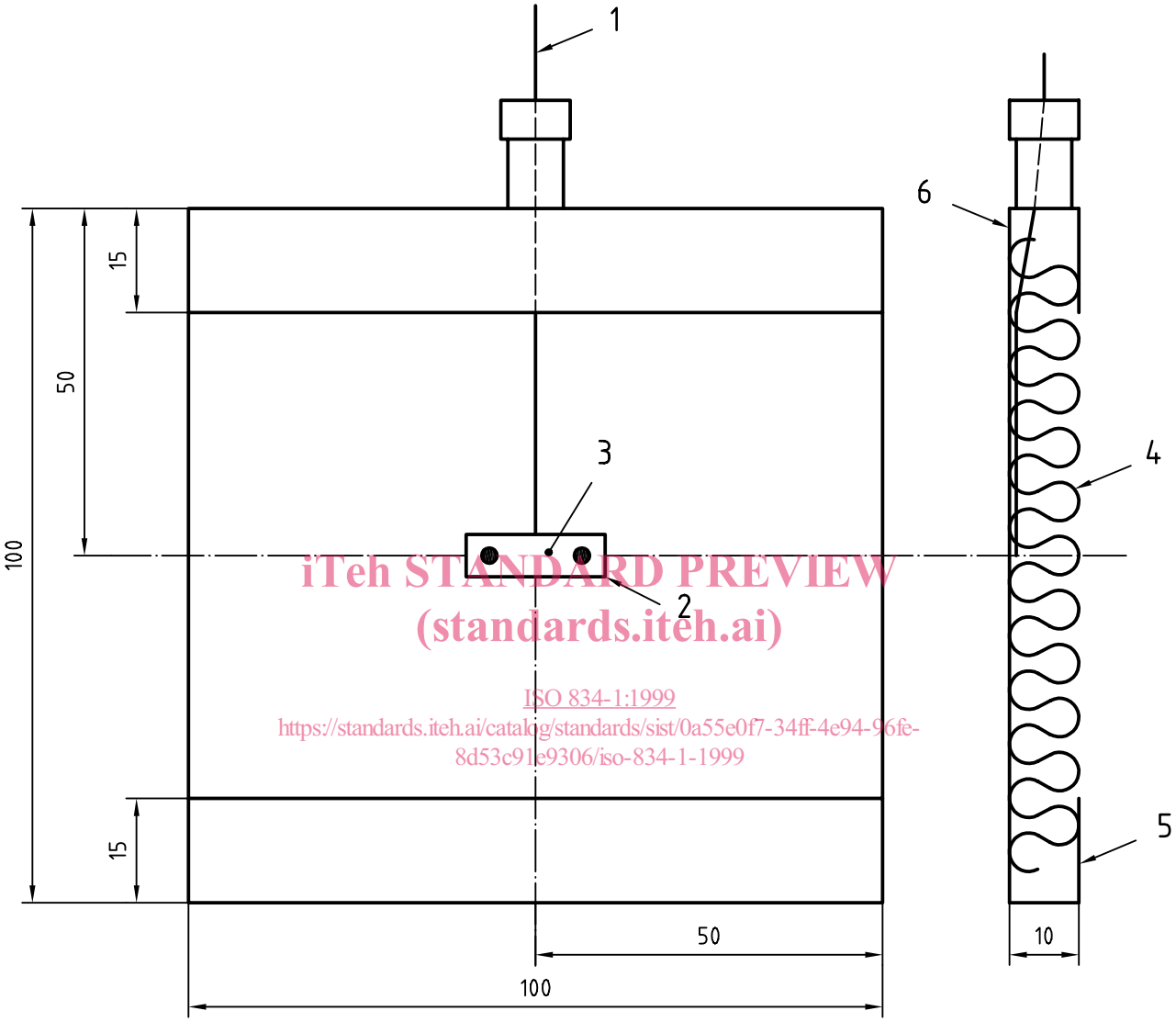
The temperature of the unexposed surface of the test specimen shall be measured by means of disc thermocouples of the type shown in figure 2. In order to provide a good thermal contact, thermocouple wires, 0,5 mm in diameter, shall be soldered or welded to a 0,2 mm thick by 12 mm diameter copper disc. Each thermocouple shall be covered with a 30 mm x 30 mm x 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 kg/m^3 ± 100 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.

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.

Dimensions in millimetres

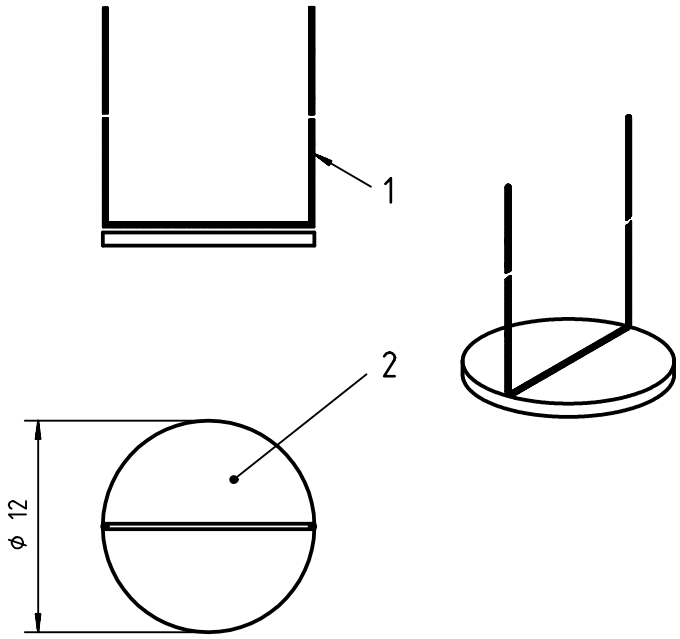


Key

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 ± 0,1) mm thick
6 Face A

Figure 1 — Illustration of plate thermometer

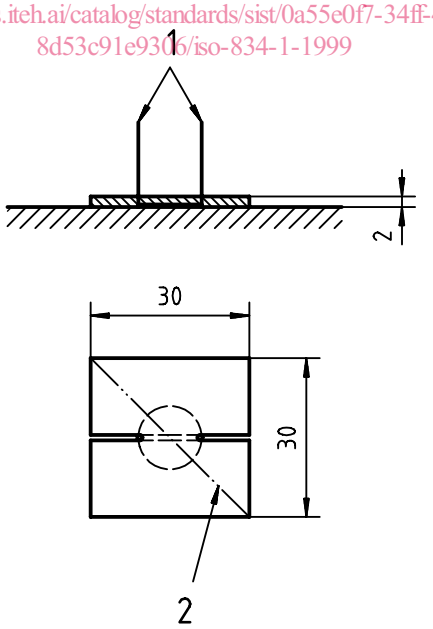
Dimensions in millimetres



Key

1 Thermocouple wire, of 0,5 mm diameter
2 Copper disc, 0,2 mm thick

a) Copper disc measuring junction



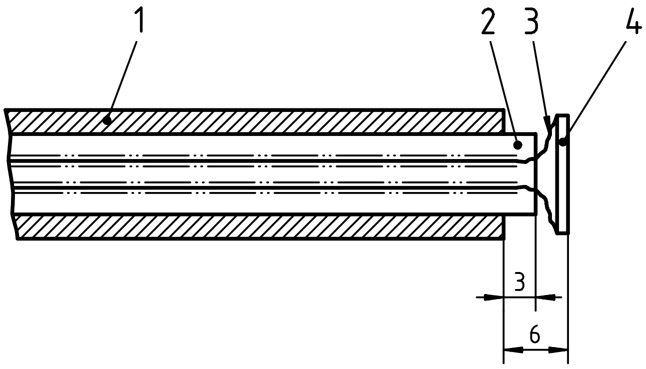
Key

1) Cuts to allow pad to be positioned over copper disc
2) Alternative cut location

b) Copper disc and insulating pad

Figure 2 — Unexposed surface thermocouple and insulating pad

Dimensions in millimetres



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 thermocouples

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 thermocouples

A thermocouple shall be used to indicate the ambient temperature within the laboratory 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, as defined in 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.