SLOVENSKI STANDARD
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Preskusne metode za ugotavljanje prispevka k požarni odpornosti konstrukcijskih elementov - 7. del: Zaščita lesenih elementov

Test methods for determining the contribution to the fire resistance of structural members - Part 7: Applied protection to timber members

Prüfverfahren zur Bestimmung des Beitrages zum Feuerwiderstand von tragenden Bauteilen - Brandschutzmaßnahmen für Holzbauteile

Méthodes d'essai pour déterminer la contribution à la résistance au feu des éléments de construction - Partie 7: Protection appliquée aux éléments en bois

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13.220.50	Požarna odpornost gradbenih materialov in elementov	Fire-resistance of building materials and elements
91.080.20	Lesene konstrukcije	Timber structures

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Test methods for determining the contribution to the fire resistance of structural members - Part 7: Applied protection to timber members

Méthodes d'essai pour déterminer la contribution à la résistance au feu des éléments de construction - Partie 7: Protection appliquée aux éléments en bois

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This draft European Standard is submitted to CEN members for enquiry. It has been drawn up by the Technical Committee CEN/TC 127.

If this draft becomes a European Standard, 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.

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

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Foreword

This document (prEN 13381-7:2014) has been prepared by Technical Committee CEN/TC 127 “Fire safety in buildings”, the secretariat of which is held by BSI.

This document is currently submitted to the CEN Enquiry.

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

This European Standard 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 standard are:

Part 1: Horizontal protective membranes.

Part 2: Vertical protective membranes.

Part 3: Applied protection to concrete members.

Part 4: Applied 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 8: Applied reactive protection to steel members.

Part 9: Applied fire protection systems to steel beams with web openings.

Part 10: Applied protection to solid steel rods.

Caution

The attention of all persons concerned with managing and carrying out this fire resistance test, is drawn to 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 shall be made and safety precautions shall be identified and provided. Written safety instructions shall be issued. Appropriate training shall be given to relevant personnel. Laboratory personnel shall ensure that they follow written safety instructions at all times.

The specific health and safety instructions contained within this Standard shall be followed.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to announce this European Standard: Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Malta, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and the United Kingdom.

1 Scope

This Part of this European Standard specifies test methods to be followed for determining the contribution of fire protection systems to the fire resistance of structural timber members.

Such fire protection systems include claddings, sprayed fire protection and reactive coatings.

The method is applicable to all fire protection systems used for the protection of timber members. These can be fixed directly, totally or in part, to the timber member and can include an air gap between the fire protection system and the timber member, as an integral part of its design.

Evaluation of timber constructions protected by horizontal or vertical protective membranes are the subject of EN 13381-1 or EN 13381-2 respectively.

The test method is applicable to the determination of the contribution of fire protection systems to the fire resistance of loadbearing timber structural members including floors, roofs, walls, beams and columns.

This European Standard contains the fire test which specifies the test to be carried out to determine the ability of the fire protection system at a specified thickness to delay the temperature rise throughout the timber member, to determine the ability of the fire protection system at a specified thickness to remain coherent and fixed to the timber member and to provide data for determining the charring rate of the protected test member, when exposed to the standard temperature/time curve according to the procedures defined herein. This European Standard is not appropriated to classify the tested assembly according to EN 13501-2.

Where specified in national building regulations, there can be a need to subject reactive protection material to a smouldering curve. The test for this and the special circumstances for this are detailed in Annex G.

The fire test methodology makes provision for the collection and presentation of data which can be used as direct input to the calculation of fire resistance of timber members in accordance with the procedures given in EN 1995-1-2.

A description of the relationship of this test method and the assessment of the results obtained therefrom to EN 1995-1-2 and guidelines for the use of this test method in accordance with that standard are given in Annex B.

This European Standard also contains the assessment which prescribes how the analysis of the test data shall be made and gives guidance to the procedures by which interpolation shall be undertaken.

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 timber constructions with the specified thickness and fixation of the applied fire protection system tested.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

EN 301, Adhesives, phenolic and aminoplastic, for load-bearing timber structures - Classification and performance requirements

EN 338, Structural timber – Strength classes

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

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

EN 1365-1, *Fire resistance tests for loadbearing elements – Part 1: Walls*

EN 1365-2, *Fire resistance tests for loadbearing elements – Part 2: Floors and roofs*

EN 1365-3, *Fire resistance tests for loadbearing elements – Part 3: Beams*

EN 1365-4, *Fire resistance tests for loadbearing elements – Part 4: Columns*

EN 13162, *Thermal insulation products for buildings - Factory made mineral wool (MW) products - Specification*

EN 13501-1, *Fire classification of construction products and building elements - Part 1: Classification using data from reaction to fire tests*

EN 14080, Timber structures - Glued laminated timber - Strength classes and determination of characteristic values

EN 14081, Timber structures - Strength graded structural timber with rectangular cross section - Part 1: General requirements

EN 14279*, Laminated Veneer Lumber (LVL) - Definitions, classification and specifications*

EN 15425, *Adhesives - One component polyurethane for load bearing timber structures - Classification and performance requirements*

EN ISO 2808, *Paints and varnishes – Determination of film thicknesses (ISO 2808)*

IEC 60584-1, *Thermocouples - Part 1: E.M.F. specifications and tolerances (IEC 65B/737/CD:2009)*

ISO 13943, Fire safety – Vocabulary (ISO 13943:2008)

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

ISO 834-12, *Specific requirements for separating elements evaluated on less than large scale furnaces*

3 Terms and definitions, symbols and units

3.1 Terms and definitions

For the purposes of this European Standard, the terms and definitions given in EN 1363-1, EN ISO 13943 and ISO 8421-2, together with the following, apply.

3.1.1
board
a part of a building assembly of typically not reactive material, used as a part or as fire protection material

3.1.2
char line
the border-line between char layer and the residual cross section assumed to be equal with the position of the 300 degree Celsius isotherm

3.1.3
charring depth
distance from the original surface of the timber member to the char line

3.1.4
charring specimen
a non-load bearing, instrumented, laminated timber specimen containing one temperature measurement station incorporated into a large scale test specimen, into a large scale test or a model scale test specimen to follow the charring behind a fire protection system

3.1.5
failure time
time at which failure of the fire protection system occurs, due to detachment of a significant area or sudden significant temperature rise upon the initially protected timber surface

3.1.6
fire protection material
material or combination of materials applied to the surface of a timber structural member for the purpose of increasing its fire resistance

3.1.7
fire protection system
fire protection material together with a prescribed method of attachment to a timber structural member for which the fire protection system may include multiple layers of materials and multiple combinations of materials

3.1.8
model scale test
test to determine the charring rate during the protected charring phase on a furnace of full scale or less than full scale depending on the dimension of the model scale test specimen

3.1.9
passive fire protection materials
materials which do not change their physical form upon heating, provide fire protection by virtue of their physical or thermal properties, and they may include materials containing water which, on heating, is removed to produce cooling effects

3.1.10
reactive fire protection materials
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

3.1.11
timber structural member
element of building construction which may be loadbearing or non-loadbearing and which is mainly constructed from solid timber and/or other wood based products

3.1.12
fire protection
protection afforded to the timber member by the fire protection system such that the rise of temperature of the timber and fixings is limited or delayed throughout the period of exposure to fire

3.1.13
stickability
ability of a fire protection material to remain sufficiently coherent and in position without failure due to detachment of a significant area or sudden significant temperature rise upon the initially protected timber surface

3.1.14
temperature measurement station
a number of thermocouples in different depths which are installed within the charring specimen

3.1.15
test specimen
assembly of the timber or wood based test member with its fire protection system

3.1.16
spreader beam
stiff beam used in large scale tests to distribute the load uniformly placed on the top of the large scale floor test specimen or the large scale wall test specimen over the whole width of the specimen

3.1.17
start of charring
point in time when the temperature measurement at an initially fire protected timber surface reaches or exceeds 300°C.

3.1.18
wood defect
knot, bark pocket, resin pocket, pith or crack

3.1.19
large scale test
loaded test to determine the start of charring behind the fire protection system and the stickability of a fire protection system (applied to a horizontal or vertical timber framed assembly or to a timber beam) on a full scale furnace

3.2 Symbols and units

Symbol	Unit	Description
A	mm^2	Area.

$E_{0.05}$	N/mm²	Fifth percentile value of modulus of elasticity.
I_z	mm^4	Second Moment of area about the z-axis
L_{exp}	mm	Length of the specimen exposed to the heating.
L_{sup}	mm	Length of the specimen between centres of supports.
T	°C	Temperature.
TC		Thermocouple.
b	mm	Width of the large scale test specimen.
c	mm	Centre distance of loaded joists.
d	mm	Vertical distance between horizontal joints.
d_{char}	mm	Charring depth.
d_{TC}	mm	Distance of the thermocouple from the exposed side of the timber member.
$f_{c,0,d}$	N/mm²	Design compressive strength along the grain.
$f_{c,0,k}$	N/mm²	Characteristic compressive strength along the grain.
h	mm	Depth of the timber member. The height of a large scale test specimen The depth of the model scale test specimen The height of the joists in a large scale wall test.
h_c	mm	Depth of the aerated concrete member.
h_D	mm	Thickness of the decking of the large floor element.
h_p	mm	Thickness of the fire protection system. In the case of two or more layers of fire protection material h_p is the sum of the thicknesses.
h_D	Mm	Thickness of the decking at the non-exposed side for large scale wall test specimens and large scale floor test specimens.
i_z	mm	Radius of inertia about the z-axis
k_{mod}		Modification factor for duration of load and moisture content.
l	mm	Length of the large scale wall specimen.
l_c	mm	Length of the aerated concrete members.
l_a	mm	Length of the screw penetrating in the wood.
l_m	mm	Measurement length. Length where thermocouples are distributed.
l_s	mm	Length of the model scale test specimen
s	mm	Distance between thermocouples.
s_f	mm	Minimum distance to the furnace walls.
t	min	Time.
t_{ch}	Min	Start of charring at the surface of a timber member.
$t_{ch,model}$	min	Time when the average temperature of the surface TC attached to the model scale specimen reaches 300°C
t_{300}	min	Time at which the temperature indicated by a thermocouple placed at the surface of the timber test member or at a specified point within a protected
t_f	min	Failure time of the protection for stickability.
t_{test}	min	Time of termination of test.

w_c	mm	Width of the aerated concrete members
w_f	mm	Width of the opening to which the tested element is mounted
w_s	mm	Width of the charring specimen.
x	mm	Centre distance between first 2 outer joists or studs of a large scale wall test specimen or a large scale floor test specimen Length of a defect
β	mm/min	charring rate
β_o	mm/min	One-dimensional charring rate according to EN 1995-1-2
β_n	mm/min	Notional charring rate according to EN 1995-1-2.
β_2	mm/min	Charring rate behind a fire protection system according to EN 1995-1-2
γ_M		Partial factor for material properties, also accounting for model uncertainties and dimensional variations.
λ_D	W/mK	Declared thermal conductivity according to EN 13162
λ_y		Slenderness ratio corresponding to bending about the y-axis
$\lambda_{rel,y}$		Relative slenderness ratio corresponding to bending about the y-axis
λ_z		Slenderness ratio corresponding to bending about the z-axis

4 Test equipment

4.1 General

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

4.2 Furnace

The furnace shall permit the dimensions of the test specimens to be exposed to heating, as specified in Clause 6 and their installation upon or within the test furnace to be as specified in Clause 7.

4.3 Loading equipment

Loading equipment shall conform to that specified in EN 1363-1. The loading system shall permit loading of the magnitude defined in 5.3 to be applied.

5 Test conditions

5.1 Test procedure

5.1.1 General

The procedures given in EN 1363-1 shall be followed in the performance of this test unless specific contrary instructions are given in this standard.

Large scale tests shall be performed on timber walls or timber floors or on timber beams.

The charring behind a fire protection system shall be determined by incorporating 3 charring specimens in the large scale test specimen or in the model scale test specimen (see Annex A).

The EN 1365-1, EN 1365-2 or EN 1365-3 test method(s) and test specimen(s) appropriate to the use of the fire protection material, specified by the sponsor, shall be followed with the following additional requirements:

The temperature performance, stickability, the surface temperature of the timber members, the temperature throughout the depth of the charring specimens and general behaviour of the fire protection system and its failure, under fire load in conjunction with deflection during the test shall be examined with additional instrumentation.

5.2 Support and restraint conditions

All supports shall not counteract the deformation under load and shall be capable to rotate sufficiently.

- The wall test specimen shall have two free vertical edges. The top and bottom ends should be supported as given in Figure 6 or Figure 7.

- The floor test specimen shall have one fixed support and one sliding support. The floor test specimen shall not be restrained parallel to the joists.

- The beam test specimen shall have one fixed support and one sliding support.

- The model scale test specimen shall be placed on a furnace frame.

5.3 Loading conditions

Load shall be applied to the large scale test specimens according to the relevant large scale test.

- Loading conditions for large scale wall test: the magnitude and distribution of the load applied to the specimen shall be calculated taking into account the weight of the loading system. The maximum effect produced by the total applied load shall be 30% of the buckling resistance at normal temperature according to EN 1995-1-1 using γ_M=1,0 and k_{mod}=1,0.

- Loading conditions for large scale floor test: the magnitude and distribution of the load applied to the specimen shall be calculated taking into account the dead weight of the specimen (measured or derived by calculation from samples of the components) and the weight of the loading system. The maximum effect produced by the total applied load shall be 60% of the resistance according to EN 1995-1-1 using γ_M=1,0 and k_{mod}=1,0.

- Loading conditions for beams: the magnitude and distribution of the load applied to the specimen shall be calculated taking into account the dead weight of the specimen (measured or derived by calculation from samples of the components) and the weight of the loading system. The maximum effect produced by the total applied load shall be 60% of the resistance according to EN 1995-1-1 using γ_M=1,0 and k_{mod}=1,0. The shear induced by the applied load shall not exceed the maximum shear resistance.

In Annex E examples of load calculations can be found.

6 Test specimens

6.1 General

The test specimens shall be designed in order to withstand at least the requested failure time of the protection system.

The test(s) shall be chosen to suit the scope of the assessment and will include loaded specimens and unloaded specimens.

Test results of the large scale test(s) shall be used for the determination of the start time of charring, the charring rate behind the fire protection system and the stickability of the tested protection system.

A model scale test shall be used to determine the ability of a reactive fire protection system to protect a timber member and/or to evaluate the charring rate behind a fire protection system.

6.2 Number

6.2.1 General

The appropriate test or tests to be carried out shall be as given in 5.1. For each EN 1365 test method to be used, the following shall be carried out:

a) Test result to be applicable to floors (and therefore to walls and beams according to 5.1):

— one large scale floor test with incorporated charring test specimens at the thickness as requested by the sponsor.

b) Test result to be applicable only to walls:

— one large scale wall test with incorporated charring test specimens at the thickness as requested by the sponsor.

c) Test result to be applicable only to beams (and therefore to columns according to 5.1).

— one large scale beam test with incorporated charring test specimens at the thickness as requested by the sponsor;

6.2.2 Fire protection system variations

Additional test specimens shall be tested to provide further test data for the fire protection system when it is required to consider:

— different construction and fixing variables: One large scale test per variable shall be tested at the minimum fire protection system thickness requested by the sponsor;

— the test to the smouldering curve (see Annex G). One model scale test for minimum thickness tested on the large scale.

6.3 Size

The test specimens shall follow the requirements of the standard series EN 1365 and the specifications of the sponsor with additional requirements for instrumentation and the build-up specified in this standard.

The large scale test specimen shall have at least 1 full size dimensions of the protection system as used in practice.

- Walls: the exposed dimensions of the wall shall be as specified in EN 1365-1.
- Floors: the exposed dimensions of the floor shall be at least 4 000 mm length and 3 000 mm width according to EN 1365-2.
- Beams: the exposed length of the beam shall be at least 4 000 mm according to EN 1365-3.