

Fire Behaviour of Building Materials and Building Components

Building Components Definitions, Requirements and Tests

DIN
4102
Part 2

Brandverhalten von Baustoffen und Bauteilen: Bauteile, Begriffe, Anforderungen und Prüfungen

This Standard has been prepared in the Special Section "Einheitliche Technische Baubestimmungen" (Mandatory Standards concerning Technical Building Regulations) of the Normenausschuss Bauwesen (Standards Committee for Building and Civil Engineering) (NABau). It has been recommended to the Chief Building Inspectorates by the Institut für Bautechnik (Institute for Building Technology), Berlin, for introduction in the building code procedure.

This Standard contains the basis for the definitions-by-test of the terms

"feuerhemmend" = fire retardant,

"feuerbeständig" = fire resistant and

"hochfeuerbeständig" = highly fire resistant.

It gives concrete form to the definitions for fire protection technology of the State (regional) Government Building Codes, the associated Implementation Orders and other legal orders and administrative orders concerning fire protection in buildings.

In conjunction with the revision of

DIN 4102 Part 2 Fire behaviour of building materials and building components; definitions, requirements and tests on building components

DIN 4102 Part 3 Fire behaviour of building materials and building components; definitions, requirements and tests on special building components

DIN 4102 Part 4 Fire behaviour of building materials and building components, allocation to definitions and the "Supplementary regulations for DIN 4102" — in each case February 1970 issue — the content of the Standard has also been rearranged:

DIN 4102 Part 1 Fire behaviour of building materials and building components; building materials; definitions, requirements and tests (formerly covered by the supplementary regulations mentioned above)

DIN 4102 Part 2 Fire behaviour of building materials and building components; building components; definitions, requirements and tests

DIN 4102 Part 3 Fire behaviour of building materials and building components; fire walls and non-load-bearing external walls; definitions, requirements and tests

DIN 4102 Part 4 Fire behaviour of building materials and building components; schedule and application of classified building materials, building components and special building components (at present circulating as draft)

DIN 4102 Part 5 Fire behaviour of building materials and building components; fire barriers, barriers in lift wells and glazings resistant against fire; definitions, requirements and tests

DIN 4102 Part 6 Fire behaviour of building materials and building components; ventilation ducts; definitions, requirements and tests

DIN 4102 Part 7 Fire behaviour of building materials and building components; roofings; definitions, requirements and tests

DIN 4102 Part 8 Fire behaviour of building materials and building components; small scale test furnace (at present circulating as draft)

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Dimensions in mm

1 Scope

This Standard lays down definitions, requirements and tests relating to fire protection technology for building components. Building components within the meaning of this Standard are walls, floors, columns, joists, staircases etc.

Components which have to meet special requirements relating to fire protection technology, such as fire walls, non-load-bearing external walls, fire barriers (doors, flaps, rolling shutters etc.), barriers in lift wells, glazings of fire resistance category G, ventilation ducts and roofings are dealt with in DIN 4102 Part 3 or Part 5 to Part 7 as regards definitions, requirements and tests.

2 Other relevant Standards

DIN 1025 Part 1	Steel sections; hot rolled I-beams; narrow flange I-beams, I range, dimensions, weights, permissible variations, static values
DIN 1025 Part 2	Steel sections; hot rolled I-beams, wide flange I-beams, IPB and IB range, dimensions, weights, permissible variations, static values
DIN 1025 Part 3	Steel sections; hot rolled I-beams; wide flange I-beams, lightweight type, IPBI range; dimensions, weights, permissible variations, static values
DIN 1025 Part 4	Steel sections; hot rolled I-beams; wide flange I-beams, heavy type, IPBv range, dimensions, weights, permissible variations, static values
DIN 1025 Part 5	Steel sections; hot rolled I-beams; medium flange I-beams, IPE range, dimensions, weights, permissible variations, static values
DIN 1045	Concrete and reinforced concrete structures; design and construction
DIN 1053 Part 1	Masonry; calculation and construction

DIN 4074 Part 1	Building timber for wood building components; quality conditions for converted building timber (soft-wood)
DIN 4102 Part 1	Fire behaviour of building materials and components; building materials; definitions, requirements and tests
DIN 4102 Part 4	Fire behaviour of building materials and components; allocation to definitions (February 1970 issue)
DIN 4102 Part 4	(at present circulating as draft) Fire behaviour of building materials and components; schedule and application of classified building materials, components and special components
DIN 4223	Reinforced roof and floor slabs of aerated concrete; directions for dimensioning, manufacture, use and test
DIN 14 200	Subsequent issue (at present circulating as draft) Water flow through nozzle orifices
DIN 43 710	Electrical temperature measuring instruments; thermo-voltages and materials for thermocouples
DIN 51 601	Liquid fuels; diesel fuel, minimum requirements
DIN 51 603 Part 1	Liquid fuels; oil fuels, oil fuel EL, minimum requirements
DIN 61 640	Surgical dressings; absorbent wadding for medical purposes
DIN 68 705 Part 3	Plywood; veneer boards for building, quality conditions
DIN 68 763	Chipboards; flat pressboard for the building industry; definitions, properties, testing, control

3 Definitions

The fire behaviour of building components is characterized by the fire resistance time and by other properties listed below.

The fire resistance time is the minimum time in minutes during which a component fulfils the requirements stated in Sections 5.2 to 5.6 in the test according to Section 6. Components are classified into the fire resistance categories according to Section 5 corresponding to their fire resistance time.

4 Proof of fire resistance categories

4.1 With fire tests

The fire resistance category of components must be proved by a test certificate on the basis of tests according to this Standard ¹⁾²⁾.

The criterion for classification in a fire resistance category is the least favourable result of tests on at least 2 test specimens.

4.2 Without fire tests

The components listed in DIN 4102 Part 4 are to be allocated to the fire resistance category indicated there without proof according to Section 4.1.

5 Fire resistance categories, requirements

5.1 General

The fire resistance categories stated in Table 1 are distinguished.

Table 1. Fire resistance categories F

Fire resistance category	Fire resistance time in minutes
F 30	≥ 30
F 60	≥ 60
F 90	≥ 90
F 120	≥ 120
F 180	≥ 180

5.2 Requirements to be met by components of fire resistance category F 30

5.2.1 Separating components must prevent the passage of fire during a test period of not less than 30 minutes. This requirement is deemed not to be fulfilled if, with the test furnace under the pressure described in Section 6.2.5, a pad of cotton wool held against the unexposed side in the test according to Section 6.2.6 is brought to ignition, or if flames occur on the unexposed side.

5.2.2 In the test according to Section 6.2.8, the unexposed side shall not undergo a temperature rise of more than 140 K an average above the initial temperature of the test specimen at the start of the test during a test period of not less than 30 minutes; at no measuring point shall a temperature rise of more than 180 K above the initial temperature occur.

5.2.3 Separating walls must in addition withstand the impact test according to Section 6.2.9 in such a manner that after a test period of not less than 30 minutes the requirements of Sections 5.2.1 and 5.2.2 remain fulfilled.

5.2.4 During a test period of not less than 30 minutes load-bearing components shall not fail under their permissible design load, nor non-load-bearing components under their dead load.

5.2.5 Load-bearing walls without separating function shall not fail during a test period of not less than 30 minutes under their permissible design load during a two-side fire attack according to Section 6.2.4. This applies in particular to parts of internal walls, internal walls with openings which are not closed by fire barriers of at least comparable fire resistance category, and to external walls up to 1.0 m wide.

5.2.6 In the case of simply supported components, which are stressed entirely or predominantly in bending, the rate of deflection shall not exceed the value.

$$\frac{\Delta f}{\Delta t} = \frac{l^2}{9000 \cdot h}$$

during a test period of not less than 30 minutes.

Wherein

l Span in cm

h Static height in cm

Δf Change in deflection in cm during a time interval Δt of one minute

Δt Time interval of one minute

$\Delta f / \Delta t$ Rate of deflection in cm/min

5.2.7 In the case of steel columns which cannot be tested under their design load, the temperature of steel shall not exceed 500 °C at any measuring point.

5.2.8 Components with claddings intended to improve the fire resistance time must fulfil the requirements according to Sections 5.2.1 to 5.2.7 in this connection. This applies in particular to components with suspended ceilings, claddings, facing shells and coatings ¹⁾.

If claddings which are unventilated at the rear are tested in conjunction with the standard designs mentioned in Section 7 and if the overall construction fulfils the requirements according to Section 5.2.1 to 5.2.7, then the necessary proof with such cladding including the type of fixing is also deemed to be furnished for all other designs using the same type of component (see Sections 7.2.2, 7.2.3 etc.).

¹⁾ The fitness of coatings, films and similar protective layers which are applied internally on the surface or in the joints of building components and which are only rendered effective by thermal stressing (e.g. intumescent coatings) and of plaster renderings which are necessary for fire protection technology and which are not retained on the component by a suitable backing (e.g. ribbed expanded metal or woven wire cloth) cannot be assessed solely according to this Standard; further proofs have to be provided (e.g. in the context of the granting of a general "bauaufsichtliche Zulassung" (building code licence)).

²⁾ If the room situated below a suspended ceiling is required to meet the requirements of escape routes and if such room is bounded by walls reaching to the suspended ceiling which are not dimensioned according to DIN 1053 Part 1 or DIN 1045, then the fitness of the components bounding the escape route cannot be assessed solely according to this Standard; further proofs have to be furnished (e.g. in the context of the granting of a general "bauaufsichtliche Zulassung").

For the assessment of

- a) designs with claddings ventilated at the rear and
- b) Suspended ceilings in conjunction with steel plate floors — also with a covering of concrete or lightweight insulating building materials —

Section 7 is not applicable; instead, standard tests with the intended type of design are to be carried out.

Suspended ceilings which are to be classified for themselves alone must, inclusive of their fixing, fulfil the requirements of separating floors according to Sections 5.2.1, 5.2.2 and 5.2.4.

5.3 Requirements to be met by components of fire resistance category F 60

For classification according to definition into fire resistance category F 60, building components must fulfil the requirements according to Section 5.2 during a test period of not less than 60 minutes in conformity with their function.

5.4 Requirements to be met by components of fire resistance category F 90

5.4.1 For classification according to definition into fire resistance category F 90, the components must fulfil the requirements according to Section 5.2 during a test period of not less than 90 minutes in conformity with their function.

5.4.2 In the case of columns with claddings a test specimen must withstand a hose stream test according to Section 6.2.10 immediately after a fire test. This must be accomplished without causing the load-bearing steel parts or the vertical reinforcing bars with their stirrups and tie wire to be exposed in a manner which threatens danger.

5.5 Requirements to be met by components of fire resistance category F 120

For classification according to definition into fire resistance category F 120, building components must fulfil the requirements for components of fire resistance category F 90 during a test period of not less than 120 minutes in conformity with their function.

5.6 Requirements to be met by components of fire resistance category F 180

For classification according to definition into fire resistance category F 180, building components must fulfil the requirements for components of fire resistance category F 90 during a test period of not less than 180 minutes in conformity with their function.

6 Testing of building components

6.1 Test equipment and test specimens

The test equipment shall be located in closed rooms. For the tests at least 2 test specimens of like kind are to be subjected to the test.

In their dimensions, design, material, type of execution and manner of installation the test specimens shall correspond with practical application. Components which cannot be tested in the dimensions used in practical application must be exposed to the fire in at least the following dimensions:

Walls (width x height)	2.0 m x 2.5 m
One-way floor structures: (width x length)	2.0 m x 4.0 m

Two-way floor structures:	4.0 m x 4.0 m
Staircases: in the intended width and	4.0 m length
Beams and joists:	4.0 m (length)
Columns and piers:	3.0 m (height)

If components subject to bending or bending combined with longitudinal loading cannot be tested under the theoretically stipulated design load, a reference element with capability of being tested shall be prepared for the test.

6.2 Test procedure

6.2.1 Time for performance of fire tests

The test specimens shall not be tested until the strength on which the static calculation has been based is attained and the elimination of water has been completed. To ensure this, the test specimens are to be stored under conditions appropriate to the structure concerned until attainment of the equilibrium moisture content. Components made of materials the moisture content of which fluctuates widely should preferably be stored in closed rooms at 50 to 70 % relative humidity and approx. 20 °C. If necessary, the test specimens should be weighed at intervals during the drying-out process until the weight stays the same on five successive days.

When large, non-weighable components are concerned, reference elements are to be prepared or cut out and these stored in the same way as the test specimens. At these test specimens the amount of drying-out is then determined. In the direction of heat transmission the reference elements shall have the dimensions of the test specimen and in the directions perpendicular thereto are to be so reduced in size as to yield weighable elements. They are to be covered with material impermeable to water and water vapour in such a manner that they can only dry out on those surfaces which correspond with the area attacked by the fire, or the non-exposed surface. If the prescribed checking of drying-out is not practicable, the test specimens shall not be subjected to the fire tests before the following periods have elapsed

- when lightweight concrete is used not until an age of 200 days has been reached,
- when standard concrete is used not until an age of 100 days has been reached
- and
- when claddings with hydraulic binders are used not until an age of 30 days has been reached.

6.2.2 Selection of test specimens and stressing

6.2.2.1 Where different types of execution or identical execution in different dimensions are involved, the test specimen to be tested shall be the least favourable one as stated by the test station.

6.2.2.2 Components and components with claddings are to be tested in conformity with practice complete with their structural joints.

In the case of walls, the test specimens must have at least two vertical joints according to Fig. 1. If for practical use horizontal joints are also envisaged, the test specimens must contain at least one horizontal joint also according to Fig. 2.