National Standards Authority of Ireland

IRISH STANDARD

I.S. EN 1364-2:2000

ICS 13.220.50

FIRE RESISTANCE TESTS FOR NON-LOADBEARING ELEMENTS - PART 2: CEILINGS

National Standards
Authority of Ireland
Dublin 9
Ireland

Tel: (01) 807 3800
Tel: (01) 807 3838

This Irish Standard was published under the authority of the National Standards Authority of Ireland and comes into effect on. March 17, 2000

Price Code H

Údarás um Chaighdeáin Náisiúnta na hÉireann

EUROPEAN STANDARD
NORME EUROPÉENNE
EUROPÄISCHE NORM

EN 1364-2

August 1999

ICS 13.220.50

English version

Fire resistance tests for non-loadbearing elements - Part 2: Ceilings

Essais de résistance au feu des éléments non porteurs - Partie 2: Plafonds

Feuerwiderstandsprüfungen für nichttragende Bauteile - Teil 2: Unterdecken

This European Standard was approved by CEN on 18 February 1999.

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 Central Secretariat 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 Central Secretariat has the same status as the official versions.

CEN members are the national standards bodies of Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and United Kingdom.

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

Central Secretariat: rue de Stassart, 36 B-1050 Brussels

Ref. No. EN 1364-2:1999 E

Contents **Page**

Foreword

This European Standard 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of an identical text or by endorsement, at the latest by February 2000, and conflicting national standards shall be withdrawn at the latest by February 2000.

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

This European Standard 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.

EN 1364 'Fire resistance tests for non-loadbearing elements' consists of the following

Part 1: Walls

Part 2: Ceilings

Part 3: Curtain walls - full configuration (in course of preparation)

Part 4: Curtain walls - part configuration (in course of preparation)

Introduction

Testing of ceilings is carried out in two modes:

a) with fire from below the ceiling, with no cavity above, or

b) with fire from above the ceiling where the fire is contained in a closed cavity.

Caution

The attention of all persons concerned with managing and carrying out this fire resistance test is drawn to the fact that fire testing may be hazardous and that there is a possibility that toxic and/or harmful smoke and gases may be evolved during the test. Mechanical and operational hazards may 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 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.

Safety note: Monitoring for integrity by the cotton pad or other means and insulation by use of the roving thermocouple from above a test specimen (in the case of fire from below) or within a void beneath a fire test specimen (in the case of fire from above) can be hazardous unless the risks associated with these practices are considered and appropriate precautions taken to protect operators from radiation, smoke, hot gases and from contact with furnace flame.

Operators shall not reach over the test specimen (in the case of fire from below) or enter the void beneath a test specimen (in the case of fire from above) to carry out inspection tests of any type during the test.

1 Scope

This part of EN1364 specifies a method for determining the fire resistance of ceilings, which in themselves possess fire resistance independent of any building element above them. This Standard is used in conjunction with EN 1363-1.

The method is applicable to ceilings, which are either suspended by hangers or fixed directly to a supporting frame or construction, and to self supporting ceilings.

Within this test method, the ceiling is exposed to fire, with the exposure being applied either:

a) from below the ceiling, or

b) from above the ceiling to simulate fire within the cavity above the ceiling.

The contribution to fire resistance which a suspended ceiling may provide as a protective membrane to loadbearing elements is determined using a procedure which will be given in an ENV in preparation.

2 Normative references

This European Standard incorporates by dated or undated reference provisions from other publications. These normative references are cited at the appropriate places in the text and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this standard only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies.

EN 1363-1	Fire resistance tests Part 1: General requirements
EN 1363-2	Fire resistance tests Part 2: Alternative and additional procedures
prEN ISO 13943	Fire safety - Vocabulary (ISO/DIS 13943:1998)

3 Definitions

For the purposes of this Part of EN 1364 the definitions given in EN 1363-1 and prEN ISO 13943, together with the following, apply:

3.1 ceiling: A non-loadbearing element of a building construction designed to provide horizontal fire separation.

3.2 self-supporting ceiling: A ceiling with a span from wall to wall, without any additional suspension devices.

3.3 suspended ceiling: A ceiling which is suspended from a supporting construction.

3.4 cavity: The space between the upper surface of the ceiling and the underside of any floor, roof or its supporting construction.

3.5 test specimen: The full ceiling specimen submitted for test, including hangers, fittings, insulating materials and features such as lighting, ventilation and access and inspection panels.

3.6 standard supporting construction: A horizontal loadbearing construction to which a suspended ceiling is attached for the test.

3.7 fittings: All devices penetrating the ceiling, e.g lighting and ventilation systems not otherwise covered by a specific fire test.

4 Test equipment

The test equipment shall be as specified in EN 1363-1 or, if appropriate, EN 1363-2.

5 Test conditions

The heating and pressure conditions and the furnace atmosphere shall conform to those given in EN 1363–1 or, if applicable, EN 1363-2.

6 Test specimen

6.1 Size

6.1.1 Self-supporting ceilings exposed to fire from below or from above

When the ceiling in practice is equal to or greater than the size of the furnace opening, then it shall be tested at a size of at least (4 x 3) m. The span of the ceiling shall be in the direction of the larger dimension. (see also 6.3.2).

When the ceiling in practice is smaller than (4 x 3) m, in either direction, then it shall be tested full size and the furnace aperture shall be provided with closures of adequate fire resistance around the extremities of the test specimen.

6.1.2 Suspended ceilings exposed to fire from below and above

The test specimen shall be of size such that at least (4 x 3) m is exposed to the furnace conditions. The direction of the main components (see 6.3.2) shall be in the direction of the larger dimension.

When the ceiling in practice is smaller than (4 x 3) m, in either direction, then it shall be tested full size and the furnace aperture shall be provided with closures of adequate fire resistance around the extremities of the test specimen.

6.2 Number

A single test specimen shall be tested unless the most onerous test configuration, identified in 6.3.2, cannot be defined, in which case separate tests shall be carried out for each configuration.

6.3 Design

6.3.1 General

The test specimen shall be fully representative of the ceiling intended for use in practice. It shall model the edges between the ceiling and walls, the joints and jointing materials to be used in practice. It shall be designed to be mounted only from below.

The test specimen shall include any appropriate fittings which are an essential part of the specimen and may influence its behaviour in test.

Where fixtures and fittings do not form an integral part of the ceiling but may be fitted subsequently in a manner that may affect the fire resistance of the ceiling, then these shall be the subject of a separate full size test incorporating those fittings.

When the ceiling design includes both longitudinal and transverse joints, the test specimen shall include both such joints.

6.3.2 Orientation

If the longitudinal and transverse directions of the ceiling are constructed differently, the performance of the test specimen may vary depending upon the direction aligned with the longitudinal axis. The specimen shall be designed 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.

6.3.3 Support conditions

The following support conditions for the ceilings are specified and shall be followed unless the sponsor requests otherwise. In this case the differing support conditions shall be described in the test report and the validity of the results shall be restricted accordingly.

Cavity barriers incorporated as a part of the test specimen are allowed.

When the test specimen is full size in both directions, it shall be fixed as in practice. When it is smaller in one or both directions than in practice the following support conditions shall apply:

a) for a self supporting ceiling, there shall be one free edge which shall be in the direction of the main supporting member. There shall be no allowance made for longitudinal movement of the edges or thermal expansion in either direction, other than that provided for in the ceiling system.

b) for a suspended ceiling, with fire from below, all edges shall be fixed to the specimen support frame without any allowance for longitudinal movement of the edges or thermal expansion in either direction, other than that provided for within the ceiling system.

c) for a suspended ceiling, with fire from above, two adjacent edges shall be fixed to the specimen support frame without any allowance for longitudinal movement of the edges or thermal expansion in either direction other than that provided for within the ceiling system. No gap around the specimen is allowed on the four edges.

6.4 Construction

The test specimen shall be constructed as described in EN 1363-1.

6.5 Verification

Verification of the test specimen shall be carried out as described in EN 1363-1.

7 Installation of test specimen

7.1 General

The test specimen shall be installed as far as possible in a manner representative of its use in practice. It shall be mounted from below without access from above, and be installed by the same method and procedures recommended in the installation manual which shall be provided by the sponsor.

The test specimen shall be mounted in a test frame or furnace to prohibit thermal elongation. Grid members shall be tightly fitted to a test frame or furnace walls in order that the thermal expansion behaviour of grid members and expansion devices may be correctly evaluated.

Profiles bearing the various components or panels of the ceiling 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 shall be representative of practice and shall be installed within the test specimen and not at its perimeter.

Provisions for sealing the furnace shall be made when the test specimen is smaller than the furnace aperture.

7.2 Standard supporting construction

7.2.1 General

The test specimen shall be installed using a standard supporting construction according to the fire exposure conditions being evaluated as follows:

7.2.2 Exposure to fire from below

The test specimen shall be open to the laboratory on its upper face (see figure 1).

For suspended ceilings, these shall be supported by steel beams, IPE 140 or equivalent which shall be of sufficient length to provide an exposed length of at least 4 m. The supported length (span) shall be the exposed length plus up to half the width of the bearing.

7.2.3 Exposure to fire from above

The upper fire compartment closure shall form a cavity of height of 1,5 m to 2 m.

For a self supporting ceiling, an unloaded fire compartment closure satisfying the specifications for furnace linings, for example, aerated concrete slabs with a thickness of approximately 120 mm, as shown in figure 2, shall be used to close the furnace.

For a suspended ceiling, the fire compartment closure and supporting construction, as shown in figure 3, shall comprise aerated concrete slabs with a thickness of approximately 120 mm density (650 ± 200) Kg/m^3, supported by two steel beams, 2 m apart and no closer than 500 mm to the edge, of type IPE 140 or equivalent, with an exposed length of at least 4 m. The fire resistance of the concrete slabs and steel beams shall be not less than the anticipated fire resistance of the ceiling under test, nor not greater than 30 mins above the anticipated fire resistance of the ceiling under test. For further information on loading see 10.1.

8 *Conditioning*

All components and materials of the test construction shall be conditioned as specified in EN 1363-1.

9 Application of instrumentation

9.1 Thermocouples

9.1.1 Furnace thermocouples (plate thermometers)

Plate thermometers shall be provided in accordance with EN 1363-1. There shall be at least one for every 1,5 m^2 of the exposed surface area of the test construction. The plate thermometers shall be oriented so that side 'A' faces the floor of the furnace in the case of fire from below. Plate thermometers shall be oriented so side 'A' faces the standard supporting construction in the case of fire from above.

For test specimens with less than 6 m^2 exposed area, a minimum of four plate thermometers shall be used.

9.1.2 Unexposed surface thermocouples

9.1.2.1 Average temperature

Five thermocouples shall be evenly distributed over the test specimen to monitor the average temperature of the unexposed surface of the ceiling. They shall be placed with one in the centre of the ceiling and one at the centre of each quarter section.

When testing corrugated or ribbed ceiling constructions the number of thermocouples on the unexposed face shall be increased to six to provide an equal number at points of maximum and minimum ceiling thickness.

Thermocouples for determination of average unexposed face temperature shall avoid features, e.g. hotspots, by at least 50 mm. Examples of these are thermal bridges, joints, junctions and through connections and fixings such as bolts, screws etc.

When fibrous or resilient thermal insulation materials are included on the upper surface of the ceiling, as part of the ceiling specification, then in the case of fire exposure from below thermocouples shall be placed on top of that thermal insulation material using thermocouple weights. These shall not reduce the thickness of the thermal insulation material by more than 10%. An example of a suitable thermocouple weight is shown in figure 4.

9.1.2.2 Maximum temperature

Thermocouples shall be used for determining the maximum temperature rise on the unexposed face of the ceiling at locations where higher temperatures might be expected, e.g joints or metal fittings etc. The use of the roving thermocouple needs precautions for safety reasons (see Introduction).

When fibrous or resilient thermal insulation materials are included on the upper surface of the ceiling, as part of the ceiling specification, then in the case of fire exposure from below thermocouples shall be placed on top of that thermal insulation material using thermocouple weights. These shall not reduce the thickness of the thermal insulation material by more than 10%. An example of a suitable thermocouple weight is shown in figure 4.

9.2 Pressure

Pressure within the furnace shall be measured as described in EN 1363-1.

9.3 Deflection (exposure to fire from above only)

Deflection measurements of the supporting construction shall be made as described in EN 1363-1. The deflection sensing device shall be located at the anticipated point of maximum deflection. Where this point cannot be determined, measurements shall be taken at more than one point.

10 Test procedure

10.1 Application of load (suspended ceilings with fire from above)

This supporting construction may require loading to simulate the maximum design stress of the supporting construction.

Note: Details of the loading which may be applied to the supporting construction is given in an ENV under preparation (contribution to fire resistance of protective membranes).

10.2 Fire test

Carry out the test using the equipment and procedures in accordance with EN 1363-1 and if appropriate, EN 1363-2.

10.3 Pressure control

In the case of fire from below, measure and control the furnace pressure as specified in EN 1363-1.

In the case of fire from above, measure and control the furnace pressure 100 mm above the ceiling as specified in EN 1363-1 at a value of (10 ± 2) Pa above that in the void beneath the ceiling.

10.4 Deflection

Observe the deflection of the suspended ceiling (fire from below) and monitor the deflection of the supporting construction (fire from above) as specified in EN 1363-1.

10.5 Integrity

Monitor the unexposed face of the ceiling for integrity only by the cotton pad and sustained flaming method in accordance with EN 1363-1. For practical and safety reasons it is not possible to use gap gauges to evaluate integrity and visual assessment shall be used.

Safety note: Precautions shall be taken to protect operators from the effects of heat, flames and smoke, especially if degradation of the ceiling during the test results in its partial or total collapse. Operators shall not lean over the test specimen when carrying out this test, in the case of fire from below. In the case of fire from above, operators shall not enter the void beneath the ceiling during the test.

10.6 Insulation

Measure and record the temperature rise of the unexposed face of the ceiling for insulation according to EN 1363-1 using the thermocouples specified in 9.1.2.1 and 9.1.2.2.

Safety note: The use of the roving thermocouple may not be possible for safety reasons. Operators shall not lean over the test specimen to carry out this test with fire from below, and shall not enter the void beneath the ceiling with fire from above.

10.7 Observations during the test

Make observations of the behaviour of the specimen in accordance with EN 1363-1. For tests with exposure to fire from above special attention shall be given to the observation and reporting of gaps, partial collapse of the ceiling and smoke in the void beneath the ceiling.

Safety note: Precautions shall be taken to protect operators whilst making such observations from the effects of heat and smoke, especially if degradation of the ceiling during the test results in its partial or total collapse. Operators shall not enter the void beneath the ceiling during the test.

11 Performance criteria

11.1 General

The performance of the ceiling shall be judged against the following performance criteria.

11.2 Integrity

11.2.1 Fire from below

The criteria by which the integrity performance of the test specimen is judged are given in EN 1363-1, except that gap gauges shall not be used.

11.2.2 Fire from above

The ceiling shall be deemed to fail the criterion for integrity when exposed to a standard fire from above, when visible openings or flames are observed along the unexposed surface of the ceiling. Such openings or deterioration shall be judged as

a) being when a component of the ceiling has fallen down or where an edge of a component has left its supporting profile element.

b) the formation of gaps visually assessed as being equivalent to those measured by the gap gauges as described in EN 1363-1.

11.3 Thermal insulation

The ceiling shall be deemed to fail the criterion of thermal insulation if the limits as defined in EN 1363-1 are exceeded.

12 Test report

In addition to the items required by EN 1363-1, the following shall also be included in the test report

a) reference that the test was carried out in accordance with EN 1364-2.

13 Field of direct application of test results

13.1 General

The applicability of the test results shall be restricted to other constructions where the installation of the ceiling is carried out from below.

13.2 Self-supporting ceilings exposed to fire from below or from above

13.2.1 Size

a) For ceilings where both length and width are less than (4 x 3) m, and which were tested at full size, the results may be applied to ceilings of the same size or less than that tested.

b) For ceilings of full size span less than 4 m but of width equal to or greater than 3 m (tested at full size span and 3 m width) and in which the most onerous direction lies in the 4 m direction of the furnace, the results may be applied to ceilings of the same span or less than that tested. There shall be no restriction on application of the result in the width direction. The provisions with

respect to most onerous configuration as given in 6.3.2 shall be followed in the direct application of results.

c) For ceilings of full size span greater than or equal to 4 m but of width less than 3 m (tested at 4 m span and full size width) and in which the most onerous direction lies in the 4 m direction of the furnace, the results may be applied to ceilings up to 4.4 m long. The width is restricted to equal or less than that tested. The provisions with respect to most onerous configuration as given in 6.3.2 shall be followed in the direct application of results.

d) For ceilings where both length and width are greater than or equal to (4 x 3) m in practice, and which were tested at (4 x 3) m size, and in which the most onerous direction lies in the 4 m direction of the furnace, the results may be applied to ceilings up to 4.4 m long. There shall be no restriction on application of the result in the width direction. The provisions with respect to most onerous configuration as given in 6.3.2 shall be followed in the direct application of results.

13.2.2 Fittings

Fittings which may be installed are those which have been included in the test specimen, with a distribution per unit area not greater than that tested.

13.2.3 Cavities above self supporting ceilings exposed to fire from below

The test results are valid for cavities of any height.

13.3 Suspended ceilings with fire from below

13.3.1 Size

Test results obtained on a (4 x 3) m, or greater, test specimen may be applied to ceilings of any dimension, provided that the distance between the suspension devices is not increased, and that provisions for expansion are increased accordingly.

13.3.2 Fittings

Test results on ceilings containing fittings with their own suspension devices may be applied to ceilings containing such suspension devices provided the distribution does not exceed those tested.

13.3.3 Cavity

The test results are valid for cavities of any height.

13.4 Suspended ceilings with fire from above

13.4.1 Size

Test results obtained on a (4 x 3) m, or greater, test specimen, may be applied to ceilings of any dimension, provided that the distribution of the hangers is not reduced, i.e the distance between hangers. The span of grid elements and the load on the hanger, shall not be increased.

13.4.2 Length of supporting hangers

The test results are applicable to ceilings suspended by steel hangers of length less than, or equal to, that tested.

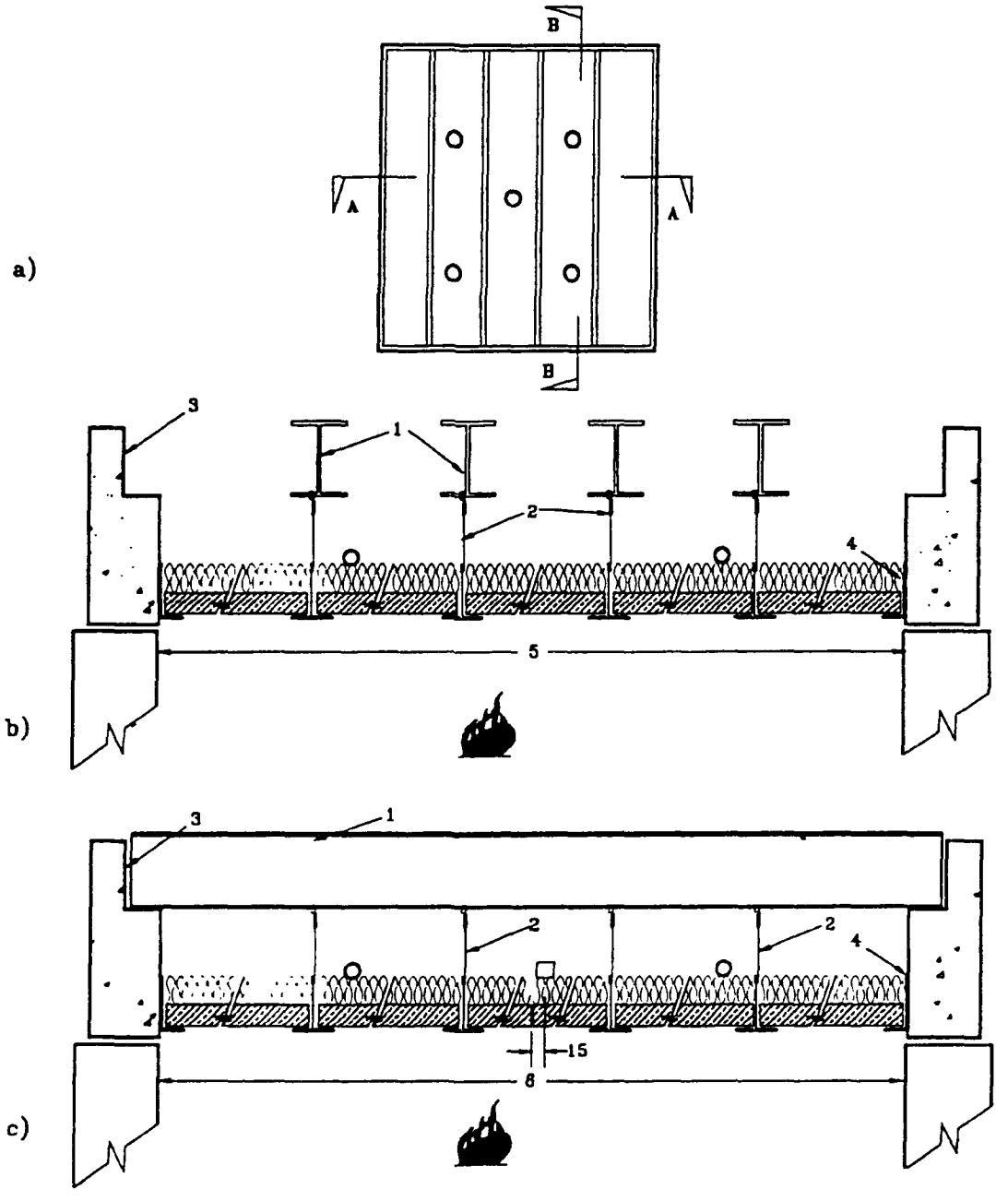
13.4.3 Supporting construction with fire from above

The test results are considered valid for all supporting constructions having a resistance to fire greater than, or equal to, that of the test specimen, i.e slabs with density and/or thickness equal or greater than tested, and to any steel beams having a lower section factor and at least the same fire protection.

13.4.4 Cables, pipes etc above the ceiling

The test results are only applicable to the inclusion of cables, pipes etc above the ceiling provided they are installed in such a manner that they give no additional load to the ceilings during the fire.

Dimensions in mm

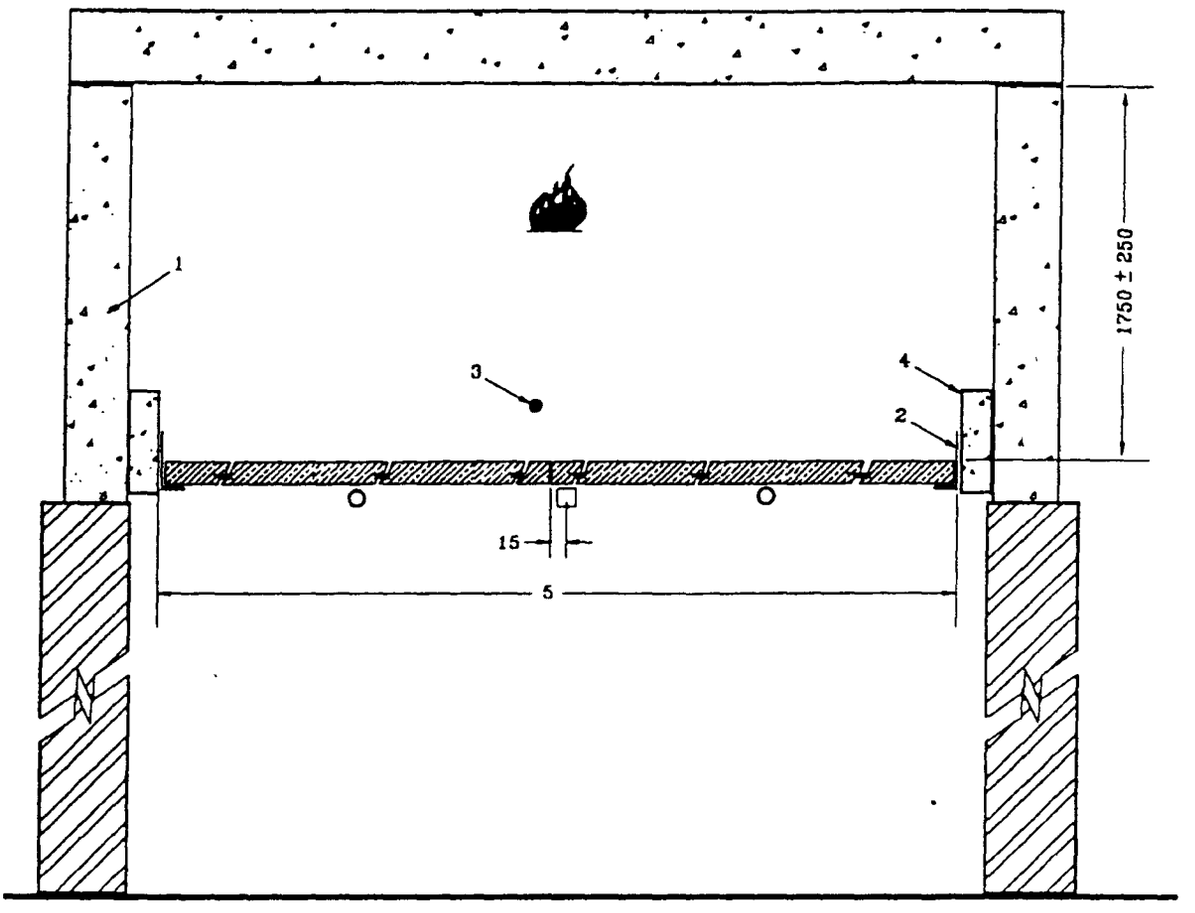


○	thermocouple for average temperature rise
□	thermocouple for maximum temperature rise

a)	plan
b)	section at 'A' 'A'
c)	section at 'B' 'B'
1	steel beam
2	steel suspension device
3	test frame
4	specimen edge support (fixed as in practice)
5	exposed width 3m (or full size if <3 m)
6	exposed length 4m (or full size if < 4 m)

Figure 1: Example of ceiling exposed to fire from below suspended (illustrated) or self supporting

Dimensions in mm

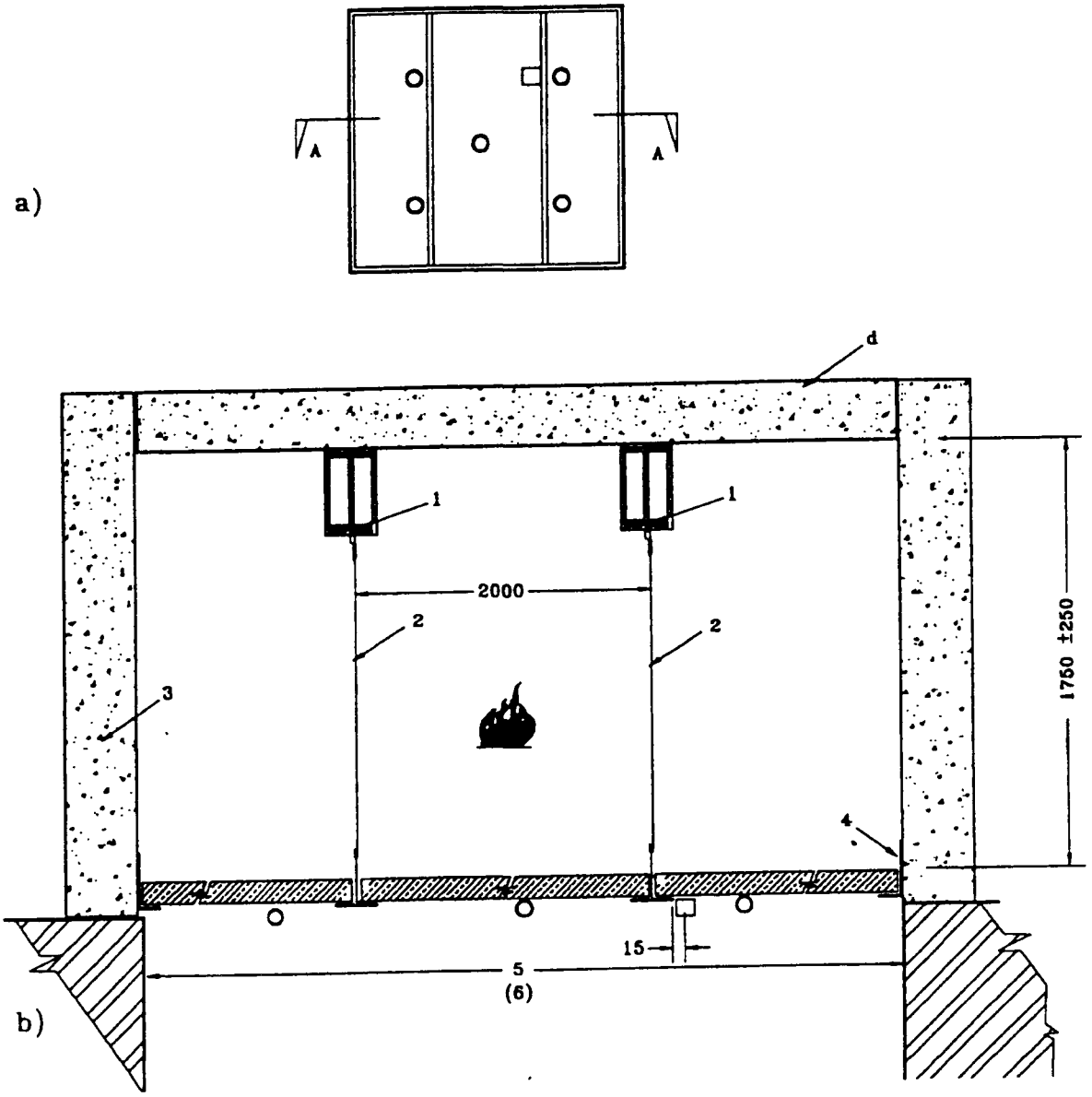


○	thermocouple for average temperature rise
□	thermocouple for maximum temperature rise

1	aerated concrete slab (120 mm thick)
2	specimen edge support
3	pressure measuring sensor
4	test frame
5	exposed length 4 m (or full size if < 4 m) exposed width 3 m (or full size if < 3 m)

Figure 2: Example of self supporting ceiling exposed to fire from above

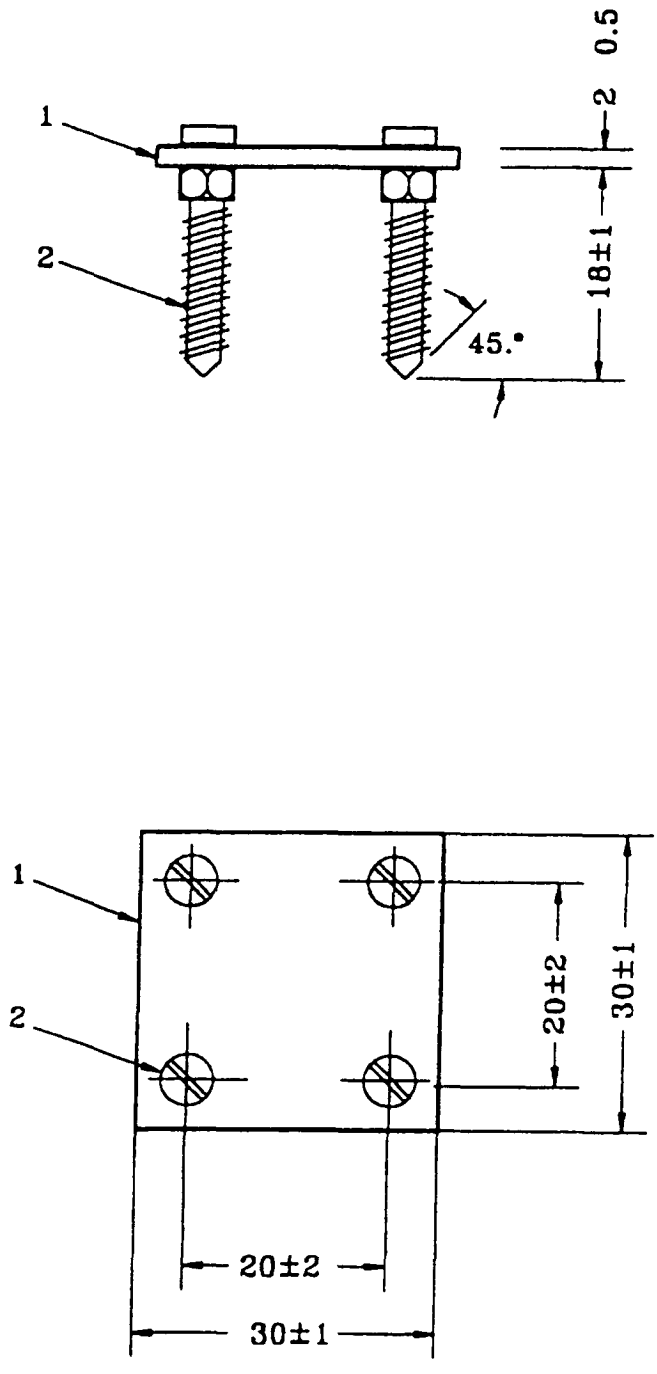
Dimensions in mm



o	thermocouple for average temperature rise-
□	thermocouple for maximum temperature rise
a)	plan from below
b)	section at 'A' 'A'
1	steel beam of an exposed length of at least 4 m
2	steel suspension device
3	aerated concrete slab (~ 120 mm thick)
4	specimen edge support (fixed as in practice)
5	exposed width 3 m (or full size if < 3 m)
(6)	exposed length 4 m (or full size if < 4 m)

Figure 3: Example of suspended ceiling exposed to fire from above

Dimensions in mm



1 steel sheet
2 M3 x 20 mm screw

Figure 4: Examples of thermocouple weight for resilient materials