

Test methods for determining the contribution to the fire resistance of structural members - Part 10: Applied protection to solid steel bars in tension

EESTI STANDARDI EESSÕNA

NATIONAL FOREWORD

See Eesti standard EVS-EN 13381-10:2020 sisaldab Euroopa standardi EN 13381-10:2020 ingliskeelset teksti.	This Estonian standard EVS-EN 13381-10:2020 consists of the English text of the European standard EN 13381-10:2020.
Standard on jõustunud sellekohase teate avaldamisega EVS Teatajas.	This standard has been endorsed with a notification published in the official bulletin of the Estonian Centre for Standardisation.
Euroopa standardimisorganisatsioonid on teinud Euroopa standardi rahvuslikele liikmetele kättesaadavaks 06.05.2020.	Date of Availability of the European standard is 06.05.2020.
Standard on kättesaadav Eesti Standardikeskusest.	The standard is available from the Estonian Centre for Standardisation.

Tagasisidet standardi sisu kohta on võimalik edastada, kasutades EVS-i veebilehel asuvat tagasiside vormi või saates e-kirja meiliaadressile standardiosakond@evs.ee.

ICS 13.220.50, 91.080.13

Standardite reprodutseerimise ja levitamise õigus kuulub Eesti Standardikeskusele

Andmete paljundamine, taastekitamine, kopeerimine, salvestamine elektroonsesse süsteemi või edastamine ükskõik millises vormis või millisel teel ilma Eesti Standardikeskuse kirjaliku loata on keelatud.

Kui Teil on küsimusi standardite autorikaitse kohta, võtke palun ühendust Eesti Standardikeskusega:
Koduleht www.evs.ee; telefon 605 5050; e-post info@evs.ee

The right to reproduce and distribute standards belongs to the Estonian Centre for Standardisation

No part of this publication may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying, without a written permission from the Estonian Centre for Standardisation.

If you have any questions about copyright, please contact Estonian Centre for Standardisation:

Homepage www.evs.ee; phone +372 605 5050; e-mail info@evs.ee

English Version

Test methods for determining the contribution to the fire resistance of structural members - Part 10: Applied protection to solid steel bars in tension

Méthodes d'essai pour déterminer la contribution à la résistance au feu des éléments de construction - Partie 10 : Protection appliquée aux barres d'acier pleines précontraintes (tirants)

Prüfverfahren zur Bestimmung des Beitrages zum Feuerwiderstand von tragenden Bauteilen - Teil 10: Brandschutzmaßnahmen für Stahl-Vollstäbe unter Zugbeanspruchung

This European Standard was approved by CEN on 14 March 2020.

CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration. Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the CEN-CENELEC Management Centre or to any CEN member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CEN member into its own language and notified to the CEN-CENELEC Management Centre has the same status as the official versions.

CEN members are the national standards bodies of Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Republic of North Macedonia, Romania, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and United Kingdom.



EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

CEN-CENELEC Management Centre: Rue de la Science 23, B-1040 Brussels

Contents	Page
European foreword	4
Introduction.....	5
1 Scope	6
2 Normative references	7
3 Terms and definitions, symbols and units	7
3.1 Terms and definitions.....	7
3.2 Symbols and units.....	8
4 Test equipment.....	9
4.1 General	9
4.2 Furnace.....	9
5 Test procedures	9
5.1 General	9
5.2 Support conditions.....	9
5.3 Number of test specimens	9
5.4 Size of test specimens.....	10
5.5 Construction of steel test specimens	10
5.5.1 Steel specification.....	10
5.5.2 Surface treatment and application of the fire protection material	10
5.6 Composition of fire protection materials	10
5.6.1 General	10
5.6.2 Thickness of applied reactive protection materials	10
5.7 Selection of test specimens	10
6 Installation of the test specimens.....	12
6.1 Test specimen installation patterns	12
6.2 Installation of the steel bars	13
6.3 Furnace Load	13
7 Conditioning of the test specimens	13
8 Application of instrumentation.....	13
8.1 General	13
8.2 Instrumentation for measurement and control of furnace temperature	13
8.2.1 General	13
8.2.2 Furnace temperature in the region of test specimens	13
8.3 Instrumentation for the measurement of steel temperatures.....	14
8.4 Instrumentation for the measurement of pressure	14
9 Test procedure	14
9.1 General	14
9.2 Furnace temperature and pressure.....	14
9.3 Temperature of steelwork	14
9.4 Observations	15
9.5 Termination of test	15
10 Test results.....	15
10.1 Acceptability of test results.....	15

10.2	Presentation of test results in the test report.....	15
11	Assessment.....	16
11.1	General.....	16
11.2	Assessment procedure for thermal performance.....	16
12	Report of the assessment.....	16
13	Limits of the applicability of the results of the assessment.....	17
13.1	General.....	17
13.2	Range in fire protection thickness.....	17
13.3	Range in dimensions.....	17
Annex A	(normative) Linear interpolation analysis.....	20
Annex B	(normative) Loaded test.....	26
B.1	General.....	26
B.2	Test equipment.....	26
B.3	Test specimens.....	26
B.4	Application of instrumentation.....	26
B.5	Installation of test specimens.....	26
B.6	Application of load.....	26
B.7	Correction of data.....	27
Annex C	(normative) Maximum thickness selection and stickability correction for reactive coatings.....	28
Annex D	(informative) A-deviations.....	30
Bibliography	31

European foreword

This document (EN 13381-10:2020) has been prepared by Technical Committee CEN/TC 127 “Fire safety in buildings”, the secretariat of which is held by BSI.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by November 2020, and conflicting national standards shall be withdrawn at the latest by November 2020.

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

This document is complementary and supportive to EN 13381-4 and EN 13381-8.

It is one of a series of standards for evaluating the contribution to the fire resistance of structural members by applied fire protection materials. Other parts of this series are:

- *Part 1: Horizontal protective members*
- *Part 2: Vertical protective members*
- *Part 3: Applied protection to concrete members*
- *Part 4: Applied passive protection to steel members*
- *Part 5: Applied protection to concrete/profile sheet steel and composite members*
- *Part 6: Applied protection to concrete filled hollow steel columns*
- *Part 7: Applied protection to timber members*
- *Part 8: Applied reactive protection to steel members*
- *Part 9: Applied fire protection systems to steel beams with web openings*

All the above Standards were prepared under a standardization request given to CEN by the European Commission and the European Free Trade Association. However, whilst this European Standard is complimentary and supportive to EN 13381-4 and EN 13381-8, it falls outside of the scope of that standardization request and its results cannot be used as a basis of any European Classification for Resistance to Fire. It does, however, provide a valuable common basis for the fire protection industry to evaluate products and for national authorities to determine a product’s suitability to provide an appropriate level of fire protection to steel members in tension.

Attention is drawn to the A-deviation, in accordance with Annex E of the CEN/CENELEC Internal Regulations Part 2:2017, granted to DIN by virtue of the evidence presented in Annex D that indicates the existence of a conflicting national methodology supporting existing regulatory requirements in Germany.

According to the CEN-CENELEC Internal Regulations, the national standards organisations of the following countries are bound to implement this European Standard: Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Republic of North Macedonia, Romania, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.

Introduction

The evaluation of a product's capability to provide fire protection performance to I or H section, or hollow section, columns and beams is undertaken by test and assessment procedures detailed in EN 13381-4 for passive (non-reactive) fire protection products and in EN 13381-8 for reactive (intumescent) fire protection products.

The scopes of both the above standards specifically exclude the evaluation of solid bars used as tension members. This document, therefore, provides supplementary test and assessment procedures to those given in EN 13381-4 and EN 13381-8 to extend a product's scope of application to cover solid circular or rectangular bars used as tension members. It is equally applicable to passive and reactive fire protection products.

The evaluation represents an assessment of a product's fire insulation performance across a range of solid circular and/or rectangular cross section bars on the basis of tests on unloaded specimens and where appropriate loaded specimens. At the point of failure the strain generated on the bottom flange of a loaded beam during testing to EN 13381-4 or EN 13381-8 is greater than that produced in circular or rectangular bars in tension. Also, the strain generated during loaded column testing is similar to that generated in circular or rectangular bars in tension.

In addition, recent testing of loaded and unloaded bars protected with reactive coatings has shown that the benefit of a loaded test is very much dependant on product thickness; increased thickness of product reduces the difference between loaded and unloaded testing. A minimum generic thickness cannot be specified, however, as this is product dependent. Within EN 13381-8, product stickability is determined from loaded beam and/or loaded column testing at intended maximum product thickness. Therefore, where the scope of testing in this document uses lower thicknesses, then loaded testing in accordance with Annex B should be carried out.

In all cases, the maximum protection thickness tested on unloaded bars should not be greater than the maximum from loaded beams, columns or hollow columns tested to EN 13381-4 for passive fire protection products or tested to EN 13381-8 for reactive fire protection products. If higher thicknesses are required to provide any level of fire protection performance, then this should be validated on the basis of testing loaded bars in accordance with Annex B of this document.

For passive fire protection products, similar loaded tests are only required when the system fixing details to a tension member are not considered to fairly represent those used in the products EN 13381-4 evaluation.

An appropriate supplementary loaded test is, therefore, included in this document as a Normative Annex B to be applied only when required as detailed above.

Caution: The attention of all persons concerned with managing and carrying out this fire resistance test, is drawn to the fact that fire testing can be hazardous and that there is a possibility that toxic and/or harmful smoke and gases can be evolved during the test. Mechanical and operational hazards can also arise during the construction of test elements or structures, their testing and the disposal of test residues.

An assessment of all potential hazards and risks to health should be made and safety precautions should be identified and provided. Written safety instructions should be issued with the manufacturer's health and safety product data sheet.

Appropriate training should be given to relevant personnel. Laboratory personnel should ensure that they follow written safety instructions at all times.

The specific health and safety instructions contained within this document should be followed.

1 Scope

This document specifies a fire test method and an assessment procedure for determining the contribution of fire protection systems to the fire resistance performance of circular and rectangular steel bars used as tension members.

This document applies to fire protection materials that have already been tested and assessed in accordance with EN 13381-4 or EN 13381-8.

For other section shapes such as angles, channels and flats, reference can be made to EN 13381-4 and EN 13381-8. This document does not include steel or any other cold formed bar used as reinforcement in concrete construction.

For other solid bar geometries such as oval or triangular cross section, these are subject to a separate test package in accordance with the principles of Clause 5 of this document.

Fire protection performance is determined by testing of unloaded tension members, although additional loaded test evidence can be required for certain product types subject to certain conditions specified in the document.

The method is applicable to all fire protection systems used for the protection of solid bar up to a maximum diameter of 130 mm and includes sprayed fire protection, reactive coatings, cladding protection systems and multi-layer or composite fire protection materials. In the case of rectangular bar, the maximum side length is limited to 130 mm with a maximum aspect ratio of 2:1 against the shorter side length. For dimensions greater than 130 mm it is appropriate to use rectangular or circular hollow sections tested and assessed in accordance with EN 13381-4 and EN 13381-8 provided they have been tested in the same orientation.

The evaluation is designed to cover a range of thicknesses of the applied fire protection material, a range of steel bar dimensions, a range of specified temperatures and a range of valid fire protection periods.

The test method is applicable to fire protection systems which are intimately in contact with the bar, or which include an airspace between the bar and the protection system as given in EN 13381-4.

This document also provides the assessment procedure, which prescribes the analysis of the test data and gives guidance on the procedures to undertake interpolation.

This document caters for testing in both vertical and horizontal orientations. Results from horizontally orientated bar can be applied to any orientation, whilst results from vertically orientated bar are only used for horizontal bars when the data has been corrected in accordance with Annex C.

This document gives the fire test procedures, carried out to provide data on the thermal characteristics of the fire protection system, when exposed to the standard temperature/time curve specified in EN 1363-1.

The assessment procedure is used to establish:

- a) on the basis of data derived from testing steel bar, any practical constraints on the use of the fire protection system under fire test conditions (the physical performance);
- b) on the basis of the temperature data derived from testing steel bar 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 application of the results to different steel types and sizes over the range of thicknesses of the applied fire protection system tested.

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.

EN 1363-1, *Fire resistance tests - Part 1: General requirements*

EN 10025 (all parts), *Hot rolled products of structural steels*

EN 13381-4, *Test methods for determining the contribution to the fire resistance of structural members - Part 4: Applied passive protection to steel members*

EN 13381-8, *Test methods for determining the contribution to the fire resistance of structural members - Part 8: Applied reactive protection to steel members*

EN ISO 13943, *Fire safety - Vocabulary (ISO 13943)*

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

3 Terms and definitions, symbols and units

3.1 Terms and definitions

For the purposes of this document, the terms and definitions given in EN 1363-1, EN ISO 13943 and ISO 8421-2, 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/>

3.1.1

steel bar

circular or rectangular solid bar composed entirely of steel with a consistent cross sectional size throughout its length

3.1.2

reactive fire protection material

reactive material which is specifically formulated to provide a chemical reaction upon heating such that its physical form changes and in so doing provides fire protection by thermal insulative and cooling effect

3.1.3

passive fire protection material

material which does not change its physical form on heating, providing protection by virtue of its physical or thermal properties

Note 1 to entry: They may include materials containing water which, on heating evaporates to produce cooling effects.

3.1.4

fire protection system

fire protection material together with any supporting system including mesh reinforcement and a specified primer and top coat if applicable