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Preskusne metode za ugotavljanje prispevka k požarni odpornosti konstrukcijskih elementov - 1. del: Vodoravne zaščitne membrane

Test methods for determining the contribution to the fire resistance of structural members - Part 1: Horizontal protective membranes

Prüfverfahren zur Bestimmung des Beitrages zum Feuerwiderstand von tragenden Bauteilen - Teil 1: Horizontal angeordnete Brandschutzbekleidungen

Méthodes d'essai pour déterminer la contribution à la résistance au feu des éléments de construction - Partie 1 : Membranes de protection horizontales

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Test methods for determining the contribution to the fire resistance of structural members - Part 1: Horizontal protective membranes

Méthodes d'essai pour déterminer la contribution à la résistance au feu des éléments de construction - Partie 1 : Membranes de protection horizontales

Prüfverfahren zur Bestimmung des Beitrages zum Feuerwiderstand von tragenden Bauteilen - Teil 1: Horizontal angeordnete Brandschutzbekleidungen

This European Standard was approved by CEN on 7 May 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.

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COMITÉ EUROPÉEN DE NORMALISATION
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European foreword

This document (EN 13381-1:2020) 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of an identical text or by endorsement, at the latest by January 2021, and conflicting national standards shall be withdrawn at the latest by January 2021.

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 supersedes EN 13381-1:2014.

The main changes with respect to the previous edition are listed below:

Clarifications regarding the following items:

- a) determination of the characteristic surface temperature curve;
- b) limits of applicability (addition of integrity and insulation performances in the tables);
- c) assessment when the semi-natural fire test is performed (Annex A).

This document has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association.

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

- *Part 2: Vertical protective membranes,*
- *Part 3: Applied protection to concrete members,*
- *Part 4: Applied passive protection to steel members,*
- *Part 5: Applied protection to concrete/profiled sheet steel 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.*

The fire protection capacity of the horizontal protective membrane can be nullified by the presence of combustible materials in the cavity above the membrane. The applicability of the results of the assessment is limited according to the quantity and position of such combustible materials within that cavity. The amount of combustible material permissible in the cavity is typically given in national regulations.

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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.

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Introduction

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. 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.

WARNING: When performing this test method, laboratories should expect that there can be significant quantities of smoke released. This smoke release is expected to be very significant where the fire test involves timber and timber based components. Laboratories should ensure that appropriate smoke extraction facilities are provided.

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EN 13381-1:2020 (E)**1 Scope**

This document specifies a test method for determining the ability of a horizontal protective membrane, when used as a fire resistant barrier, to contribute to the fire resistance of standard horizontal structural building members as defined in 6.4.2.

Test of horizontal protective membrane installed under a specific non-standard floor should be tested according to EN 1365-2.

This document contains the fire test which specifies the tests which are carried out whereby the horizontal protective membrane, together with the structural member to be protected, is exposed to a fire test according to the procedures defined herein. The fire exposure, to the temperature/time curve given in EN 1363-1, is applied from below the membrane itself.

The test method makes provision, through specified optional additional procedures, for the collection of data which can be used as direct input to the calculation of fire resistance according to the processes given within EN 1992-1-2, EN 1993-1-2, EN 1994-1-2 and EN 1995-1-2.

This document also contains the assessment which provides information relative to the analysis of the test data and gives guidance for the interpretation of the results of the fire test, in terms of loadbearing capacity criteria of the protected horizontal structural member.

In special circumstances, where specified in national building regulations, there can be a need to subject the protection material to a smouldering curve. The test for this and the special circumstances for its use are detailed in Annex C.

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 structures, membranes and fittings.

This document applies only where there is a gap and a cavity between the horizontal protective membrane and the structural building member. Otherwise, the test methods in EN 13381-3, EN 13381-4 or EN 13381-5, as appropriate, apply.

Tests are intended to be carried out without additional combustible materials in the cavity.

Annex A gives details of assessing the performance of the ceiling when exposed to a semi-natural fire.

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 1363-1:2020, *Fire resistance tests — Part 1: General Requirements*

EN 1363-2, *Fire resistance tests — Part 2: Alternative and additional procedures*

EN 1992-1-1, *Eurocode 2: Design of concrete structures — Part 1-1: General rules and rules for buildings*

EN 1992-1-2, *Eurocode 2: Design of concrete structures — Part 1-2: General rules — Structural fire design*

EN 1993-1-1, *Eurocode 3: Design of steel structures — Part 1-1: General rules and rules for buildings*

EN 1993-1-2, *Eurocode 3: Design of steel structures — Part 1-2: General rules — Structural fire design*

EN 1994-1-1, *Eurocode 4: Design of composite steel and concrete structures — Part 1-1: General rules and rules for buildings*

EN 1994-1-2, *Eurocode 4 — Design of composite steel and concrete structures — Part 1-2: General rules — Structural fire design*

EN 1995-1-1, *Eurocode 5: Design of timber structures — Part 1-1: General — Common rules and rules for buildings*

EN 1995-1-2, *Eurocode 5: Design of timber structures — Part 1-2: General — Structural fire design*

EN 312, *Particleboards — Specifications*

EN 823, *Thermal insulating products for building applications — Determination of thickness*

EN 12467, *Fibre-cement flat sheets — Product specification and test methods*

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 13381-5, *Test methods for determining the contribution to the fire resistance of structural members — Part 5: Applied protection to concrete/profiled sheet steel composite member*

EN 13381-7, *Test methods for determining the contribution to the fire resistance of structural members — Part 7: Applied protection to timber 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:

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

3.1.1

horizontal structural building member

horizontal structural element of building construction which is loadbearing, separating and which is fabricated from concrete, steel, steel/concrete composite or timber

3.1.2

horizontal protective membrane

horizontal membrane or ceiling lining that does not form any part of any loadbearing part of the structure and can comprise multiple layers of materials, together with any supporting framework, hangers, fixings and any insulation materials which is either suspended from or attached directly to a structural building member, or is self-supporting and fixed beneath a structural building member, and which is intended to give additional fire resistance to that structural building member, as for example ceiling tiles resting on a light supporting frame, ceiling boards, metal trays, plastered and similar ceilings not directly applied to the underside of the structural member

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3.1.3

separating gap

distance between the non-exposed surface of the horizontal protective membrane and the lowest surface of the exposed side of the structural building member

3.1.4

cavity

whole void or voids between the non-exposed surface of the horizontal protective membrane and the highest surface of the exposed side of the structural building member

3.1.5

horizontal protective membrane test specimen

full horizontal protective membrane assembly submitted for test, including typical fixing equipment and methods and typical features such as insulating materials, light fittings, ventilation ducts and access panels

3.1.6

fire protection

protection afforded to the structural building member by the horizontal protective membrane system such that the temperature on the surface of the structural building member and within the cavity is limited throughout the period of exposure to fire

3.1.7

characteristic temperature

average of the mean temperature and the maximum individual temperature [(mean + maximum)/2] for a group of thermocouples

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3.2 Symbols and units

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Symbol	Unit	Designation
$A_{m/v}$	m ⁻¹	Section factor of unprotected steel beam (see EN 13381-4).
L_{exp}	mm	Exposed length of the structural building member.
L_{spec}	mm	Total length of the main beams or members of the structural building member.
L_{sup}	mm	Centre to centre distance between the supports of the structural building member tested.

4 Test equipment

4.1 General

The furnace and test equipment shall be as specified in EN 1363-1.

4.2 Furnace

The furnace shall be designed to permit the dimensions of the test specimen to be exposed to heating to be as specified in 6.4.1 and its installation to be as described in Clause 7.

4.3 Loading equipment

Loading shall be applied according to EN 1363-1. The loading system shall permit loading, of the magnitude defined in 5.3, to be uniformly applied along the length and width of the test specimen at loading points positioned as defined in 5.3.

The loading equipment shall not inhibit the free movement of air above the test specimen and no part of the loading equipment, other than at the loading points, shall be closer than 60 mm to the unexposed surface of the test specimen.

5 Test conditions

5.1 General

A horizontal structural building member, including any supporting construction, which carries a horizontal protective membrane, to be used as a fire resistant barrier against fire from below, is subjected to predefined loading and to the fire test defined herein.

The temperature within the cavity and the surface temperature of the structural building member are measured throughout the test.

Any leakage through the structural floor slab and at the sides of the structure shall be minimized. The gap between the floor slab and the furnace shall be made tight by e.g. mineral wool pads or similar in such a way that the slab can deflect vertically.

It is recommended that the test is continued until the characteristic temperature recorded by all thermocouples within the cavity reaches the appropriate limiting temperature of the structural building members used or until any individual temperature recorded within the cavity rises to 750 °C for concrete, steel, or concrete/profiled steel composite members and 500 °C for timber structural members.

The procedures given in EN 1363-1 and, if applicable, in EN 1363-2, shall be followed in the performance of this test method unless specific contrary instruction is given. Where required, the semi-natural fire test shall be performed in accordance with Annex A.

5.2 Support and restraint conditions

5.2.1 Standard conditions

The test specimen shall be tested as a simply supported one way structure with two free edges and an exposed surface and span as specified in 6.4.1.

It shall be installed to allow freedom for longitudinal movement and deflection using at one side rolling support(s) and at the other hinge support(s) as shown in Figure 1.

The surface of the bearings shall be smooth concrete or steel plates. The width of the bearings shall be at least as wide as the beam.

5.2.2 Other support and restraint conditions

Support and restraint conditions differing from the standard conditions specified in 5.2.1 shall be described in the test report and the validity of the results restricted to that tested.

5.3 Loading conditions

The test specimen shall be subjected to loads determined in accordance with EN 1363-1. The means of determination of the load shall be clearly indicated in the test report.

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The applied load shall be calculated such that the maximum bending moment equals 60 % of the ultimate cold condition limit state value of the design moment resistance specified in the appropriate structural Eurocodes (EN 1992-1-1, EN 1993-1-1, EN 1994-1-1 and EN 1995-1-1).

The design moment resistance shall be calculated using either the actual or nominal material properties, derived according to 6.5, of the loadbearing member with a material safety factor (γ_m) equal to 1,0.

The load shall be symmetrically applied to the test specimen either along two transverse loading lines, applied at $1/4 L_{sup}$ and $3/4 L_{sup}$ and separated from each other by a distance of $L_{sup}/2$, see Figure 2, or by the use of dead weights. In both cases the loading shall produce stresses approximating to a uniformly distributed load.

The method of loading shall be by a system which will produce a bending moment, which is uniform over at least 20 % of the span of the beam around mid-span.

Point loads shall be transferred to the test specimen, along the two transverse loading lines, through load distribution beams or plates, see Figure 1 and Figure 3, the total contact area between these and the test specimen shall be as specified in EN 1363-1.

Load distribution beams, for safety reasons, shall have a height to width ratio < 1 .

If the load distribution plates are of steel or any other high conductivity material, they shall be insulated from the surface of the test specimen by a suitable thermal insulation material.

Unexposed surface thermocouples shall not be closer than 100 mm to any part of the load distribution system.

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6 Test specimens**6.1 General**

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One test specimen shall normally be required. <https://standards.iteh.ai/catalog/standards/sist/12ff4947-8d16-4970-aa75-545606b0dde/sist-en-13381-1-2020>

The structural building member to be used in the test shall be as given in 6.4.1 and be chosen from the standard elements described in 6.4.2 and be representative of that to be used in practice.

Where a horizontal protective membrane is manufactured with elements or components of variable size or may be installed by different procedures, then separate tests shall be carried out on elements or components at maximum and minimum sizes (the components which are cut to finish the ceiling extremities shall not be considered as smaller size components). The installation procedures for which the sponsor requires approval shall be deemed as being represented by the fire test.

The horizontal protective membrane to be used in the test shall be constructed as described in 6.3 and shall be installed according to practice, by the procedures given in the installation manual or other written instruction provided by the sponsor. It shall include all thermal insulating layers or materials to be used in practice within the cavity.

6.2 Fixtures and fittings

All fixtures and fittings, such as light fittings, ventilation openings and access panels expected to be installed, shall be tested in a separate full size test. The installation and frequency of use of these shall then if possible be representative of practice. Such fixtures and fittings shall not be installed within the test specimen at a distance of less than 250 mm from any of its edges.

6.3 Horizontal protective membranes

The test specimen shall reproduce the conditions of use, including junctions between membrane and walls and edge panels, joints and jointing materials and be installed from below by the same method and procedures as given in the installation manual, or in written instructions, which shall be provided by the sponsor.

It shall be fitted with all the components for hanging, expansion and abutting, plus any other fixtures which are to be defined by the sponsor, with a frequency representative of practice.

For horizontal protective membranes which are suspended from the structural building member by hangers, the suspension system and the length of the hangers shall be representative of practice.

The profiles bearing the various panels shall be installed against each other without any gap, unless a gap (or gaps) is required for design purposes. In this case the gap (or gaps) at the junctions of main runners shall be representative of that to be used in practice and shall be installed within the main runners and not at their ends.

The profiles within the test specimen shall include a joint representative of joints to be used in practice in both longitudinal and transverse directions.

The horizontal protective membrane shall be fixed according to normal practice on all four edges, either directly to the furnace walls or to a test frame. A test frame, where used, shall be fixed directly to the horizontal structural building member being protected, or to the furnace walls.

If the construction or properties of the horizontal protective membrane are different in the longitudinal and transverse directions, the performance of the specimen may vary depending upon which components are aligned with the longitudinal axis. If known from experience, the specimen shall be installed so as to represent the most onerous condition by arranging the more critical components parallel to the longitudinal axis. If the more onerous condition cannot be identified, two separate tests shall be carried out with the components arranged both parallel and perpendicular to the longitudinal axis.

6.4 Structural building members supporting horizontal protective membranes

6.4.1 General principles

The dimensions of the structural building member supporting the horizontal protective membrane and which is exposed to the furnace shall be:

- a) exposed length (L_{exp}) : at least 4 000 mm
- b) span (L_{sup}) : L_{exp} plus up to 400 mm maximum at each end
- c) length (L_{spec}) : L_{exp} plus up to 500 mm at each end
- d) exposed width : at least 3 000 mm

The additional length, required for installation purposes, shall be kept as small as practically possible.

Test specimens of exposed width less than 3 000 mm may be tested according to this method. However, application of the result shall be restricted to constructions of equal or less width than that tested.

The gap between the structural building member and the longitudinal furnace walls or simulated furnace walls shall not exceed 30 mm and shall be sealed with compressed mineral fibres or ceramic fibres of adequate fire performance (or comparable materials of equivalent performance) to allow both deflection of the member under heating conditions and prevention of leakage of hot gases during the test.