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

**Part 14:
Requirements for the testing and
assessment of applied fire protection
to solid steel bar**

Essais de résistance au feu — Éléments de construction —

*Partie 14: Exigences pour les essais et l'évaluation de la protection
contre l'incendie appliquée aux barres pleines en acier*



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Published in Switzerland

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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 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).

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. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

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*.

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

In building construction, high strength solid steel bar is often used as hangars and ties for supporting other structural elements that are required to be fire resistant. As a result, these members are also required to provide the same level of fire performance which usually involves applying either passive or reactive fire protection materials to maintain their structural stability for a specified period of fire resistance.

Small scale tensile tests on loaded steel specimens and subjected to transient heating conditions representing typical heating rates in fire, have demonstrated that when tensile strains of around 1 % to 3 % are attained, the specimens enter the onset of 'runaway' whereby the strain rate accelerates resulting in failure within a further small rise in temperature. Similar strains are also experienced in the lower flange of protected steel floor beams at the limit of deflection (span/30) when tested in accordance with ISO 834-6 and in loaded column tests when specimens undergo thermal expansion with extensions approaching 1 % strain before the onset of structural instability.

A purpose of loaded fire resistance tests is to demonstrate the integrity (stickability) of the fire protection materials to the steel member. Since similar strains are experienced in tension members as experienced on beams and columns, the integrity performance of the fire protection on loaded beams and columns is considered to be representative of the ability of the fire protection materials to remain adhered to steel bars provided the methods of application/fixing are the same.

This document is therefore primarily concerned with the collection of thermal test data on unloaded protected solid steel bar from which an assessment is carried out to determine the thickness of the fire protection material to meet specific periods of fire resistance, or limiting temperature criteria for steel bar of different diameters or thicknesses. Research has shown that data on circular hollow sections cannot be used for determining the protection thickness for solid bar and therefore a separate test standard for unloaded solid sections is required.

Fire-resistance tests — Elements of building construction —

Part 14:

Requirements for the testing and assessment of applied fire protection to solid steel bar

1 Scope

This document specifies a test and assessment method for determining the contribution of fire protection systems to the fire resistance of circular and rectangular solid steel bar. ISO 834-10 and ISO 834-11 cover other section shapes such as angles, channels and flats. This document is not intended to be used for twisted wire or for cold or hot rolled steel bar which is primarily used for the reinforcement of concrete.

This document is applicable for the protection of solid bar up to a maximum diameter of 130 mm and in the case of rectangular bar the maximum side length shall be limited to 130 mm with a maximum aspect ratio of 2:1 against the shorter length side. Beyond these limits, the solid steel bars are covered in ISO 834-10 and ISO 834-11.

This document is intended to be used with any applied fire protection system, including multi-layered systems, that have demonstrated their integrity/stickability when tested on floor beams and hollow sections under load, and assessed in accordance with ISO 834-11.

This document does not incorporate results from a loaded test on a tension member. Guidance for conducting a fire test on a steel bar under a tensile load is provided in [Annex C](#).

This document contains the fire test methodology to provide data on the thermal characteristics of the fire protection system when exposed to the standard temperature/time curve specified in ISO 834-1. It also contains an assessment method for the analysis of the test data.

The limits of applicability of the results of the assessment arising from the fire test are defined together with permitted direct application of the results to different steel types and sizes over the range of thicknesses of the applied fire protection system tested.

The assessment procedure is used to establish:

- on the basis of temperature data derived from testing steel bars, any practical constraints on the use of the fire protection system under fire test conditions, (the physical performance);
- on the basis of the temperature data derived from testing steel bars, the thermal properties of the fire protection system, (the thermal performance).

The limits of applicability of the results of the assessment arising from the fire test are defined together with permitted direct application of the results to different steel types and sizes of steel bar over the range of thicknesses of the applied fire protection system tested.

This document describes testing in both the vertical and horizontal orientations at the discretion of the sponsor.

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*

ISO 834-10, *Fire resistance tests — Elements of building construction — Part 10: Specific requirements to determine the contribution of applied fire protection materials to structural steel elements*

ISO 834-11, *Fire resistance tests — Elements of building construction — Part 11: Specific requirements for the assessment of fire protection to structural steel elements*

ISO 8421-2, *Fire protection — Vocabulary — Part 2: Structural fire protection*

ISO 13943, *Fire safety — Vocabulary*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 834-1, ISO 8421-2 and ISO 13943, and the following 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 fire protection

protection afforded to the steel member by the fire protection system such that the temperature of the steel member is limited throughout the period of exposure to fire

3.2 fire protection system

fire protection material together with any supporting system including mesh reinforcement as tested

3.3 fire protection thickness

dry thickness of the fire protection system

Note 1 to entry: For reactive fire protection systems, the thickness is the mean dry film thickness of the coating excluding primer and top coat if applicable.

3.4 maximum steel temperature

highest average temperature recorded at any measurement station

3.5 passive fire protection material

sprayed coatings or renderings formulated with ingredients enabling the retention of their physical form upon heating while providing insulation to the substrate

3.6 reactive fire protection material

reactive materials which are specifically formulated to provide a chemical reaction upon heating such that their physical form changes and in so doing provide fire protection by thermal insulative and cooling effects