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Fire resistance tests - Part 1: General requirements

Feuerwiderstandsprüfungen - Teil 1: Allgemeine Anforderungen

Essais de résistance au feu - Partie 1 : Exigences générales

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13.220.50	Požarna odpornost gradbenih materialov in elementov	Fire-resistance of building materials and elements

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Fire resistance tests - Part 1: General requirements

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This European Standard was approved by CEN on 4 November 2019.

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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.

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

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European foreword

This document (EN 1363-1:2020) 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of an identical text or by endorsement, at the latest by August 2020, and conflicting national standards shall be withdrawn at the latest by August 2020.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 supersedes EN 1363-1:2012.

The main change compared to EN 1363-1:2012 is:

a) a redefinition for the load bearing capacity criterion.

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 technically related to ISO 834-1 prepared by ISO/TC92/SC2 “Fire resistance tests”.

EN 1363, *Fire resistance tests*, consists of the following parts:

— *Part 1: General requirements* (this European standard);

— *Part 2: Alternative and additional procedures*;

— *Part 3: Verification of furnace performance* (published as an ENV).

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 objective of determining fire resistance is to assess the behaviour of a specimen of an element of building construction when subjected to defined heating and pressure conditions. The method provides a means of quantifying the ability of an element to withstand exposure to high temperatures. It does so by setting criteria against which the loadbearing capacity, the fire containment (integrity) and the thermal transmittance (insulation) functions amongst other characteristics can be evaluated.

A representative sample of the element is exposed to a specified regime of heating and the performance of the test specimen is monitored on the basis of criteria described in the standard. Fire resistance of the test element is expressed as the time for which the appropriate criteria have been satisfied. The times so obtained are a measure of the adequacy of the construction in a fire; but they have no direct relationship with the duration time of a real fire.

Caution

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

An assessment of all potential hazards and risks to health needs to be made and safety precautions need to be identified and provided. Written safety instructions will be issued. Appropriate training will be given to relevant personnel. Laboratory personnel will ensure that they follow written safety instructions at all times.

Uncertainty of measurement of fire resistance

There are many factors which can affect the result of a fire resistance test. Those concerned with the variability of the specimen including its materials, manufacture and installation are not related to the uncertainty of measurement. Of the remainder, some, such as the different thermal dose provided by different furnaces, are much more significant than others such as the accuracy of calibration of the data logging system.

Because of the very labour intensive nature of the test, many of the factors that have a bearing on the result are operator-dependent. The training, experience and attitude of the operator is thus crucial to eliminate such variables which can significantly affect the degree of uncertainty of measurement. Unfortunately, it is not possible to numerically quantify these factors and therefore any attempt to determine uncertainty of measurement that does not take into account operator-dependent variables is of limited value.

1 Scope

This document establishes the general principles for determining the fire resistance of various elements of construction when subjected to standard fire exposure conditions. Alternative and additional procedures to meet special requirements are given in EN 1363-2.

The principle that has been embodied within all European standards relating to fire resistance testing is that where aspects and procedures of testing are common to all specific test methods e.g. the temperature/time curve, then they are specified in this test method. Where a general principle is common to many specific test methods but the details vary according to the element being tested (e.g. the measurement of unexposed face temperature), then the principle is given in this document, but the details are given in the specific test method. Where certain aspects of testing are unique to a particular specific test method (e.g. the air leakage test for fire dampers), then no details are included in this document.

The test results obtained might be directly applicable to other similar elements, or variations of the element tested. The extent to which this application is permitted depends upon the field of direct application of the test result. This is restricted by the provision of rules which limit the variation from the tested specimen without further evaluation. The rules for determining the permitted variations are given in each specific test method.

Variations outside those permitted by direct application are covered under extended application of test results. This results from an in-depth review of the design and performance of a particular product in test(s) by a recognized authority. Further consideration on direct and extended application is given in Annex A.

The duration for which the tested element, as modified by its direct or extended field of application, satisfies specific criteria will permit subsequent classification.

All values given in this document are nominal unless otherwise specified.

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 520, *Gypsum plasterboards — Definitions, requirements and test methods*

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

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

EN ISO 13943:2017, *Fire safety — Vocabulary (ISO 13943:2017)*

EN 60584-1, *Thermocouples — Part 1: EMF specifications and tolerances (IEC 60584-1)*

3 Terms, definitions, symbols and designations

3.1 Terms and definitions

For the purposes of document, the terms and definitions given in EN ISO 13943:2017 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 http://www.iso.org/obp

3.1.1
actual material properties
properties of a material determined from representative samples taken from the test specimen for the fire test according to the requirements of the specific product standard

3.1.2
characteristic material properties
properties of a material which are specified for a grade of material which may be used for design purposes

3.1.3
associated construction
form of construction required to test some types of test specimen

EXAMPLE The aerated concrete slabs on top of a beam.

3.1.4
deflection
movement associated with structural and or thermal actions

3.1.5
discontinuity
interruption in the construction associated with a change in material or a joint

Note 1 to entry: Examples of discontinuities are the joint between two adjacent boards in a partition, or the joint between one type of construction and another, such as the joint between a partition and a doorset or the joint between a partition and a glazed area within it.

3.1.6
element of building construction
defined construction component, such as a wall, partition, doorset, floor, roof, beam or column

3.1.7
exposed face
side of the test construction that is exposed to the heating conditions of the test

3.1.8
glowing
emittance of light without flaming associated with combustion of a material

3.1.9
insulation
ability of a test specimen 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

3.1.10
integrity
ability of a test specimen of a separating element of building construction, when exposed to fire on one side, to prevent the passage of flames and hot gases through and to prevent the occurrence of flames on the unexposed side

3.1.11
loadbearing capacity
ability of a test 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, deflection

3.1.12
loadbearing element
element that is intended for use in supporting an external load in a building and maintaining this support in the event of a fire

3.1.13
neutral pressure plane
elevation at which the pressure is equal inside and outside of the furnace

3.1.14
notional floor level
assumed floor level relative to the position of the building element in service

3.1.15
restraint
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

EXAMPLE Examples of different types of restraint are: longitudinal, rotational and lateral.

3.1.16
separating element
element that is intended for use in maintaining separation between two adjacent areas of a building in the event of a fire

3.1.17
supporting construction
construction that may be required for the testing of some building elements into which the test specimen is assembled

Note 1 to entry: For example, the wall into which a doorset is fitted, See Annex B.

3.1.18
sustained flaming
continuous flaming for a period of time greater than 10 s

3.1.19
test construction
complete assembly of the test specimen together with its supporting construction

3.1.20
test frame
frame containing the test construction for the purpose of mounting onto the furnace

3.1.21
test load
load applied to the test specimen

3.1.22
test specimen
element (or part) of building construction provided for the purpose of determining either its fire resistance or its contribution to the fire resistance of another building element

3.1.23
discrete area(s)
portion(s) of the total surface of the test specimen, which may be expected to have different fire insulation performance

3.2 Symbols and designations

For the purposes of this document, the following symbols and designations apply.

Symbol	Unit	Description
A	°C min	the area under the average furnace temperature/time curve
A_s	°C min	the area under the standard temperature/time curve
C	mm	axial contraction measured from the start of heating
d	mm	the 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
D	mm	the deflection measured from the commencement of heating
h	mm	the initial height of the loaded vertical test specimen
L	mm	the length of the span of the test specimen
t	min	the time from the commencement of heating
T	°C	the temperature within the test furnace
ΔT	K	the temperature difference or the temperature rise

4 Test equipment

4.1 General

Equipment used to carry out the test consists essentially of the following:

a) a specially designed furnace to subject the test specimen to the test conditions;

b) control equipment to enable the temperature of the furnace to be controlled as required in 5.1;

c) equipment to control and monitor the pressure of the hot gases within the furnace as required in 5.2;

d) a frame in which the test construction 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 load;

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

g) equipment for measuring the deflection of the test specimen;

h) equipment for evaluating integrity and for establishing compliance with the performance criteria described in Clause 11;

i) equipment for establishing the elapsed time;

j) equipment for measuring the oxygen concentration of furnace gases.

4.2 Furnace

The test furnace 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.

Other special furnaces may be required for specific elements.

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.

The furnace shall be capable of providing the standard fire exposure conditions with respect to thermal exposure and pressure.

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

4.3 Loading equipment

The loading equipment shall be capable of subjecting test specimens to the level of loading determined in accordance with 5.4. 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, axial loading or eccentric loading as appropriate for the test construction. The loading equipment shall be capable of maintaining the test load at a constant value (±5 % of the required value) without changing its distribution and following the maximum deflection and the rate of deflection of the test specimen until failure of loadbearing capacity occurs as defined in 11.3 or for the duration of the test, whichever occurs sooner.

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 deflection 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.

4.4 Test frames

Special test frames or other means shall be employed to reproduce the boundary and support conditions appropriate for the test constructions as required by 5.5. Different types of test constructions will require test frames of differing stiffness. The performance of the test frames shall be evaluated by applying an expansion force within the frame at mid-width between two opposite members and measuring the increase in the internal dimension. The increase shall not exceed 5 mm with an applied force of 25 kN. This evaluation shall be conducted in both directions of the frame.

Where test frames are to meet different requirements, these other requirements are given in the specific test method.

4.5 Instrumentation

4.5.1 Temperature

4.5.1.1 Furnace thermocouples

The furnace thermocouples shall be plate thermometers comprised of an assembly of a folded nickel alloy plate, a thermocouple fixed to it and insulation material.

The folded metal plate shall be constructed from a strip of austenitic nickel based superalloy for high temperature oxidation resistance, (150 ± 1) mm long by (100 ± 1) mm wide by (0,7 ± 0,1) mm, 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 EN 60584-1, contained within mineral insulation in a heat resisting steel alloy sheath of nominal diameter range of 1 mm to 3 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 strip made from the same material as the plate. The 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 and with a density of (280 ± 30) kg/m^3.

Before the plate thermometers are first used, the folded plate part shall be aged by immersing it in a pre-heated oven at 1 000 °C for 1 h, or exposing it in a fire resistance furnace for 90 min during a test carried out following the standard temperature/time curve given in 5.1.1.

Where 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.

4.5.1.2 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, type K thermocouple wires, as defined in EN 60584-1, 0,5 mm in diameter (with tolerances as defined in EN 60584-1) shall be soldered to a 0,2 mm thick by 12 mm diameter copper disc. It is also permitted to use thermocouples whose wires have been twisted together and then soldered to the copper disc.

Each thermocouple shall be covered with a (30 ± 2) mm × (30 ± 2) mm × (2 ± 0,5) mm thick insulating pad, silicate-fibre based and classified as A1 or A2 according to EN 13501-1. The pad material shall have a density of (900 ± 100) kg/m^3, unless specified otherwise in specific test standards. The insulation pads shall be cut to accommodate the thermocouple wires. If the thermocouple wires are soldered separately to the disc as shown in Figure 2, the slots may originate from opposite corners of the pad or from mid way along opposite edges. The measuring and recording equipment shall be capable of operating within the limits specified in 4.6.

In the case of non-planar surface of the test specimen, the disc and/or pad shall be deformed to follow the main surface profile. If there is difficulty in fixing the standard pad, the size of the pad may be reduced on two parallel sides subject to covering the disc.