Brandteknisk provning av byggnadsdelar –
Bidrag till brandmotstånd –
Del 1: Horisontellt skyddande skikt

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

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

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Foreword

This Technical Specification (CEN/TS 13381-1:2005) has been prepared by Technical Committee CEN/TC 127 “Fire safety in buildings”, the secretariat of which is held by BSI.

This Technical Specification has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association, and supports essential requirements of the Construction Products Directive. As there was little experience in carrying out these tests in Europe, CEN/TC127 agreed that more experience should be built up during a pre-standardization period before agreeing text as European Standards. Consequently all other Parts are being prepared as European Prestandards.

This Technical Specification 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 ENV are:

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 7: Applied protection to timber members.

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 should be given in national regulations.

Annexes A and B are normative.

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 European Technical Specification should be followed.

WARNING: When performing this test method, laboratories should expect that there may 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.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to announce this CEN Technical Specification: Austria, Belgium, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Slovakia, Slovenia, Spain, Sweden, Switzerland and United Kingdom.
1 Scope

This Part of this European Prestandard 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 horizontal structural building members.

This European Technical Specification 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 to the side which would be exposed in practice and 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.

A related test method for determining the contribution to the fire protection of vertical structural members by vertical protective membranes is given in Part 2 of this ENV.

This European Technical Specification 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.

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 European Technical Specification 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 ENV 13381-3, ENV 13381-4 or ENV 13381-5, as appropriate, apply.

Tests shall 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 referenced documents are indispensable for the application 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, Fire resistance tests — Part 1: General requirements

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


3 Terms and definitions, symbols and units

3.1 Terms and definitions

For the purposes of this European Technical Specification, the terms and definitions given in EN 1363-1, EN ISO 13943 and ISO 8421-2 and the following apply:

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
any horizontal membrane or ceiling lining plus 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

The horizontal protective membrane does not form any part of any loadbearing part of the structure and can comprise multiple layers of materials

3.1.3 separating gap
distance between the uppermost surface of the horizontal protective membrane and the lowest surface of the underside of the structural building member

3.1.4 cavity
whole void or voids between the uppermost surface of the horizontal protective membrane and the highest surface of the underside 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

3.2 Symbols and units

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Unit</th>
<th>Designation</th>
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<tbody>
<tr>
<td>( L_{\text{exp}} )</td>
<td>mm</td>
<td>Length of the structural building member, plus the horizontal protective membrane, which is exposed to the furnace.</td>
</tr>
<tr>
<td>( L_{\text{sup}} )</td>
<td>mm</td>
<td>Centre to centre distance between the supports of the structural building member tested.</td>
</tr>
<tr>
<td>( L_{\text{spec}} )</td>
<td>mm</td>
<td>Total length of the main beams or members of the structural building member.</td>
</tr>
<tr>
<td>( A_{m/V} )</td>
<td>m(^{-1})</td>
<td>Section factor of unprotected steel beam (see ENV 13381-4).</td>
</tr>
</tbody>
</table>

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 mean 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 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.

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 ($\gamma_m$) equal to 1,0.

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

Point loads shall be transferred to the test specimen, along the two transverse loading lines, through load distribution beams or plates, see Figures 1 and 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.

6 Test specimens

6.1 General

One test specimen shall normally be required.

Horizontal protective membranes suspended from the structural building member by hangers or similar fixings or attached to the structural building member by a framework structure, would typically be:

— 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.

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.

Alternatively the actual structural building member to be used in practice may be used, however the application of the result shall be restricted to that member only.

Where a horizontal protective membrane is manufactured with elements or components of variable size or may be installed by different procedures, then a unique test shall be carried out on elements or components at maximum and minimum sizes. 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 ducts and access panels expected to be installed, should be included in the test specimen. The installation and frequency of use of these should 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 specimen and not at its perimeter.

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 \( (L_{\text{exp}}) \) : at least 4 000 mm
b) span \( (L_{\text{sup}}) \) : \( L_{\text{exp}} \) plus up to 200 mm maximum at each end
c) length \( (L_{\text{spec}}) \) : \( L_{\text{exp}} \) plus up to 350 mm at each end
d) exposed width : at least 3 000 mm