

DIN EN 13381-3



ICS 13.220.50; 91.080.40

Supersedes
DIN V ENV 13381-3:2003-09**Test methods for determining the contribution to the fire resistance of structural members –****Part 3: Applied protection to concrete members;****English version EN 13381-3:2015,****English translation of DIN EN 13381-3:2015-06**

Prüfverfahren zur Bestimmung des Beitrages zum Feuerwiderstand von tragenden Bauteilen –

Teil 3: Brandschutzmaßnahmen für Betonbauteile;

Englische Fassung EN 13381-3:2015,

Englische Übersetzung von DIN EN 13381-3:2015-06

Méthodes d'essai pour déterminer la contribution à la résistance au feu des éléments de construction –

Partie 3: Protection appliquée aux éléments en béton;

Version anglaise EN 13381-3:2015,

Traduction anglaise de DIN EN 13381-3:2015-06

Document comprises 68 pages

Translation by DIN-Sprachendienst.

In case of doubt, the German-language original shall be considered authoritative.



A comma is used as the decimal marker.

National foreword

This document (EN 13381-3:2015) has been prepared by Technical Committee CEN/TC 127 “Fire safety in buildings” (Secretariat: BSI, United Kingdom).

The responsible German body involved in its preparation was the *DIN-Normenausschuss Bauwesen* (DIN Standards Committee Building and Civil Engineering), Working Committee NA 005-52-02 AA *Brandverhalten von Baustoffen und Bauteilen — Bauteile*.

Amendments

This standard differs from DIN V ENV 13381-3:2003-09 as follows:

- a) the prestandard status has been changed to that of a full standard;
- b) the standard has been editorially revised;
- c) Clause 1 “Scope” has been modified;
- d) Clause 3 “Terms and definitions” has been extended;
- e) Annex D (normative) “Calculation of stresses in standard concrete structures” has been added;
- f) Annex E (informative) “Calculation of the load to apply on concrete member” has been added;
- g) the bending moment has been modified to be adapted to the thickness of the slab;
- h) the location of the thermocouple used within beams for the calculation of equivalent thickness of concrete is now at 25 mm away from the beam bottom corner instead of 55 mm;
- i) the graphs to be used for the determination of equivalent concrete thickness for slabs have been improved and extended and are directly available in the standard.

Previous editions

DIN V ENV 13381-3: 2003-09

English Version

**Test methods for determining the contribution to the fire
resistance of structural members - Part 3: Applied protection to
concrete members**

Méthodes d'essai pour déterminer la contribution à la
résistance au feu des éléments de construction - Partie 3:
Protection appliquée aux éléments en béton

Prüfverfahren zur Bestimmung des Beitrages zum
Feuerwiderstand von tragenden Bauteilen - Teil 3:
Brandschutzmaßnahmen für Betonbauteile

This European Standard was approved by CEN on 8 November 2014.

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, Former Yugoslav Republic of Macedonia, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, 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: Avenue Marnix 17, B-1000 Brussels

Contents

Page

Foreword.....	5
1 Scope	7
2 Normative references	7
3 Terms and definitions, symbols and units.....	8
3.1 Terms and definitions	8
3.2 Symbols and units	9
4 Test equipment	10
4.1 General.....	10
4.2 Furnace	10
4.3 Loading equipment.....	10
5 Test conditions	10
5.1 General.....	10
5.2 Support and restraint conditions	11
5.2.1 Standard support and restraint conditions.....	11
5.2.2 Other support and restraint conditions.....	11
5.3 Loading conditions.....	11
6 Test specimens	12
6.1 Type and number of test specimens	12
6.1.1 Type of test specimens	12
6.1.2 Number of test specimens.....	12
6.2 Size of test specimens	13
6.2.1 Concrete slabs	13
6.2.2 Concrete beams	13
6.3 Construction of concrete test specimens	14
6.3.1 Concrete slab test members.....	14
6.3.2 Concrete beam test members	14
6.3.3 Fabrication of concrete test members	14
6.3.4 Application of fire protection material (except ceiling) to concrete test member	15
6.3.5 Installation of a ceiling below the concrete slab	15
6.4 Composition of test specimen component materials	16
6.4.1 Concrete	16
6.4.2 Steel reinforcement	16
6.4.3 Fire protection system	16
6.5 Properties of test materials	16
6.5.1 General.....	16
6.5.2 Concrete	16
6.5.3 Steel reinforcement	17
6.5.4 Fire protection materials	17
6.6 Verification of the test specimen	17
7 Installation of the test construction.....	18
7.1 Concrete large slab test specimens	18
7.2 Concrete small slab test specimens.....	18
7.3 Concrete beam test specimens.....	18
8 Conditioning.....	18

9	Application of instrumentation	19
9.1	General	19
9.2	Instrumentation for measurement of furnace temperature.....	19
9.2.1	Slab specimens	19
9.2.2	Beam specimens	19
9.3	Instrumentation for the measurement of test specimen temperature	19
9.3.1	General	19
9.3.2	Large and small concrete slab test specimens.....	20
9.3.3	Beams.....	20
9.3.4	Equivalent locations as referred to in 11.2 are:	21
9.4	Instrumentation for the measurement of pressure.....	22
9.5	Instrumentation for the measurement of deformation	22
9.6	Instrumentation for the measurement of applied load	22
10	Test procedure.....	22
10.1	General	22
10.2	Furnace temperature and pressure	22
10.3	Application and control of load	22
10.4	Temperature of test specimen	23
10.5	Deformation	23
10.6	Observations.....	23
10.7	Termination of test	23
11	Test results	23
11.1	Acceptability of test results	23
11.2	Presentation of test results	24
12	Test report.....	25
13	Assessment	25
13.1	General	25
13.2	Concrete slabs.....	26
13.3	Concrete beams.....	26
13.4	Insulation.....	27
13.5	Stickability.....	27
13.6	Equivalent thickness of concrete	27
14	Report of the assessment	27
15	Limits of applicability of the results of the assessment	28
16	Additional limits of applicability of the results of the assessment for suspended ceilings used as protection system	30
16.1	Height of the cavity	30
16.2	Exposed width of test specimen.....	30
16.3	Properties of the horizontal protective membrane	30
16.4	Size of panels within the horizontal protective membrane.....	30
16.5	Fixtures and fittings	30
16.6	Gaps between grid members and test frame or walls	31
Annex A (normative)	Test method to the smouldering fire or slow heating curve.....	44
A.1	Introduction.....	44
A.2	Evaluation of the results.....	44
Annex B (normative)	Measurement of properties of fire protection materials.....	46
B.1	General	46
B.2	Thickness of fire protection materials	46
B.3	Density of applied fire protection materials	47

B.3.1	General.....	47
B.4	Moisture content of applied fire protection materials.....	48
Annex C	(normative) Equivalent thickness of concrete.....	49
C.1	General.....	49
C.1.1	General.....	49
C.1.2	Equivalent thickness of concrete slabs - preliminary data collection	49
C.1.3	Equivalent thickness of concrete beams - preliminary data collection	49
C.2	Equivalent thickness of concrete slabs and beams - assessment methodology.....	50
Annex D	(normative) Calculation of stresses in standard concrete structures	58
D.1	General.....	58
D.2	Relevant concrete structures	58
D.3	Distribution of stresses across the section of the concrete structures	58
D.4	Mechanical study	59
D.4.1	Equilibrium of external forces	59
D.4.2	Determination of the position of the neutral axis (x)	59
D.4.3	Determination of the quadratic modulus	60
D.4.4	Determination of stresses in reinforcement bars and concrete	60
Annex E	(informative) Calculation of the load to apply on concrete member	63
E.1	Remind and scheme.....	63
E.2	Calculation of the force of the spring for a loaded beam	63
E.3	Calculation of the force of the spring for a loaded large slab	64
Bibliography	66

Foreword

This document (EN 13381-3:2015) 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 October 2015 and conflicting national standards shall be withdrawn at the latest by October 2015.

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

This document supersedes ENV 13381-3:2002.

This document has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association, and supports essential requirements of 89/106/EEC.

The dimension tolerances regarding the manufacturing of the specimen indicated in the ENV 13381-3:2002 led to tensile stress values of $290 \pm 30 \text{ N/mm}^2$ in the reinforcement bars depending on the type of structural member. In order to harmonize the mechanical constraint applied on the structural member, the bending moment has been modified to produce the same tensile stress on reinforcement bars equal to 300 N/mm^2 . This value is corresponding to 60 % of the grade of the steel to be used. Due to this approach, the result of tests carried out according to ENV 13381-3:2002 can be taken into account for assessment according to the present document.

In comparison with ENV 13381-3:2002, the following significant changes have been made:

- the bending moment has been modified to be adapted to the thickness of the slab;
- the location of thermocouple used within beams for the calculation of equivalent thickness of concrete is now at 25 mm away from the beam bottom corner instead of 55 mm;
- the graphs to be used for the determination of equivalent concrete thickness for slabs has been improved and extended and is directly available in the standard.

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. The other parts of this standard are:

- *Part 1: Horizontal protective membranes*
- *Part 2: Vertical protective membranes*
- *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 7: Applied protection to timber members*
- *Part 8: Applied reactive protection to steel members*

Annexes A, B and C are normative.