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BSI Standards Publication

Fire resistance tests for non-loadbearing elements

Part 4: Curtain walling — Part configuration

National foreword

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EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
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CEN-CENELEC Management Centre: Avenue Marnix 17, B-1000 Brussels

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Foreword

This document (EN 1364-4:2014) 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of an identical text or by endorsement, at the latest by August 2014, and conflicting national standards shall be withdrawn at the latest by August 2014.

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 EN 1364 −4:2007.

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.

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, 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 the United Kingdom.

Introduction

WARNING

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 developed during the test. Mechanical and operational hazards can 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 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.

1 Scope

This European Standard specifies a method for determining the fire resistance of parts of curtain walling and of the perimeter seal. It examines the fire resistance to internal and external fire exposure of:

— the spandrel panel, i.e. downstand, upstand or a combination thereof, or

— the perimeter seal, or

— the fixing of the framing system (anchoring) used to attach the curtain walling to the floor element, or

— combinations thereof.

Results from tests according to this standard form the basis for classification of curtain walling type A (see 3.3 for definition).

For curtain walling type B (see 3.4 for definition) results may be used to determine fire resistance of parts of a curtain walling to increase the field of application when previously tested to EN 1364-3. For intended classification EW and for corner/faceted specimens EN 1364-3 should be used.

This European Standard does not cover double skin façades, over-cladding systems and ventilated façade systems on external walls. It does not deal with the reaction to fire behaviour of curtain walling.

This standard is intended to be read in conjunction with EN 1363-1 and EN 1363-2 as well as EN 1364-3 for curtain walling type B.

NOTE Annex A gives informative guidance on the principles of testing parts of curtain walling and the test method.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. 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 1363-2, *Fire resistance tests - Part 2: Alternative and additional procedures*

EN 1364-3, *Fire resistance tests for non-loadbearing elements - Part 3: Curtain walling - Full configuration (complete assembly)*

EN 13119, *Curtain walling - Terminology*

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

EN 13501-2, *Fire classification of construction products and building elements — Part 2: Classification using data from fire resistance tests, excluding ventilation services*

EN 13830, *Curtain walling - Product standard*

EN ISO 13943, *Fire safety - Vocabulary (ISO 13943)*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in EN 1363-1, EN 13119, EN 13830, EN ISO 13943 and the following apply.

3.1
anchoring
see *fixing of the framing system*

3.2
associated wall construction
form of construction required to close the vertical side of the furnace (not part of the test specimen)

3.3
curtain walling type A
curtain walling without fire resistant glazing outside the spandrel area – fire resistant only in the spandrel area

3.4
curtain walling type B
curtain walling with fire resistant glazing outside the spandrel area - fully fire resistant curtain walling

3.5
downstand
special type of spandrel panel, hanging down from or located in front of the floor

Note 1 to entry: See Figure A.2.

3.6
fire-resistant glazing
glazing system consisting of one or more transparent or translucent panes with a suitable method of mounting, with e.g. frames, seals and fixing materials, capable of satisfying the appropriate fire resistance criteria

3.7
fire resistant translucent or transparent spandrel panel
glass product, monolithic, laminated or insulating glass unit, manufactured by a particular manufacturer and intended to be used as spandrel panel in curtain walling, which is CE marked based on a classification according to EN 13501-2 in minimum one glazed construction

Note 1 to entry: The term “insulating” when used with “insulating glass unit” according to EN 1279–1, should not be confused with the term “insulation” used in classification standard EN 13501–2.

3.8
fixing of the framing system
system used to attach the curtain wall to the loadbearing floor. It contains the brackets but not the anchor or other devices used to fix the brackets to the floor

3.9
glazing materials
all materials used to glaze the fire resistant translucent or transparent spandrel panel into its frame

3.10
horizontally faceted curtain walling
curtain walling with an angle between horizontally adjacent infill panels at the common mullion (see Figure 1)

3.11
insulating glass unit (IGU)
glass product according to EN 1279–1

3.12
over-cladding system
protection system fixed to an external wall for weather protection

3.13
overrun time
time of fire resistance in minutes beyond the envisaged classification time, achieved in the test

3.14
perimeter seal
see EN 13119

3.15
standard configuration
standard arrangement of curtain walling components in a test specimen

3.16
supporting floor
representation of a floor, forming part of the test construction, to allow the fixing of the test specimen of the curtain walling and the installation of the perimeter seal

3.17
upstand
special type of spandrel panel, standing up from or located in front of the floor

Note 1 to entry: See Figure A.2.

4 Test equipment

4.1 General testing principles

Table 1 defines which specific standard test configuration may be used for each part of the curtain walling depending on the type of fire exposure and type of curtain walling.

The test equipment specified in EN 1363-1 and EN 1363-2 shall be used where applicable.

Table 1 — Standard test configurations and exposure conditions

Product / component of curtain walling	Type of curtain walling [a]	Fire exposure / heating conditions	Test configuration (see Annex B)	Surfaces
Spandrel panel (upstand, downstand or combinations thereof)	A	Internal (STC) + external (ef) [b]	1	S3
		Internal (STC) + external (STC) [c]	2	S3
	B	Internal (STC)	3	S2, S3
		External (STC or ef) [d]	4	S1
Perimeter seal	A	Internal (STC)	1, 5	-
	B	Internal (STC)	3, 5	-
Fixing of the framing system	A	Internal (STC)	1, 5	-
	B	Internal (STC)	3, 5	-

ef External fire curve as specified in EN 1363–2.

STC Standard temperature / time curve as specified in EN 1363–1.

For more information on the test configuration depending on the heating exposure and explanation, see Table A.1.

[a] For definition of type of curtain walling see 3.2 and 3.3

[b] In case the requirement for the external fire exposure is the external fire curve as specified in EN 1363–2.

[c] In case the requirement for the external fire exposure is the standard temperature/time curve as specified in EN 1363–1.

[d] Depending on national requirements.

4.2 Furnace configuration

A floor or a wall furnace may be chosen. The minimum dimensions of the furnace are given in Figures B.1 to B.5. For the installation of the specimen, wall or floor furnaces shall be modified, if necessary, to accommodate the three-dimensional construction. The three dimensional construction includes the perimeter seal.

The test according to EN 1364-4 is performed on a three-dimensional specimen to allow an exposure of a number of surfaces of the upstand/downstand (spandrel area) and incorporates a supporting floor, which provides the support for the curtain walling.

4.3 Supporting floor

A supporting floor is provided as a base for the attachment of the fixing of the framing system and as a location for the perimeter seal under examination. If information on the fire resistance of the curtain walling in conjunction with a particular type of floor construction is required, such a construction shall be used, see 7.2.

5 Test conditions

The pressure conditions and the furnace atmosphere shall conform to those given in EN 1363-1, subject to a nominal pressure of 20 Pa at the positions shown in Figures B.1 to B.5.

The heating conditions shall conform to those given in EN 1363-1 and/or EN 1363-2 for the test configuration selected as given in Table 1. For details see Annex B.

6 Test specimen

6.1 Size

The size of the test specimen shall be as follows:

a) the height of the spandrel area as in practice (normally about 1 m),

b) if the width of the curtain walling in practice is less than 3 m, the specimen shall be full size as in practice,

c) if the width of the curtain walling in practice is larger than 3 m, the width of the specimen shall be not less than 3 m.

NOTE 1 A width larger than 3 m may be the result of single panels with a width of more than 3 m or the result of the repetition of smaller construction units (mullion distance < 3m).

NOTE 2 The height depends on national requirements.

Where the width of a single spandrel panel (upstand/downstand) is less than 3 m, at least 3 panels with the mid panel at the maximum dimension shall be incorporated in the test specimen. Where the width of the panel is greater than or equal to 3 m, at least 3 panels with the mid panel at the maximum width shall be incorporated in the test specimen. The outer panels may be cut, subject to a minimum clearance between the mullions at the boundary of the mid panel and the inner surface of the furnace of 200 mm.

The height h is the total of upstand and downstand (spandrel area).

If the height of the specimen is smaller than the vertical opening of the furnace, the furnace opening shall be closed with a furnace closure according to 7.3.

6.2 Number of specimens

The performance of curtain walling or parts of curtain walling type A for internal and external exposure shall be determined from a single test where the specimen is heated from both sides. For details see Annex B. For curtain walling type B separate tests shall be performed for internal and external exposure.

NOTE Depending on national requirements the external exposure may be the external fire curve as specified in EN 1363–2 or the standard temperature/time curve as specified in EN 1363–1.

6.3 Design

6.3.1 General

The test specimen shall be:

— either fully representative of the construction intended for use in practice, including fixing of the framing system, expansion joints, perimeter seals, any surface finishes and fittings which are essential and may influence its behaviour in the test, or

— a standard configuration as defined in Annex B.

NOTE The use of a standard configuration allows the use of field of application rules to obtain the widest applicability of the test result to other similar constructions.

The test specimen shall consist of parts of the curtain walling. It shall fully represent the construction on which information is required. For use of field of application rules, one of the standard configurations given in Table 1 as described in Annex B shall be used, see Clause 13. The test specimen shall consist of:

— the curtain walling part,

— the perimeter seal and

— the fixing of the framing system.

If the scope of the test is the perimeter seal and movement capability is intended to be considered (see A.3.4) the fixing may be omitted.

All design features which influence fire resistance performance shall be included. If the scope of the test includes an assessment of the fixing of the framing system additional load may be required to take account of the part of the curtain walling not included in the test.

6.3.2 Standard configuration

6.3.2.1 General

A straight test specimen shall comprise a section of the curtain walling with minimum two mullions or two vertical joints between panels in case of systems without frame or mullions, fully exposed to the fire, see Figure 2. In case a T-connection and/ or cross connection is intended to be included these shall be located in the heated area.

A transom shall be used on top and bottom of the spandrel panel except it is the intention of the test to demonstrate the performance of panels not fixed on top or bottom.

A faceted specimen shall comprise minimum four sections of the curtain walling forming minimum one corner of 90 degrees and two angles of 135 degrees, all sections with a minimum width of 500 mm, minimum three sections with a width of minimum 1000 mm, see Figures 3A to 3D for examples. Two such specimens may be combined to a specimen forming two corners of 90 degrees and two angles of 135 degrees, see Figures 3E and 3F for examples.

In case a transom is located in front of the floor slab in practice the test specimen shall also contain a transom in front of the supporting floor. Such a transom is not considered being part of the perimeter seal but part of the framing.

A supporting floor shall be used for standard configurations 1, 2, 3 and 5. The design of the standard supporting floor is given in 7.2.1.

6.3.2.2 Test configuration for curtain walling type A

The test specimen shall be heated from both sides at the same time. Depending on the requirements for the external exposure the heating of conditions of the standard temperature/time curve as specified in EN 1363-1 are maintained on one side only or on both sides of the specimen – for details see Figures B.1 and B.2.

6.3.2.3 Test configuration for curtain walling type B

The test specimen shall be heated only from one side. In standard configurations for curtain walling type B the furnace closure or fire-resistant glazing may be positioned directly beneath the upstand/downstand. For the furnace closure see 7.3.

For details see Figures B.3 and B.4.

6.3.3 Restraint of the specimen

The test specimen shall be fixed to the supporting floor using the fixing of the framing system (anchoring) of the mullions as in practice. The mullions shall not be fixed at the lower end but may be fixed additionally to the

furnace frame on the upper end. The mullions may be fixed by spigot to simulate the situation that the mullions abut each other in front of the floor in practice.

In case of external fire exposure (test specimen without supporting floor, standard configuration 4 according to Figure B.4) the mullions shall be fixed to the furnace frame at the top of the specimen.

Both vertical edges shall be unrestrained. The furnace closure on the free edge between the associated wall construction or furnace frame and the mullions, e.g. a mineral wool packing, shall allow unrestrained movement of the mullions (see Figure 4).

The bottom edge of the test specimen shall be unrestrained. The furnace closure below the test specimen shall allow unrestrained extension/movement of the mullions and the spandrel panel.

At the top of the specimen a mineral wool packing shall be placed so that the top edge of the test specimen is unrestrained.

In case no fixing of the framing system is used for a test of the perimeter seal (standard configuration 5 according to Figure B.5 but without fixing of the framing system) the mullions shall be fixed to a frame at top and bottom. The edges of the spandrel panel shall remain unrestrained.

6.3.4 Surfaces

For definition of the surfaces for the installation of the thermocouples see Figure 5. The numbering of the surfaces is the same as that used in EN 1364-3.

NOTE Surface S2 is the external surface of the curtain walling.

6.3.5 Perimeter seal

6.3.5.1 Test configuration/conditions regarding seal width and depth

6.3.5.1.1 Mineral wool

Where a seal with constant depth but variable joint width is considered, it shall be tested at maximum nominal joint width. The degree of initial compression (%) exerted on the seal by the joint width as well as the direction of the compression (see Figure 17) shall be recorded.

In case mineral wool is used as backing material (e.g. for membrane forming coatings or sealants) variations of the mineral wool may be used within one test specimen provided the length of the seal with a particular backing material is minimum the same as the distance between two mullions and it is located such that the splice between different backing materials is not located in the area of the mullion.

6.3.5.1.2 Membrane forming coatings

The test shall be carried out using the minimum thickness (minimum of tolerance band for the nominal thickness) of the membrane, minimum depth of mineral wool (or other backfilling material), maximum width and minimum overlap at the substrate for the intended fire resistance performance. When a primer is part of the system, it shall be included in the test. Each primer shall be tested separately.

6.3.5.1.3 Compressible strips (including composite)

Where only one seal depth is intended to be specified for all joint widths the maximum intended nominal joint width shall be used. If the seal depth varies with the joint width a test shall be conducted at the maximum nominal joint width for each related seal depth specified by the manufacturer.

6.3.5.1.4 Elastomeric strips

The test shall be carried out using the minimum thickness (minimum of tolerance band for the nominal thickness) of the strip, maximum joint width and minimum overlap at the substrate. When a primer is part of the system it shall be included in the test. Each primer shall be tested separately.

6.3.5.1.5 Sealants

Where only one seal depth, with a specified combination of sealant to backing material thickness, is intended to be specified for all joint widths the maximum intended nominal joint width shall be used. If the thickness of the sealant or the backing material varies with the joint width a test shall be conducted at the maximum nominal joint width for each related seal depth specified by the manufacturer.

6.3.5.2 Test conditions regarding movement

In case movement capability is intended to be considered the fire test shall be commenced at maximum extension/shear of the perimeter seal.

NOTE For further information on test requirements for perimeter seals in case of required movement capability see A.3.4.

6.4 Construction

The test specimen shall be constructed as described in EN 1363-1, subject to deviating rules given in this standard.

In case a component of the curtain walling is cut all open gaps shall be closed using material of class A1 according to EN 13501-1.

6.5 Verification

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

7 Installation of the test specimen

7.1 General

The test specimen shall be fitted to the supporting floor by means of the fixing of the framing system that are used in practice, see 7.2.

7.2 Supporting floor

7.2.1 Standard supporting floor

The standard supporting floor shall have a minimum thickness of 150 mm and minimum width of 500 mm for straight specimens. For faceted specimens the minimum width shall be 200 mm (see Figure 6). The floor shall be made of reinforced concrete or made of reinforced aerated concrete and shall be restrained at three sides.

7.2.2 Non-standard supporting floor

Any floor construction as in practise may be used. The results of the test are limited to that floor construction only (no field of direct application concerning floor constructions).

7.3 Furnace closure

The furnace closure at the bottom end of the test specimen (see Figures B.3 to B.5) shall be made of a mineral wool packing of approximately 250 mm thickness and a density of maximum 50 kg/m^3 allowing movement of the specimen to a similar extent as in practice. Additional fixing to prevent falling out of the mineral wool packing is permitted.

The furnace closure at the top end of the test specimen (see Figures B. 1, B.2 and B.4) shall be made of a mineral wool packing. Intumescent material may be added on top of the mineral wool packing to avoid a gap opening in case the specimen sags.

For a test of a curtain walling type B the assembly shall be installed with an additional closure at the bottom (see Figures B.3 and B.4). Where only the perimeter seal or the fixing of the framing system is tested, the additional closure shall also be used (see Figure B.5).

7.4 Fixing of the framing system

The fixing shall be done as in practice, subject to the exception given in 6.3.1 for testing perimeter seals.

8 Conditioning

The test construction shall be conditioned in accordance with 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 except that the thermometers may be placed closer than 450 mm to any furnace surface. There shall be at least one plate thermometer on each heated side every metre length of the specimen or one per 1,5 m^2 exposed surface area per heated side of the test specimen. The higher resulting number of plate thermometers shall apply. Plate thermometers T1 and T2 shall be oriented so that side ‘A’ faces the back wall of the furnace, plate thermometers T3 and T4 shall be oriented so that side ‘A’ faces the floor of the furnace (see Figures B.1 to B.5). For details of location of plate thermometers see Annex B and Figures 9 and 10 for faceted specimens.

The set of thermocouples, designated as T1 in the figures of Annex B, is used for furnace control. The thermocouples designated T2 in the figures of Annex B are for information only.

9.1.2 Unexposed face thermocouples

9.1.2.1 General

The general rules for the attachment and exclusion of unexposed face thermocouples given in EN 1363-1 shall apply.

For internal exposure, if it is not necessary to evaluate the insulation criteria for Surfaces 2 and 5 then the thermocouples may be omitted.

9.1.2.2 Mean temperature rise

The mean temperature rise shall be measured on Surfaces 1, 2 and 3.

The mean temperature rise shall be measured on each discrete infill / panel area ≥ 0,1 m^2 by means of one thermocouple per 1,5 m^2, subject to minimum two thermocouples per discrete area. The thermocouples shall be located in two opposite corners at a distance of approximately a third of the width and approximately a third of the length of the heated part of the discrete area, see Figure 7. If due to the size of the discrete area a third thermocouple is required it shall be positioned close to the centre of the discrete area. Records from all discrete areas of the same type shall be used for calculating the mean temperature rise. Thermocouples shall not be positioned closer than 100 mm from any discrete area that is not being evaluated for insulation.

For discrete areas which are non-uniform, i.e. those which have surface corrugations or ribs, the temperature of each area/surface type shall be monitored to determine the mean temperature rise.

As there are no evaluation criteria for the perimeter seal, the mean temperature rise is not measured.

9.1.2.3 Maximum temperature rise

9.1.2.3.1 Surface 1

Thermocouples shall be applied to Surface 1 as follows and given in Figure 2.A for straight specimens and Figure 8 for faceted specimens:

— Thermocouple 1A - 20 mm below the soffit of the upper transom at mid width of the panel;

— Thermocouple 1B - on a mullion surface, parallel to the furnace opening, 20 mm below the soffit of the upper transom or the upper edge of the uppermost panel;

— Thermocouple 1C - at the junction of a mullion and the lower transom or 20 mm above the bottom end of the mullion;

— Thermocouple 1F - at mid way between two mullions at the lower transom or 20 mm above the lower edge of the lowest panel;

— Thermocouple 1G - on a mullion surface, parallel to the furnace opening, at mid way between two transoms;

— Thermocouple 1H – at mid-height of the panel with the largest area, 20 mm from the mullion for each type of spandrel panel;

— Thermocouple 1J – in the top corners of the panel with the largest area, for each type of spandrel panel, 20 mm from the mullion and the transom.

9.1.2.3.2 Surface 2

Thermocouples shall be applied to Surface 2 as follows and given in Figure 2.B for straight specimens and Figures 7 and 10 for faceted specimens:

— Thermocouple 2A – level with the soffit of the supporting floor at mid width of the panel;

— Thermocouple 2B – on a mullion surface, parallel to the furnace opening, level with the soffit of the supporting floor;

— Thermocouple 2C – at the junction of a mullion and the lower transom;

— Thermocouple 2F – at mid way between two mullions on the lower transom or 20 mm above the lower edge of the lowest panel;

— Thermocouple 2G – on a mullion surface, parallel to the furnace opening, at mid way between two transoms;

— Thermocouple 2H – at mid-height of the panel with the largest area, 20 mm from the mullion, for each type of spandrel panel;

— Thermocouple 2J – in the top corners of the panel with the largest area, for each type of spandrel panel, 20 mm from the mullion and the transom.

9.1.2.3.3 Surface 3

Thermocouples shall be applied to Surface 3 as follows and given in Figures 3.C and 3.D for straight specimens and Figures 10 and 11 for faceted specimens:

— Thermocouple 3A: on the panel at mid way between two mullions, 20 mm up from top of the supporting floor;

— Thermocouple 3B: on a mullion surface, parallel to the furnace opening, 20 mm up from top of the supporting floor;

— Thermocouple 3C: on a mullion surface, 90° to the furnace opening, 20 mm up from top of supporting floor.

9.1.2.3.4 Perimeter seal

For the determination of the maximum temperature rise, thermocouples shall be applied to the perimeter seal as follows (see Figure 12A):

— Thermocouple HV: at the top surface of the seal, centrally between the mullions and centrally across the perimeter seal;

— Thermocouple HW: at the top surface of the seal 20 mm from a mullion centrally across the perimeter seal;

— Thermocouple HV1: at the top surface of the seal located at quarter point between the mullions at the position where the seal abuts the floor;

— Thermocouple HV2: at the top surface of the seal located at quarter point between the mullions at the position where the seal abuts the panel;

— Thermocouple HZ: if there is a splice in the gap seal this thermocouple shall be positioned adjacent to the gap seal at a position 20 mm from the splice;

— Thermocouple HT – in case a transom is located in front of the supporting floor or so close to the supporting floor, that it is in contact with the perimeter seal, on top of the transom at mid length and mid width (see Figure 12B).

9.1.2.3.5 Roving thermocouple

A roving thermocouple shall be provided for measuring maximum temperature at any point.

9.1.2.3.6 Additional thermocouples

Any further thermocouples used to provide additional information (e.g. for measuring temperatures inside the wall) shall be attached without damaging the specimen.

9.1.2.4 Thermocouples on the fixing of the framing system

Thermocouples shall be provided to measure the temperature of any fixings used to attach the curtain walling to the supporting floor.

9.2 Pressure

Furnace pressure shall be measured as detailed in EN 1363-1. During the test, the pressure shall be measured at a point 100 mm below the supporting floor (internal fire exposure) or 100 mm below the top of the specimen (external fire exposure) at the points indicated in the figures in Annex B.

9.3 Radiation

If radiation is to be measured for curtain walling type A, it shall be done according to EN 1363-2. Radiometers shall be positioned opposite the geometric centre of that part of the unexposed area of the test specimen that is heated. The distance of the radiometer may be decreased compared to the requirement given in EN 1363-2 to increase the accuracy of the measurement. If the distance has been decreased the results shall be re-calculated for a distance of 1 m. Deviating from the rules given in Annex B the spandrel panel shall be extended in height such that Surface 3 has the height of the upstand as in practice, subject to minimum 500 mm. If radiation is to be measured the test specimen shall be uniform across its width, i.e. the same type of panel used in all discrete areas.

NOTE For curtain walling type B tests according to this standard are not suitable for determination of radiation.

10 Test procedure

The test shall be carried out using the equipment and according to the procedures specified in EN 1363-1 and, if applicable, EN 1363-2.

11 Performance criteria

The criteria by which the performance of the test specimen is judged are given in EN 1363-1. The results for insulation and integrity shall be presented separately for external exposure, internal exposure and the perimeter seal, as shown in Table 2.

In addition to the integrity criteria given in EN 1363-1 the spandrel panel shall remain in place over its full height of the test specimen (h as shown in Figures B.1 and B.2) for curtain walling type A.

Performance with respect to insulation is assessed for different parts of the test specimen, depending on the test configuration selected according to Table 1. Figures 3, 7, 8, 9, 11 and 13 show the groups of thermocouples to be used for this purpose for one or more of the following:

a) unexposed internal face of the spandrel panel above the supporting floor, Surface 3 (curtain walling type A),

b) unexposed internal face of the spandrel panel above the supporting floor, Surface 3, and external face, Surface 2 (curtain walling type B – internal exposure),

c) unexposed internal face of the spandrel panel, Surface 1 (curtain walling type B – external exposure),

d) unexposed surface of the perimeter seal.

The temperature of the fixing of the framing system shall be measured and recorded.

Measurement of the temperature of the fixing of the framing system is not a classification criterion but may be used in evaluating the possible reduction in structural strength of the fixing.

Performance with respect to radiation is assessed following the procedure given in Annex C.

Other observations as specified in EN 1363-1 shall be made and recorded. Falling parts from the curtain walling construction may be recorded if required according to national regulations.

NOTE There is no performance criteria associated with falling parts.

Table 2 — Performance criteria

Type of curtain walling	Fire exposure	Component / Surface	Integrity			Insulation		Radiation
			Cotton pad	Gap gauge	Flaming	Mean temperature rise	Maximum temperature rise	
A	Internal + external	S3	Y	–	Y	Y	Y a	Y
B	Internal	S2	Y	Y	Y	Y	Y a	- b
B	Internal	S3	–	–	Y	Y	Y a	- b
B	Internal	S5	Y	-	Y	-	-	-
B	External	S1	–	Y	Y	Y	Y a	- b
A, B	Internal	Perimeter seal	Y	Y	Y	–	Y	-

a For each type of panel

b For classification EW of a curtain walling type B or components of it results from a test according to EN 1364–3 shall be used

12 Test report

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

a) a reference that the test was carried out in accordance with EN 1364-4,

b) type of the curtain walling according to 3.2 or 3.3,

c) the type of specimen, i.e. straight or faceted;

d) test results identified in accordance with the performance criteria in Table 2:

e) temperature curve used;

f) if relevant, the records of radiation measurement together with the panel dimensions used in the test and the calculation for other panel dimensions according to Annex C, if applicable;

g) if required, the time when parts fell off from Surfaces S2 and S5 and their approximate size.

If during one test the internal and external exposure heating criteria have been satisfied, graphs and/or tabulated results of measurements made during the whole test shall be given separately for each exposure condition.

13 Field of direct application of test results

13.1 Rules for curtain walling type A

13.1.1 General rules

13.1.1.1 General

The rules given in 13.1.2 to 13.1.4 apply to stick constructions only. For rules for unitised constructions see Annex D.

The rules given in 13.1.2 to 13.1.4 shall not be used for curtain walling constructions with glued infill panels (e.g. Structural Sealant Glazing Systems – SSGS).

Rules which result in higher weight of the curtain walling are only applicable if the fixing of the framing system used in practice has been designed for the higher load. The measured temperature at the fixing of the framing system shall be taken into account.

In the following the terms “E classification”, “EW classification” and “EI classification” refer to classification / classes E, EW and EI according to EN 13501-2.

13.1.1.2 Exposure conditions

Test results from tests using the standard temperature time curve cover a test condition using the external fire curve but not vice versa.

For standard configuration 1 the results are applicable to external fire exposure providing the temperature recorded with thermocouples T2 comply with the requirements for the external fire exposure required.

13.1.1.3 Overrun time

For some rules to be applicable an overrun time in the fire test result compared to the envisaged classification time is required. The required overrun time is shown in Table 3. The overrun time is required for the following criteria:

— E classification: integrity

— EW classification: integrity and radiation

— EI classification: integrity and insulation

Table 3 — Overrun time

Classification time	Overrun time
≤ 20 min	minimum 3 min
30, 45 and 60 min	minimum 6 min
≥ 90 min	minimum 10 % of the classification time

13.1.2 Rules for the complete construction

13.1.2.1 Width of the curtain walling

Test results are valid for curtain walling constructions with classification E and EI of higher width provided the construction details (distance of mullions etc.) are the same as the one tested and the width of the test specimen was minimum 3m.

NOTE Width refers to the heated area of the test specimen.

13.1.2.2 Installation angle (vertical/sloped)

Test results on a vertical curtain walling cover curtain walling sloped inside or sloped outside to a maximum angle of 10° from the vertical axis for both exposure orientations (o → i and i → o).

Test results on a vertical curtain walling cover curtain walling sloped inside or sloped outside to a maximum angle of 15° from the vertical axis provided an overrun time was achieved according to Table 3 and the screws for fixing the infills permeate the mullions/transoms with the exception that in case fire resistant glazing with E or EW classification is used for the spandrel panel the maximum angle is restricted to 12,5°.

13.1.2.3 Facet angles (horizontally faceted curtain walling)

13.1.2.3.1 Installation tolerance

Facet angles (angle β in Figure 1) between 0 and 1,5°are covered by a test on a straight curtain walling. In case the curtain walling includes fire resistant translucent or transparent infill panels the rule is only applicable if the overlap of the pressure plate and/or the edge cover on the inner side of a fire resistant translucent or transparent infill panel, whatever is smaller, is minimum the same as in the fire test for infill panels with EI classification and the same as tested for infill panels with E or EW classification (see Figure 13).

13.1.2.3.2 Small facet angles

Facet angles (angle β in Figure 1) between ≥ 1,5 and 5° are covered by a test on a straight curtain walling provided

— the system remains the same as in the fire test and

— the pressure plate remains the same as in the fire test and

— the nominal inner or outer edge cover of the translucent or transparent infill panel, whichever would be decreased by the inclination of the translucent or transparent infill panel, remains the same as in the fire test and

— an overrun time according to Table 3 has been achieved.

NOTE The maximum facet angle covered will depend on the thickness of the spandrel panel and on the maximum distance the spandrel panel can be moved towards the centre of the mullion.

This rule does not apply to curtain walling with E and EW classification.

13.1.2.4 Direction of fire exposure

Test results from a test with standard configuration 1 may be used for classification of curtain walling type A for class E (i→o) and class EI ef (o→i), the latter provided the temperature on the upper plate thermometer T2 satisfies the requirements for the external exposure curve according to EN 1363-2.

Test results from a test with standard configuration 2 may be used for classification of curtain walling type A for class E (i→o) and class EI (o→i).

Test results from a test with standard configuration 3 (internal fire exposure) may be used as additional evidence to tests according to EN 1364-3 for internal fire exposure of curtain walling type B and/or related perimeter seals.

Test results from a test with standard configuration 4 (external fire exposure) may be used as additional evidence to tests according to EN 1364-3 for external fire exposure of curtain walling type B.

13.1.3 Framing system

13.1.3.1 Distance between mullions and transoms

The distance between the mullions and transoms is defined by the rules for the infill panels, based on test results on straight specimens.

Test results on a higher distance between the mullions and/or transoms cover smaller distances, subject to the rules given in 13.1.4.

Test results cover a higher distance between mullions and/or transoms than tested subject to the rules given in 13.1.4, provided that all of the relevant frame junctions in the spandrel area have been tested in accordance with this standard.

13.1.3.2 Geometry/dimension of mullions and transoms

Test results cover higher wall thickness of mullions and transoms made of metal subject to a maximum of 1,5 times the thickness used in the test. Decrease of wall thickness is not permitted.

Test results cover width and depth ranges of mullions and transoms as given in Table 4. A decrease of width and /or depth of mullions and transom is not permitted. The values given in Table 4 refer to the factor the width and depth may be higher in comparison to the width and/or depth used in the test.

Table 4 — Factor for width and depth of mullions and transoms

Framing material	Classification E and EW				Classification EI			
	Transom		Mullion		Transom		Mullion	
	Width	Depth	Width	Depth	Width	Depth	Width	Depth
Aluminium	1,25 [a, c]	1,5 [b]	1,25 [a, c]	1,5	1,25 [a]	2 [b]	1,25 [a]	2
Steel	1,25	1,5 [b]	1,25	1,5	1,25	2 [b]	1,25	2
Stainless steel (curtain walling type A)	1,25	1,5 [b]	1,25	1,5	1,25	2 [b]	1,25	2
Stainless steel (curtain walling type B)	1,25	1,5 [b]	1,25	1,5	1,25	1,5 [b]	1,25	1,5
Timber	2 [c]	1,5 [b]	2 [c]	1,5	2	4 [b]	2	4

[a] In case the transom or mullion contains a core material for the purpose of improving the fire resistance the dimensions of this core material shall be increased so that the contact area with the aluminium remains minimum the same and the overlap between the infill panel and the core material remains minimum the same.

[b] But maximum to the depth of the mullion

[c] Provided the pressure plate system is changed accordingly so that the overlap remains the same subject to the rules given in 13.1.3.7

13.1.3.3 Connection between mullions and transoms

13.1.3.3.1 Connection geometry

Figure 14 shows a cross connection, vertical T-connection, horizontal/standing and horizontal/hanging T-connection.

Test results for a cross-connection do not cover T-connections and vice versa.

A horizontal T-connection does not cover a vertical one and vice versa.

A standing T-connection does not cover a hanging T-connection and vice versa.

Test results for cross connections or T-connections with an angle of 90° between mullions and transoms cover situations where the angle between mullions and transoms is minimum 80° and maximum 100° disregarding whether the mullions are vertically oriented or not or the transoms are horizontally oriented or not. This rule also applies to corner connections of unitised systems.

13.1.3.3.2 Connection system between framing members

Test results for a particular connection system are only valid for connection systems of the same construction principle.

The dimensions of the connection system may be varied as required in relation to dimension changes of mullions and transoms according to 13.1.3.1.

13.1.3.4 Framing material

13.1.3.4.1 General

Test results for stainless steel apply to construction steel (unalloyed, low alloyed steel) but not vice versa.

Test results for steel do not apply to Aluminium and vice versa.

Test results apply only to the Aluminium alloy used in the test. Change to another Aluminium alloy is not permitted.

13.1.3.4.2 Timber framing

Test results for any solid or laminated timber type of a group according to Table 5 apply equally to all other timber types of the same group. Test results for any timber type of group 1 according to Table 5 apply equally to all other groups but not vice versa. Test results for any timber of group 2 according to Table 5 apply equally to all timber types of groups 3 and 4 but not vice versa. Test results for any timber of group 3 according to Table 5 apply equally to all timber types of group 4 but not vice versa.

Table 5 — Timber groups

Group	Timber type	Density (kg/m^3)
1	Softwood and beech	< 450
2	Hardwood excluding beech	< 450
3	Softwood and beech	≥ 450
4	Hardwood excluding beech	≥ 450

Test results for unprotected timber apply equally to protected timber but not vice versa. Test results for protected timber apply only to the type of protection used in the test. Protection means any measure, e.g. impregnation, varnish, coating or paint, intended to improve the reaction to fire classification according to EN 13501-1 or the K-classification according to EN 13501-2 of the timber.

13.1.3.5 Decorative frame surface coverings/coatings

Decorative frame surface treatments/coverings/coatings which achieve minimum class A2 according to EN 13501-1 together with the relevant frame component may be added or changed without restrictions.

Any decorative frame surface treatments/coverings/coatings with a thickness equal to or less than 1,5 mm may be added or changed without restrictions for curtain walling classified EI.

Decorative frame surface treatments/coverings/coatings of more than 1,5 mm thickness other than covered by the rule given in the first paragraph above shall be included in the test as part of the test specimen. Test results of such decorative frame coverings/coatings apply only to decorative frame coverings/coatings made of the same material type and thickness.

Decorative frame surface treatments/coverings/coatings other than covered by the rule given in the first paragraph above for curtain walling classified E or EW shall be included in the test as part of the test specimen. Test results of such decorative frame coverings/coatings apply to all types of decorative frame coverings/coatings of minimum the same reaction to fire class according to EN 13501-1 and of maximum the same thickness as used in the test if the framing system was at the unexposed side of the test specimen. Otherwise the results apply only to decorative frame coverings/coatings made of the same material type and thickness.

Test results for decorative frame surface treatments/coverings/coatings other than covered by the rule given in the first paragraph above from a test for intended classification E may be also used for classification EW.

13.1.3.6 Fixing of the framing system

Fixing system made of Aluminium / Aluminium alloys: no change in material is permitted.

Test results for a fixing system made of aluminium / aluminium alloys covers steel but not vice versa.

Fixing system made of steel: change of alloy within construction steels (unalloyed / low alloy steels) is permitted.

Test results on a particular fixing system type (anchored or cast-in or welded) are not applicable to another type.

Change in geometrical shape and/or linear dimensions within a fixing system type is permitted on the basis of a proper static calculation. The temperature at the fixing measured in the fire test shall be taken into account. If no temperature data of the fixing are available only increase in linear dimensions is permitted.

Test results for a non-insulated fixing system (not embedded in insulation material) apply equally to the fixing system embedded in insulation material of reaction to fire class A1 or A2 according to EN 13501-1 but not vice versa.

13.1.3.7 Pressure plate system

13.1.3.7.1 Edge cover / overlap of pressure plate

Results from tests with a smaller edge cover / overlap of the pressure plate on the spandrel panel are also valid for a higher edge cover / overlap but not vice versa. This rule applies for both, the outer and inner edge cover (Figure 13). This rule does not apply to fire resistant translucent or transparent spandrel panels with E or EW classification.

13.1.3.7.2 Size of pressure plate

Smaller and higher widths of the pressure plate are covered provided the moment of inertia of the pressure plate in the axis as shown in Figure 13 is minimum the same as tested and the overlap is minimum the same as tested subject to the rules given in 13.1.3.7.1.

13.1.3.7.3 Material of pressure plate

Results for aluminium pressure plates are also valid for steel pressure plates but not vice versa. The flexural strength of the pressure plate shall be equal or higher than the flexural strength used in the test.

13.1.3.7.4 Screws

Test results for screws are valid for minimum the same effective screw depth (i.e. depth in the mullion/transom) and minimum the same cross section as used in the test. The distance between the screws may be reduced but not increased.

13.1.3.7.5 Mullion and transom cover caps

Test results on any cover cap are equally valid for all other types of cover caps of minimum the same classification according to EN 13501-1.

13.1.3.8 Other fixing systems than pressure plate

Test results are only applicable to the fixing system used in the test.

Results from tests with a smaller edge cover / overlap of the fixing system on the infill panel are also valid for a higher edge cover / overlap but not vice versa. This rule applies for both, the outer and inner edge cover. This does not apply to fire resistant translucent or transparent infill panels with E or EW classification.

13.1.4 Spandrel panels

13.1.4.1 Position in relation to the floor

The standard configurations according to Annex B cover all situations of the position of the spandrel panel regarding height in relation to the floor (downstand, upstand, combination of downstand/upstand), provided the spandrel is made of one panel (no transom except at top and bottom).

13.1.4.2 Opaque (non-translucent/non-transparent) spandrel panels

13.1.4.2.1 Type / construction

Test results cover only the type / construction of the spandrel panel(s) used in the test.

13.1.4.2.2 Dimensions

Test results cover smaller panel width and height.

Test results cover a higher thickness of the panel.

Test results cover a higher thickness of the panel insulation.

Test results for an spandrel panel of particular dimensions cover dimensions up to a maximum of the tested dimension multiplied by a factor 1,2 in width and/or height but only up to an area of maximum the tested area multiplied by a factor 1,21 provided an overrun time according to Table 3 has been achieved in the test.

For classification times 30 min, 45 min and 60 min a factor 1,1 may be used to calculate the covered range of height, width and area, if the overrun time achieved in the test is less than the 6 min required in Table 3 but minimum 3 min.

For a classification time ≥ 90 min a factor 1,1 may be used to calculate the covered range of height, width and area, if the overrun time achieved in the test is less than the 10 % required in Table 3 but minimum 5 %.

Test results cover smaller distances in between fixing centres, vertical and horizontal.

13.1.4.2.3 Aspect ratio of individual spandrel panels

Test results for rectangular panels with portrait as well as landscape format cover all aspect ratios subject to the rules given in 13.1.4.4 provided that all panels have been tested in an identical framing system

13.1.4.2.4 Geometrical shapes

Test results for a rectangular panel cover all other shapes provided that their size can be cut out of the tested rectangular size, subject to the rules given in 13.1.3.3.1.

13.1.4.2.5 Materials

Test results of gypsum plasterboards except gypsum plasterboards type F according to EN 520 are valid for all types of gypsum plasterboards provided the thickness is minimum the same. Test results of gypsum plasterboards type F according to EN 520 are not valid for other types of gypsum plasterboard. Test results of all types of gypsum plasterboards apply equally to boards made of CaSi boards but not vice versa provided the thickness is minimum the same. Test results of boards made of CaSi are only valid for CaSi boards.

The thickness of the board may be increased.

Test results of a non-faced mineral wool board are equally applicable to an aluminium faced version of this mineral wool board but not vice versa.

The insulation material as used in the test shall not be changed.

The thickness of the insulation may be increased.

The type of fixing of the components to each other (e.g. gluing) shall not be changed.

External layers for optical reasons (e.g. metal, stone, concrete, glass) may be added or changed without restriction to the material.

Increased weight of the infill panels as a result of changes according to the rules above shall be considered for the anchoring, the dimensioning of mullions and transoms and the fixing system for the panels.

13.1.4.2.6 Back panel metal sheeting

Change of thickness of metal sheeting is not permitted.

13.1.4.3 Sandwich panels

The thickness of the insulation material may be increased.

Change in thickness of metal sheeting is not permitted.

Increased weight of the spandrel panels as a result of changes according to the rules above shall be considered.

13.1.4.4 Translucent or transparent spandrel panels

13.1.4.4.1 Type of fire resistant translucent or transparent spandrel panel

13.1.4.4.1.1 General

Three major types of fire resistant translucent or transparent spandrel panels were identified:

— a fire resistant translucent or transparent spandrel panel consisting only of the glass component that gives the fire resistance; this may be a monolithic pane, a laminated pane or a gel type glass depending on the required classification (E, EW or EI), indicated A in Figure 16

— an IGU consisting of the part that gives the fire resistance and a single pane for UV/acoustic/safety performance (counter pane), with or without additional coatings on either side of the counter pane, indicated B in Figure 16 (example shown with coating inside)

— an IGU consisting of the part that gives the fire resistance and a laminated pane for UV/acoustic/safety performance (counter pane), with or without additional coatings on either side of the counter pane, indicated C in Figure 16 (example shown with coating inside)

13.1.4.4.1.2 Classification EI (i → o)

Test results of type A are equally applicable to type B and C but not vice versa.

Test results of type B are equally applicable to type C and vice versa.

Test results of type B without additional coatings are equally applicable to type B with additional coatings but not vice versa.

Test results of type C without additional coatings are equally applicable to type C with additional coatings but not vice versa.

NOTE For details see Figure 16.

13.1.4.4.1.3 Classification EI (o → i)

Test results of type C are equally applicable to type B but not vice versa.

Test results of type B without additional coatings are equally applicable to type B with additional coatings and vice versa.

Test results of type C without additional coatings are equally applicable to type C with additional coatings and vice versa.

Test results of type C with additional coatings are equally applicable to type B without additional coatings but not vice versa.

NOTE For details see Figure 16.

13.1.4.4.1.4 Classification E, EW

No rules applicable.

13.1.4.4.1.5 Provisions

All rules given in 13.1.4.4.1.2 and 13.1.4.4.1.3 are valid only provided

— the glass component that gives the fire resistance is of the same type (monolithic, laminated or gel type) as tested and is made by the same manufacturer, and

— the fire resistant translucent or transparent spandrel panel is CE marked based on a classification according to EN 13501-2 in minimum one glazed construction.

13.1.4.4.2 Dimensions of individual rectangular fire resistant translucent or transparent spandrel panels

13.1.4.4.2.1 Test results cover smaller panel width and height.

13.1.4.4.2.2 Test results cover a higher thickness of the panel.

The framing system under consideration shall be able to support the additional weight due to the increased thickness of the panel.

13.1.4.4.2.3 Test results for a panel of particular dimensions cover dimensions up to a maximum of the tested dimension multiplied by a factor 1,2 in width and/or height but only up to an area of maximum the tested area multiplied by a factor 1,21 provided an overrun time according to Table 3 has been achieved in the test.

13.1.4.4.2.4 For classification times 30 min, 45 min and 60 min a factor 1,1 may be used to calculate the covered range of height, width and area, if the overrun time achieved in the test is less than the 6 min required in Table 3 but minimum 3 min.

13.1.4.4.2.5 For a classification time ≥ 90 min a factor 1,1 may be used to calculate the covered range of height, width and area, if the overrun time achieved in the test is less than the 10 % required in Table 3 but minimum 5 %.

13.1.4.4.2.6 For fire resistant translucent or transparent spandrel panels with EW classification the rules given above are only applicable if

— the mean unexposed face temperature remained below 300° C (see EN 1363-2), or

— $W_{calc,}$ calculated according to the rules given in Annex C, is equal to or smaller than W_{max} = 15 kW/m^2 for the resulting maximum height, width and area determined using the rules given in 13.1.4.4.2.3 to 13.1.4.4.2.5.

13.1.4.4.3 Aspect ratio of individual rectangular fire resistant translucent or transparent spandrel panels

Test results for rectangular translucent or transparent spandrel panels with portrait as well as landscape format cover all aspect ratios up to an area A ≤ 1/2 * ($A_{portrait}$ + $A_{landscape}$) provided that

— all translucent or transparent spandrel panels have been tested in an identical framing system,

— the largest tested width as well as the largest tested height is not exceeded.

In case an overrun time has been achieved according to Table 3 the values for $A_{portrait}$ and $A_{landscape}$ may be determined by using the rules for dimensions given in 13.1.4.4.2.

13.1.4.4.4 Geometrical shapes

Test results for a rectangular translucent or transparent spandrel panel cover all other shapes provided that their size can be cut out of the tested rectangular size, subject to the rules given in 13.1.3.3.1.

13.1.4.4.5 Asymmetry in thickness

If the translucent or transparent spandrel panel is asymmetrical in an axis perpendicular to the surface the test result is only valid for the direction and type of exposure (internal or external exposure) as tested.

13.1.4.5 Glazing materials

13.1.4.5.1 Gaskets

Gaskets with a higher material cross sectional area in the uncompressed state cover gaskets with a smaller cross sectional area but not vice versa. The cross sectional area in the uncompressed state may be increased by maximum 50 % compared to what was tested.

Test results form particular gasket geometry is also applicable to other geometries. In case of curtain walling classified E or EW no material addition (e.g. lips) is permitted on the side of the gasket that is visible in the built-in situation.

Test results cover only the gasket material used in the test.

13.1.4.5.2 Sealants

Change in type of material (e.g. acrylic, silicone) is not permitted.

Test results cover a lower sealant height (for definition see Figure 13) down to a minimum of 4 mm and a higher sealant height up to a maximum of 1,5 times the height used in the test.

The sealant depth (for definition see Figure 13) shall be minimum the same as tested.

13.1.4.5.3 Intumescent strips/layers

Changes to intumescent strips/layers are not permitted.

13.2 Rules for curtain walling type B

The rules given in EN 1364-3 apply, subject to the restrictions given in the scope of this part of the standard.

13.3 Perimeter seal

13.3.1 General

Perimeter seals tested according to this standard shall not be used where in practice movement of the perimeter joint is expected.

NOTE For information on test requirements for perimeter seals in case of required movement capability see A.3.4.

13.3.2 Material

Test results for non-faced mineral wool are equally applicable to an aluminium faced version of the same mineral wool product (brand designation) but not vice versa.

Test results for mineral wool are valid for a version with higher density of the same mineral wool product (brand designation) as long as it is compressible to the same extent as in the test, subject to restrictions depending on the direction of compression given in 13.3.4.4.

Test results for compressed mineral wool are equally applicable to mineral wool of higher compression, subject to restrictions depending on the direction of compression given in 13.3.4.4.

Changes to other materials or components are not permitted.

13.3.3 Width/depth

For definition of width and depth of the perimeter seal see Figure 15.

Test results for perimeter seals or seal components with lower depth are equally applicable to perimeter seals with higher depth but not vice versa. For membrane forming coatings and elastomeric strips the results apply for all thicknesses within the tolerance band for the membrane/strip and higher depth of mineral wool (or other backing material).

Test results for perimeter seals with higher nominal width are equally applicable to perimeter seals with narrower nominal width but not vice versa, subject to the depth of the seal or its components being minimum the same as tested and subject to the rules regarding compression (see 13.3.4.4). For membrane forming coatings and elastomeric strips the overlap on the floor and the spandrel shall be in practice minimum the same as tested.

Test results for perimeter seals with an overrun according to Table 3 cover a nominal width range up to 1,2 times the tested nominal width, except for products with distinct sizes for specific gap widths and preformed products which are kept in place by compression (no additional mechanical fixing provided).

In case an intumescent sealant is used as component of the perimeter seal its depth may be increased.

13.3.4 Fixing of the perimeter seal

13.3.4.1 For mechanically fixed seals the fixing of the perimeter seal is restricted to the fixing used in the test.

13.3.4.2 For self-adherant seals or seal components, e.g. membrane forming coatings and sealants, as well as for adhesion fixed seals or seal components, e.g. elastomeric strips, the results apply for all substrates for which the adhesion is shown to be equal to or better than that in the fire test.

NOTE An example for adhesion fixing is the use of a glue to fix the seal or seal component.

13.3.4.3 For friction fixed seals or seal components, e.g. mineral wool and compressible strips, minimum the same compression shall be used in practice as used in the test, subject to the following rule.

13.3.4.4 For mineral wool with compression direction B-B or C-C according to Figure 17 the compression shall be minimum the same as tested but sufficiently low not to induce a mechanical failure of the seal, e.g. by de-lamination fracture.

13.3.5 Covering

Tests without steel sheet covering cover perimeter seal systems including steel sheet covering, provided it is not force-fit fixed to the curtain walling, disregarding whether the steel sheet covering is installed on top or on bottom of the seal, but not vice versa.

Test results are only valid for the covering material used in the test.

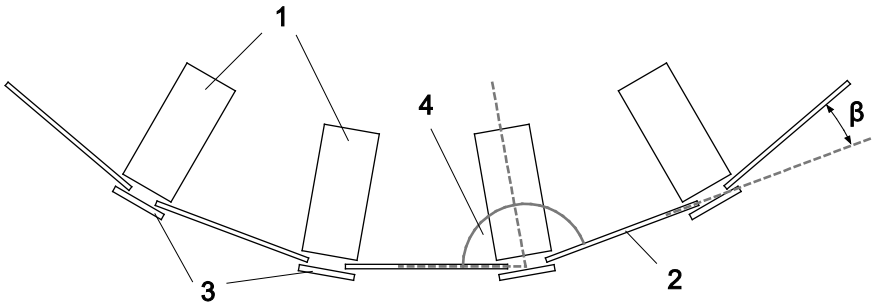
No additional coverings of reaction to fire classification B to F according to EN 13501-1 are permitted on bottom side of perimeter seals.

13.4 Supporting floor

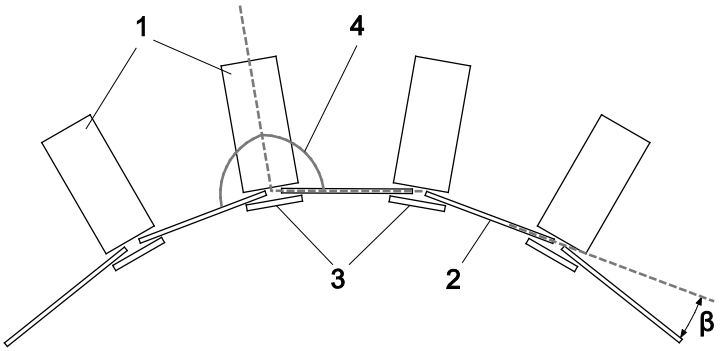
Test results obtained with the standard supporting floor construction may be applied to concrete floors of a thickness and density equal to or greater than that of the floor construction used in the test.

The test results of a curtain walling specimen tested in front of a non-standard supporting floor are valid for other floors of the same type provided the thickness as well as the fire resistance with respect to loadbearing capacity, integrity and insulation of these floors are equal to or greater than that of the non-standard floor used in the test.

A



B



Key

A case 1: angle between horizontally adjacent infill panels < 180° (horizontal section)

B case 2: angle between horizontally adjacent infill panels > 180° (horizontal section)

1 mullion

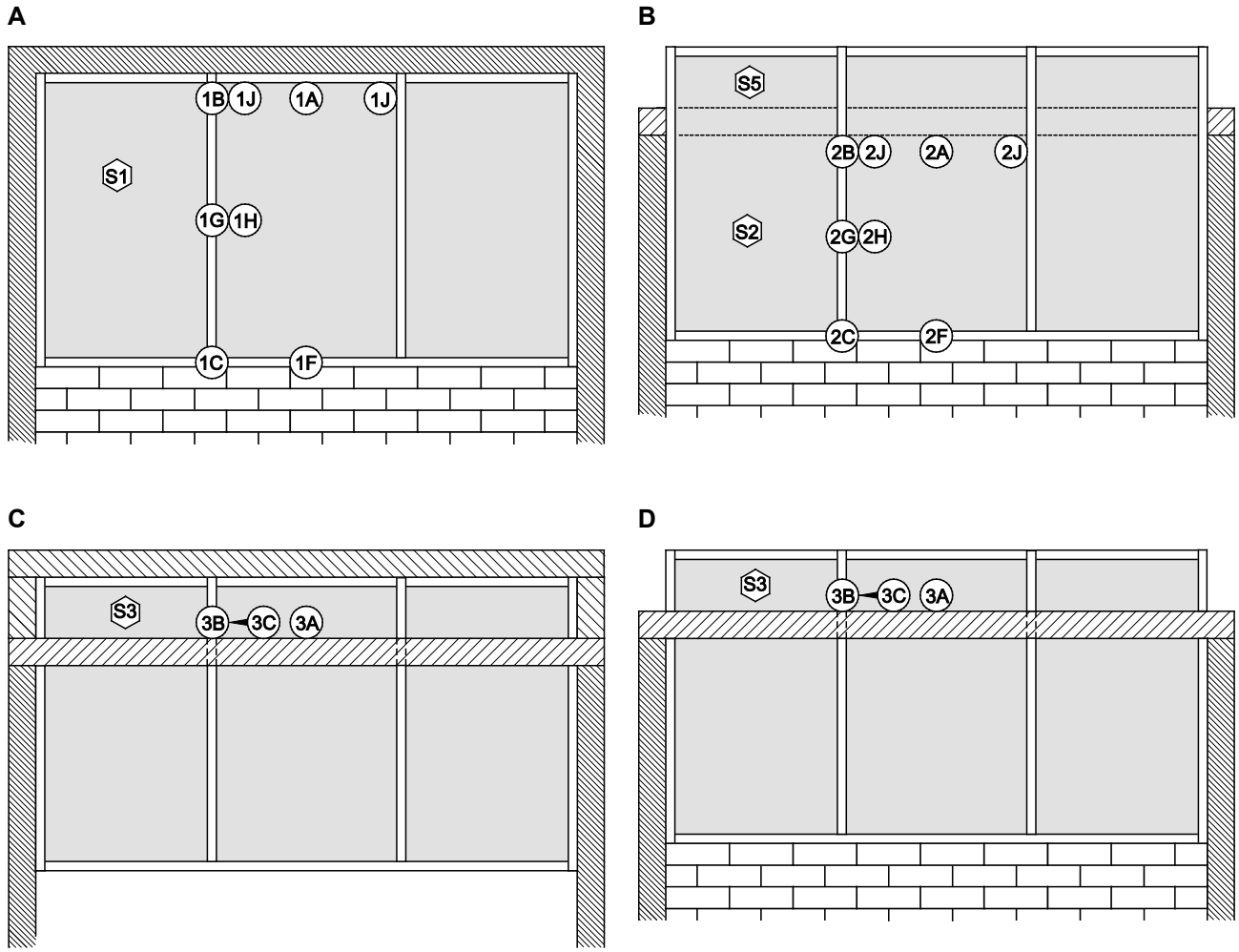
2 infill panel

3 pressure Plate

4 angle between horizontally adjacent infill panels at the common mullion

β facet angle

Figure 1 — Horizontally faceted curtain walling



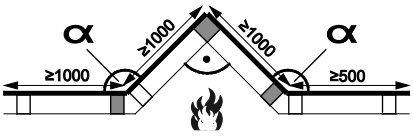
Key

A	thermocouples on Surface 1 (standard configuration 4)
B	thermocouples on Surface 2 (standard configuration 3)
C	thermocouples on Surface 3 (standard configurations 1 and 2)
D	thermocouples on Surface 3 (standard configuration 3)
	furnace closure
	supporting floor
	spandrel panel
	furnace wall
	furnace closure (in case of Surface 3 only used for standard configuration 3)
1A to 1J	location of thermocouples 1A to 1J
2A to 2J	location of thermocouples 2A to 2J
3A to 3C	location of thermocouples 3A to 3C
S1, S2, S3, S5	surfaces 1, 2, 3, 5

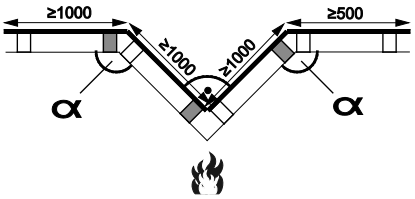
Figure 2 — Location of thermocouples (maximum temperature rise) on Surfaces S1, S2 and S3, straight specimen

Dimensions in millimetres

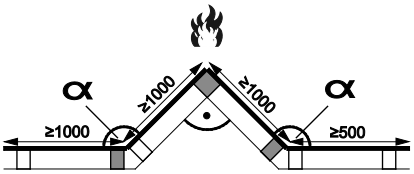
Test configuration A: i → o, convex corner



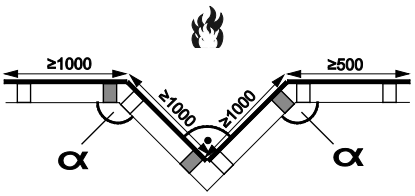
Test configuration B: i → o, concave corner



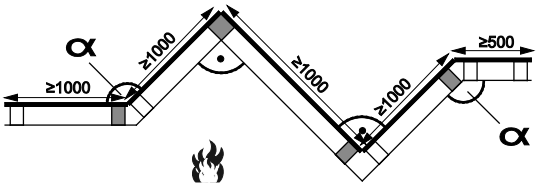
Test configuration C: o → i, convex corner



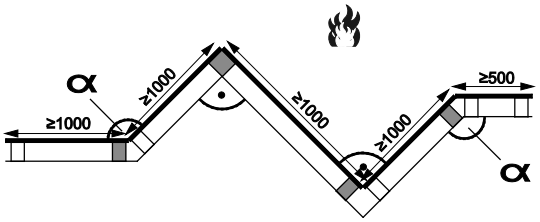
Test configuration D: o → i, concave corner



Test configuration E: i → o, combination of A and B



Test configuration F: o → i, Combination of C and D



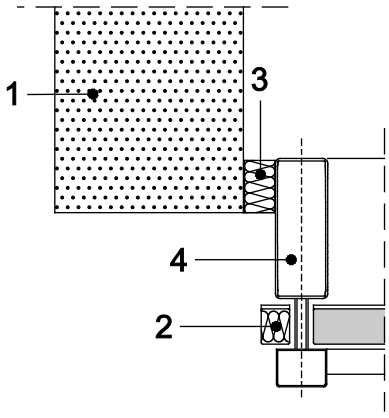
Key

mullion with thermocouples

mullion without thermocouples

α angle of 135°

Figure 3 — Options for the configuration of faceted specimens, horizontal section



Key

1 associated wall / furnace frame

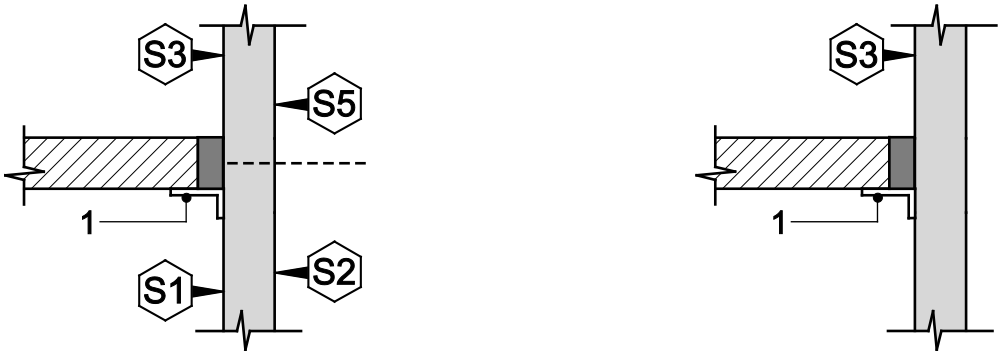
2 material of Class A1 according to EN 13501–1 to prevent buckling of the mullion

3 non-combustible packing between mullion and associated wall / furnace frame

4 mullion

Figure 4 — Furnace closure on the free edge between mullion and associated wall or furnace frame

A B



Key

supporting floor

upstand / downstand / combination

perimeter seal

1 simplified example of fixing of the framing system

A curtain walling type A

B curtain walling type B

S1 surface 1

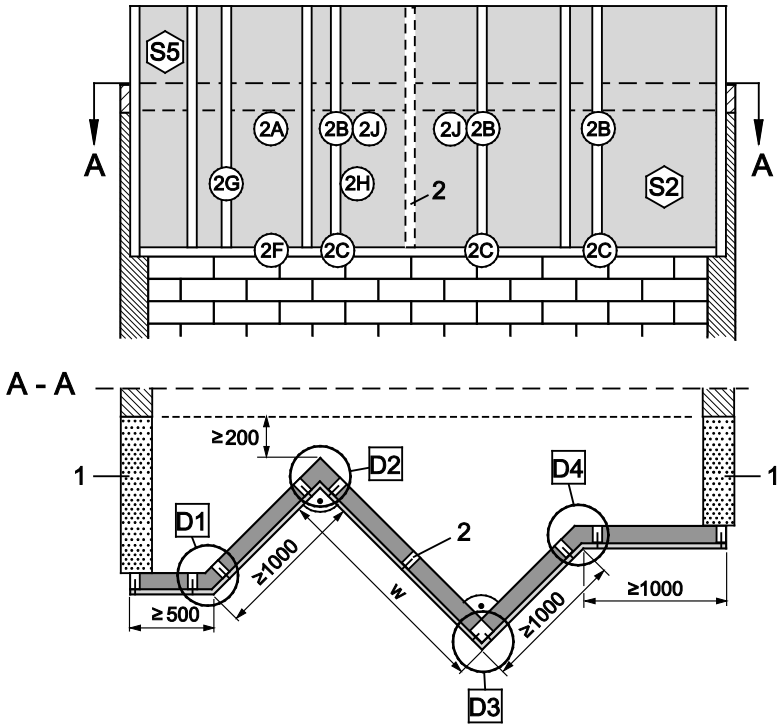
S2 surface 2

S3 surface 3

S5 surface 5

Figure 5 — Definition of surfaces relevant for determination of temperature rise on unexposed face

Dimensions in millimetres

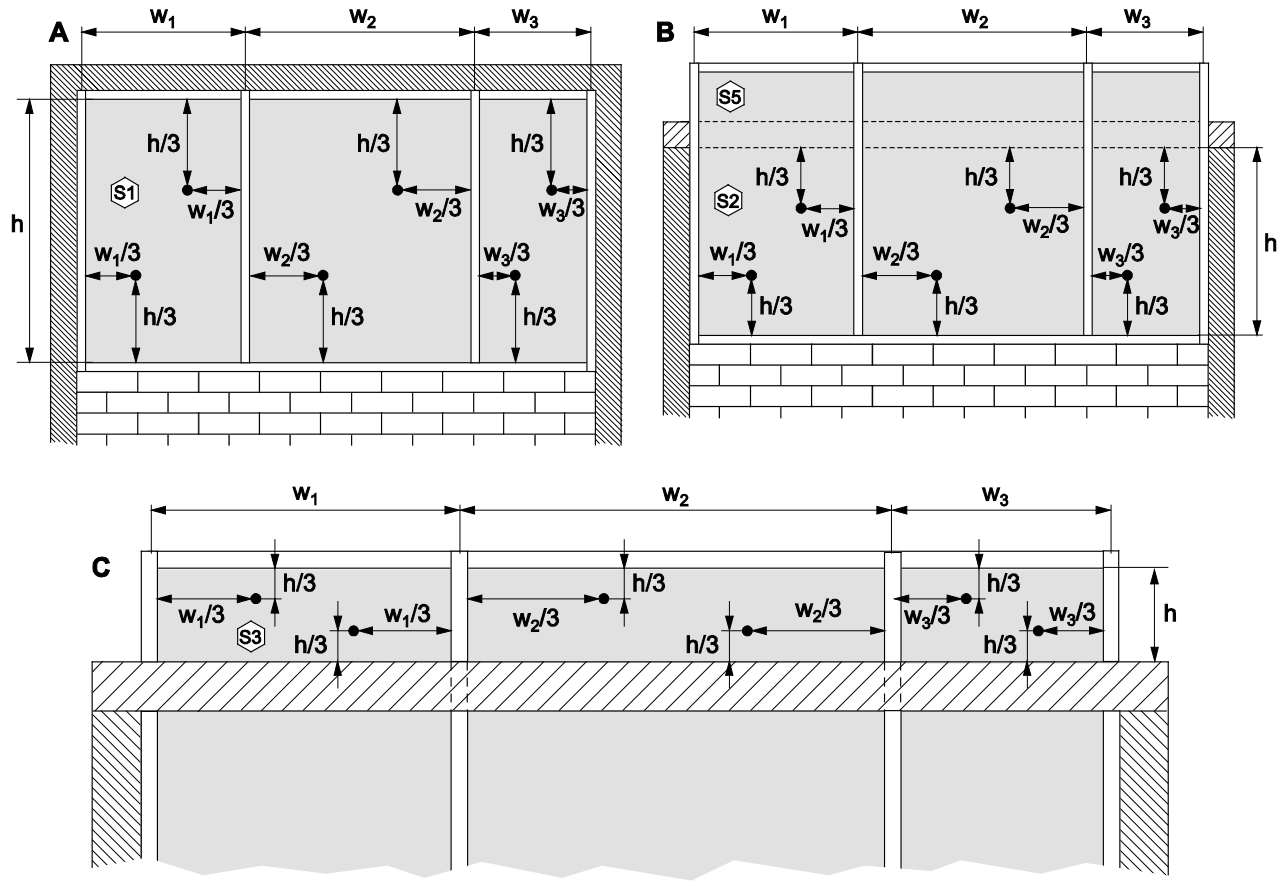


Key

	supporting floor (see 7.2)
	spandrel panel
	furnace wall
	furnace closure
1	associated wall
2	optional mullion
2A to 2J	thermocouples on Surface 2
A-A	vertical section
D1 to D4	for details see Figure 9
A-A	horizontal section
S2, S5	surfaces 2 and 5
w	width of the spandrel panel; may be varied to allow adjustment of the specimen to the furnace needs; minimum 1000 mm

NOTE Combination specimen according to Figure 3E shown as example.

Figure 6 — Location of the thermocouples (maximum temperature rise) for internal exposure – faceted specimen, view from outside the furnace



Key

A thermocouples on Surface 1 (standard configuration 4)

B thermocouples on Surfaces 2 and 5 (standard configuration 3)

C thermocouples on Surface 3 (standard configurations 3 as example)

furnace closure

supporting floor

spandrel panel

furnace wall

furnace closure (in case of Surface 3 only used for standard configuration 3)

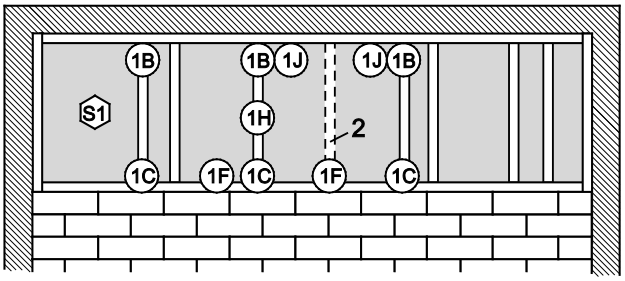
location of thermocouples

h height of spandrel panels

S1 to S5 surfaces 1, 2, 3, 5

w1, w2, w3 width of spandrel panels 1, 2 and 3

Figure 7 — Location of thermocouples (mean temperature rise) on Surfaces S1, S2 and S3, straight specimen

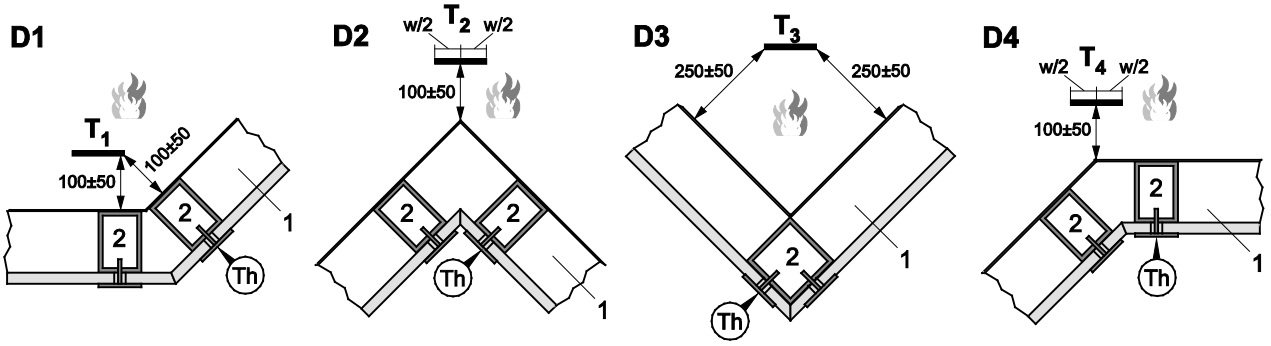


Key

	spandrel panel
	furnace wall
	furnace closure
1	associated wall
2	optional mullion
1A to 1J	thermocouples on Surface 1
S1	surface 1
NOTE	combination specimen according to Figure 3F shown as example.

Figure 8 — Location of thermocouples (maximum temperature rise) for external exposure – faceted specimen, view from outside the furnace

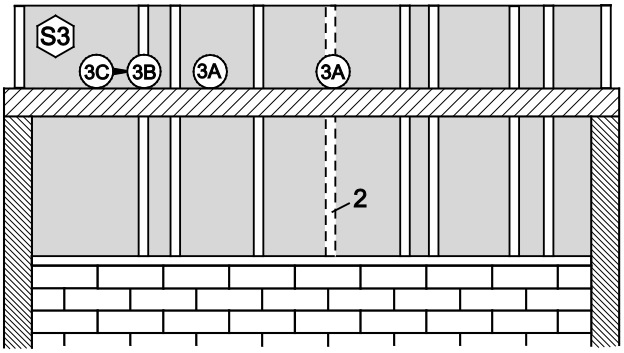
Dimensions in millimetres



Key

1	perimeter seal
2	mullion
D1	convex angle between horizontally adjacent infill panels - detail D1 from Figure 6
D2	concave corner - detail D2 from Figure 6
D3	convex corner - detail D3 from Figure 6
D4	concave angle between horizontally adjacent infill panels - detail D4 from Figure 6
T1 – T4	furnace thermometers
Th	position of thermocouples 2B, 2C and 2G
NOTE	type of mullions shown is only an example.

Figure 9 — Details of the corner / facet angle construction and location of furnace thermometers for internal exposure – faceted specimen



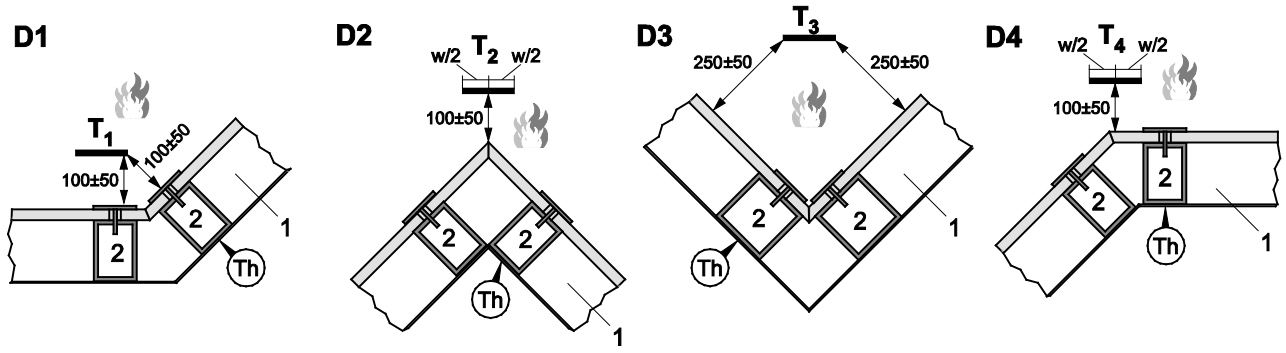
Key

	supporting floor (see 7.2)
	spandrel panel
	furnace wall
	furnace closure
1	associated wall
2	optional mullion
3A, 3B	thermocouples on Surface 3
S3	surfaces 3

NOTE combination specimen according to Figure 3E shown as example.

Figure 10 — Location of thermocouples (maximum temperature rise) for internal exposure – faceted specimen, view from inside the furnace

Dimensions in millimetres

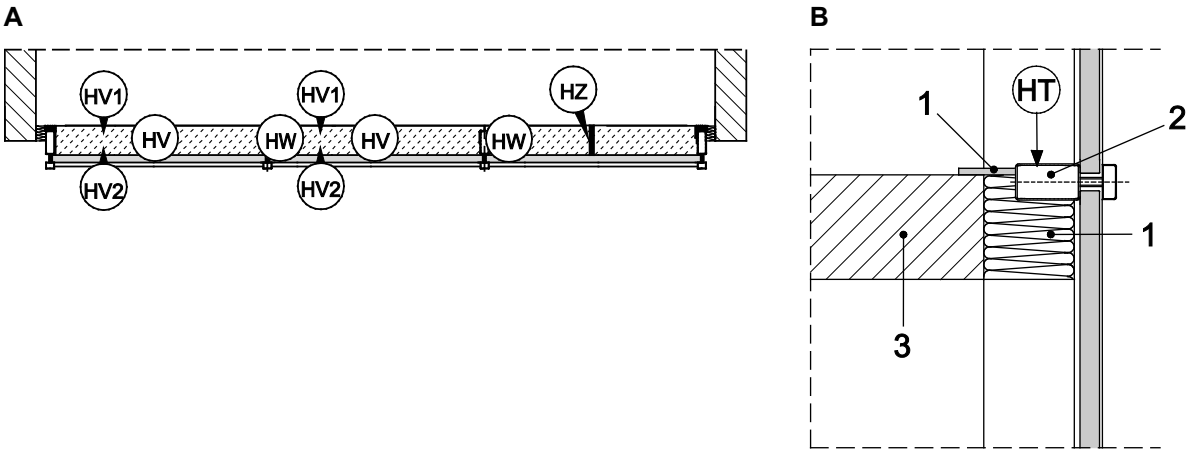


Key

1	perimeter seal
2	mullion
D1	concave angle between horizontally adjacent infill panels
D2	convex corner
D3	concave corner
D4	convex angle between horizontally adjacent infill panels
T1 – T4	furnace thermometers
Th	position of thermocouples 1B and 1C

NOTE type of mullions shown is only an example.

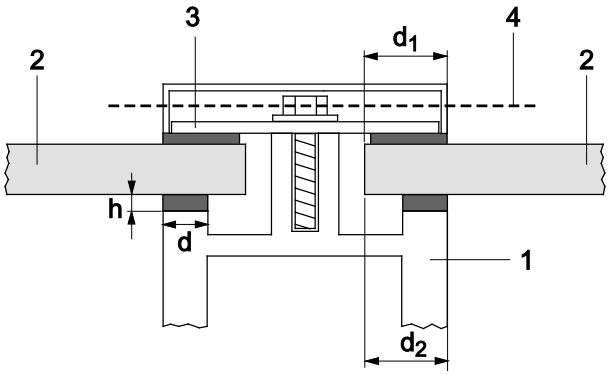
Figure 11 — Details of the corner construction and location of furnace thermometers for external exposure



Key

	perimeter seal
	splice
	vertical furnace closure
A	horizontal section
B	vertical section
1	perimeter Seal
2	transom
3	supporting floor
HV, HV1, HV2, HW	thermocouples on the perimeter seal
HZ	splice thermocouple
HT	thermocouple on transom

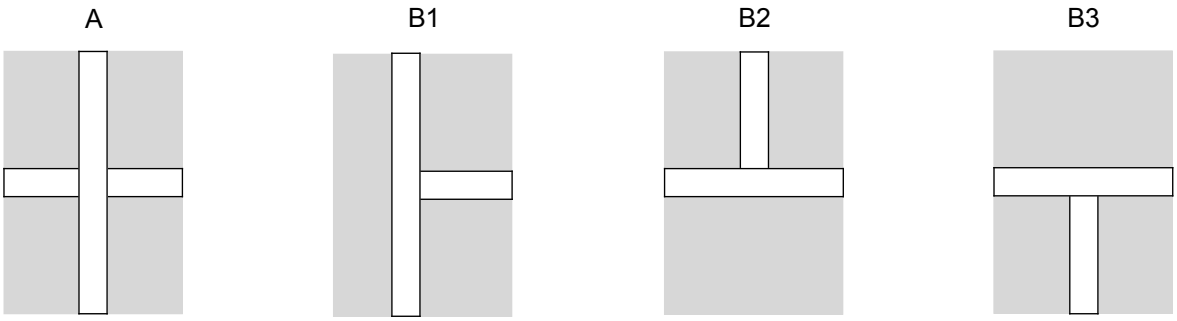
Figure 12 — Location of thermocouples on the perimeter seal



Key

1 mullion
2 infill panel
3 pressure plate
4 axis referred to in 13.1.3.7.2
d depth of the sealant / gasket
d1 outer edge cover / overlap of pressure plate
d2 inner edge cover
h height of the sealant / gasket

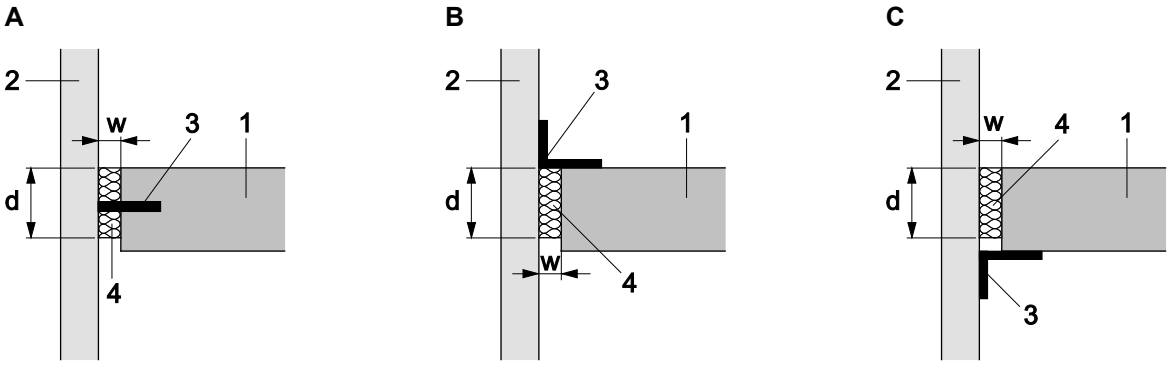
Figure 13 — Overlap of pressure plate



Key

A cross connection
B1 vertical T-connection
B2 horizontal / hanging T-connection
B3 horizontal / standing T-connection

Figure 14 — Connection between mullions and transoms



Key

A fixing in front of the floor slab

B fixing on top of the floor slab

C fixing on the underside of the floor slab

1 floor slab

2 curtain walling

3 fixing system

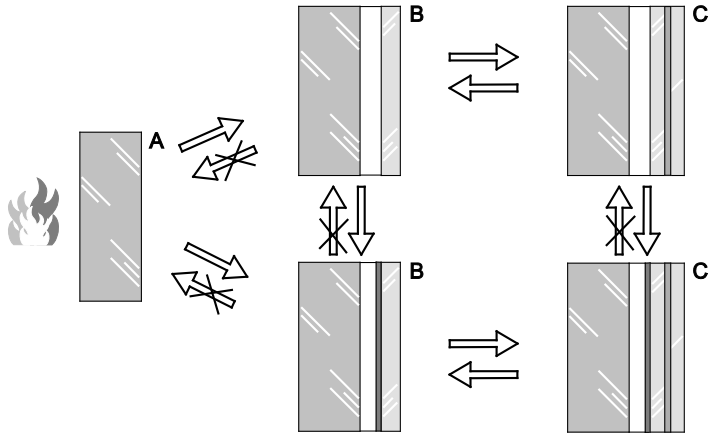
4 perimeter seal

d depth of the perimeter seal

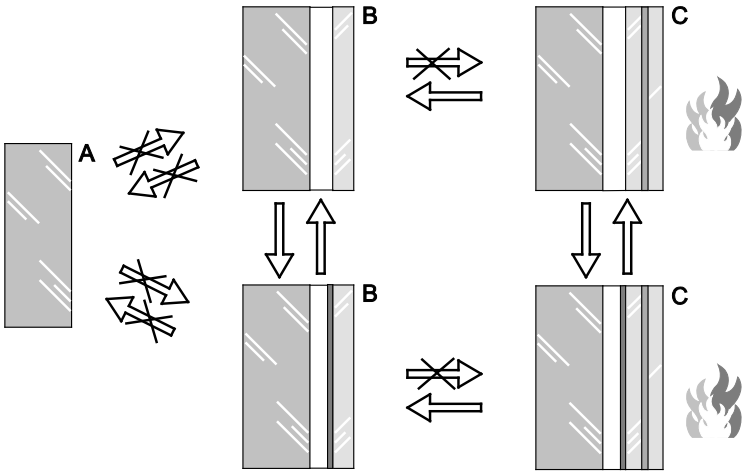
w nominal width of the perimeter seal

Figure 15 — Types of fixing of the framing system (anchoring) and definition of width and depth of the perimeter seal

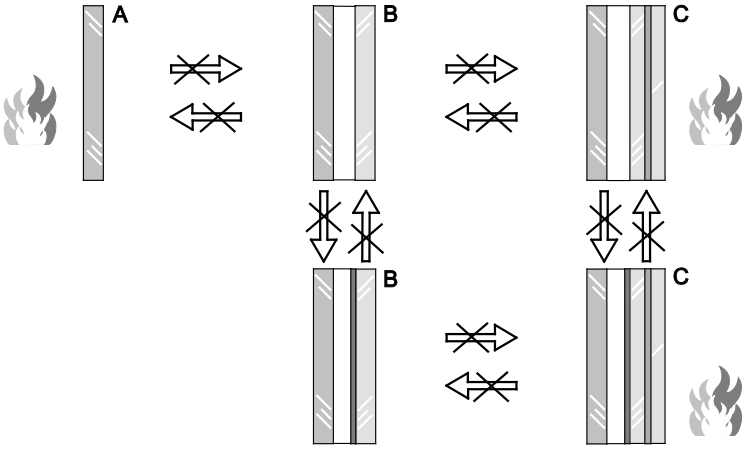
Fire resistant translucent or transparent spandrel panels for classification EI (i → o)



Fire resistant translucent or transparent spandrel panels for classification EI (o → i)



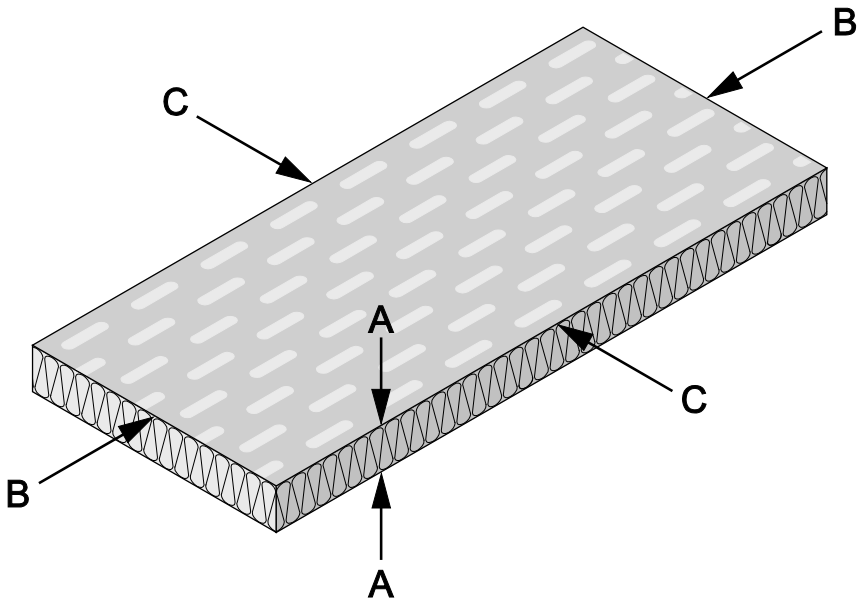
Fire resistant translucent or transparent spandrel panels for classification E, EW (o ↔ i, o → i or i → o)



Key

A, B, C type of fire resistant translucent or transparent spandrel panel

Figure 16 — Rules regarding types of fire resistant translucent or transparent spandrel panels



Key

A-A through the slab thickness, as produced

B-B along the slab length

C-C across the slab width

Figure 17 — Mineral wool – compression directions

Annex A
(informative)

Guidance on testing curtain walling – part configuration

A.1 Standard configuration

A.1.1 General

Most curtain walling are of proprietary design or of custom design and each manufacturer uses specialised techniques for the manufacture and the assembly of the systems. Unlike other wall systems, curtain walling are not fabricated by the erector from generic materials obtained through normal suppliers of building materials. Most installations have a unique configuration, on which information is required. Figure A.1 illustrates typical arrangements, but many other types are available.

The standard specifies tests which can be performed on parts of a curtain walling. Tests according this standard may be used on variations of components of a curtain walling type B in conjunction with results of tests according to part 3 of this standard (full configuration) or to test components of a curtain walling type A. The choice of test is made by the sponsor in consultation with the laboratory, to determine whether a particular standard configuration will meet the regulatory requirements.

A.1.2 Supporting floor

The standard supporting floor consists of reinforced concrete or reinforced aerated concrete provided with anchors for fixing. For special cases, steel floors or even wooden floors may be used.

A.1.3 Parts of a curtain walling

Curtain walling incorporate windows and, unless these incorporate fire-resistant glazing (curtain walling type B), the system cannot be tested in a furnace, as the failure of glazing will prevent continuation of the heating. Building regulations generally accept the use of non-fire-resistant glazing in the vision glass area of curtain walling (curtain walling type A) and hence it is only necessary to test the spandrel area. Either the upper (upstand) or the lower (downstand) part of the spandrel panel, or a combination, can be tested. In addition it is necessary to examine the other parts of the system, particularly the method of attachment to the building and the perimeter seal.

Figure A.2 shows the different types of components. Annex B shows a standard configuration for the spandrel panel using a combination of upstand and downstand with a particular part of the height of the spandrel panel above the floor that covers all arrangements of the spandrel panel regarding its height position in relation to the floor. The height above the floor is half of the spandrel panel height for curtain walling type A and a quarter for curtain walling type B to allow a sufficient portion of the spandrel panel be heated on the one side but allowing sufficient area for measuring temperature on the unexposed face. If EW classification is required (in case translucent or transparent panels are used in the spandrel area EW classification is required in some national building regulations) minimum 500 mm height of the upstand is necessary to allow measurement of radiation.

The standard configurations shown in Annex B are defined to mirror the different situation for curtain walling type A and type B: In case of type A both sides of the spandrel panel will be exposed to heat in practice regardless on which side of the curtain walling the fire starts, whereas this is not the case for curtain walling type B.

A.1.4 Specimen selection

The specimen selected for the fire test should include all the essential features of the system which have an influence on its fire performance. The specimen should include examples of typical mullion fixing, if used in practice, and joints in the spandrel panels. Even if the curtain walling is not attached to every floor or wall, the test specimen needs to include an example of these connections, except when only the perimeter seal is to be tested and a mechanically induced cycling is intended to be performed before the fire test.

When testing parts of a curtain walling, the edges of the specimen should not be protected any more than they would be in practice, as one of the aspects examined in the test is the transfer of fire through the panels to the upper level.

A.2 Test principles and requirements

Figure A.1 shows typical curtain walling.

The test procedure described in this standard is concerned with establishing the fire resistance of parts of curtain walling, which differ in concept from other types of external wall. Figure A.2 clarifies which part of EN 1364 applies to which type of curtain walling. For example, for determination the behaviour of a curtain walling type B the test described in EN 1364-3 is used.

The test is specific to parts of a curtain walling and evaluates their fire resistance for the following aspects (see Table A.1):

a) the curtain walling type B is:

— either exposed internally with the standard temperature/time curve according to EN 1363-1,

— and/or externally with the external fire exposure curve according to EN 1363-2 or the standard temperature/time curve according to EN 1363-1, depending on national requirements;

b) the curtain walling type A is exposed internally and from underneath with the standard temperature/time curve according to EN 1363-1 and at the same time externally with either the external fire exposure curve according to EN 1363-2 or the standard temperature/time curve according to EN 1363-1, depending on national requirements,

c) the perimeter seal between the floor and the curtain walling exposed from underneath with the standard temperature/time curve according to EN 1363-1;

d) the fixing of the framing system exposed from underneath with the standard temperature/time curve according to EN 1363-1;

e) cavities within the curtain walling.

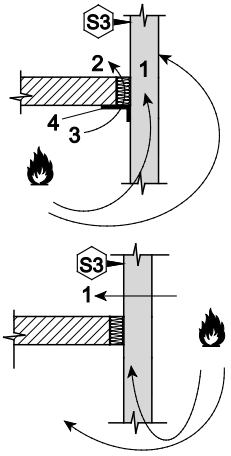
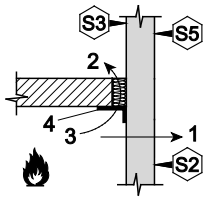
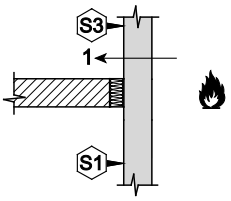
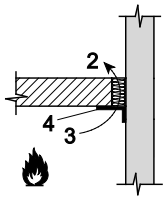
The test specified in EN 1364-4 is generally used to examine the fire resistance of parts of a curtain walling in the event of an internal and/or external fire, because normally curtain walling are built without fire-resistant glazing outside the spandrel area. This includes the ability of the parts of a curtain walling to prevent the transfer of fire to a higher level through the junction between the floor and the curtain walling and through any cavities in the curtain walling. These are national requirements.

Table A.1 summarises the above details and indicates which criteria, i.e. integrity and insulation, apply to each component.

Either a horizontal furnace of adequate depth (floor furnace) or a vertical furnace (wall furnace) may be used, provided that the specified heating and pressure conditions can be achieved.

The test specified in EN 1364-3 is used to examine full configuration of a curtain walling type B with fire-resistant glazing outside the spandrel area (fully fire resistant curtain walling).

Table A.1 — Explanation of test principles

Standard test configuration (see Annex B)	**Fire exposure** a	**Exposure conditions and surfaces tested**	**Possible classifications / remark** b	**Suitable for product / component of curtain walling to be tested**	**Type of curtain walling** c
1, 2	internal and external		Spandrel area: E (i → o), E (i ↔ o), EI (o → i), EW (o → i), Perimeter seal: EI	Upstand + Downstand, Perimeter seal, Fixing of the framing system, Combination	A
3	Internal		Spandrel area: E (i → o), EI (i → o) Perimeter seal: EI	Upstand + Downstand, Perimeter seal, Fixing of the framing system, Combination	B
4	External		Spandrel area: E (o → i), EI (o → i)	Upstand + Downstand	
5	Internal		Perimeter seal: EI	Perimeter seal, Fixing of the framing system	A, B

Key

S1, S2, S3, S5 Surface 1, 2, 3, 5

1 Integrity (and insulation 140 K/180 K) of spandrel area (upstand/downstand)

2 Integrity and insulation 180 K of perimeter seal

3 Adequacy of fixing of the framing system – loadbearing function

4 Fixing of the framing system

a Internal = Standard time temperature curve according to EN 1363–1, external = external exposure curve according to

Standard test configuration (see Annex B)	Fire exposure a	Exposure conditions and surfaces tested	Possible classifications / remark b	Suitable for product / component of curtain walling to be tested	Type of curtain walling c
EN 1363–2, subject to other requirements in national regulations. b Depending on national regulations. c For definition see 3.2 and 3.3 NOTE Curtain walling will always be asymmetrical in an axis perpendicular to the surface but the orientation is fixed. This means that always the inner side will be exposed to internal fire exposure and the outer side to the external fire conditions.					

A.3 Fire from the inside

A.3.1 General

Figures A.1 and A.2 show various constructions for external walls in practice. The choice of the test arrangements depends on how the wall is to be used in practice, on whether it is to be tested for internal or external exposure to fire and on whether type A or type B is used in practice.

In the European countries the national requirements differ. The fire safety objective is to prevent a fire from the room of origin to spread to other compartments above, below or beside it within the building.

A.3.2 Curtain walling type A

For curtain walling type A the part configuration simulates a situation where the window was broken by the fire by exposing the specimen to fire from both sides (standard configurations 1 and 2). The performance criteria for this exposure are:

a) integrity for the part configuration,

b) insulation for the internal face above the floor (upstand),

c) integrity and insulation for the perimeter seal, if required.

The temperature of the fixing of the framing system has to be measured but is not an acceptance criterion, see also A.3.5.

Standard configuration 1 is used when the requirement for the o → i classification is the external fire exposure curve according to EN 1363-2. Standard configuration 2 is used when the requirement for the o → i classification is the standard temperature/time curve according to EN 1363-1.

The insulation criterion on the external face of the curtain walling is of no interest in case of non-fire-resistant glazing because of the simulation of the broken windows.

A.3.3 Curtain walling type B

For curtain walling type B the part configuration simulates a situation where the window or vision glass area withstands the fire by exposing the specimen to fire only from one side using an additional furnace closure (standard configurations 3 and 4). The performance criteria for this exposure are:

a) Integrity or integrity and insulation for the part configuration depending on the intended classification,

b) integrity and insulation for the perimeter seal, if required.

The temperature of the fixing of the framing system has to be measured but is not an acceptance criterion, see also A.3.5.

Where the standard configurations for curtain walling type B are used always two separate tests are necessary to determine both internal and external fire exposure for classification (i ↔ o).

A.3.4 Perimeter seal

Where the intention of the test is only the perimeter seal or the fixing of the framing system, standard configuration 5 is recommended but also configuration 1 or 3 depending on the type of curtain walling may be used. Results from standard configuration 3 may be restricted to curtain walling type B.

Rules regarding test requirements in case movement capability for the perimeter seal is required are given in ETAG 026-3.

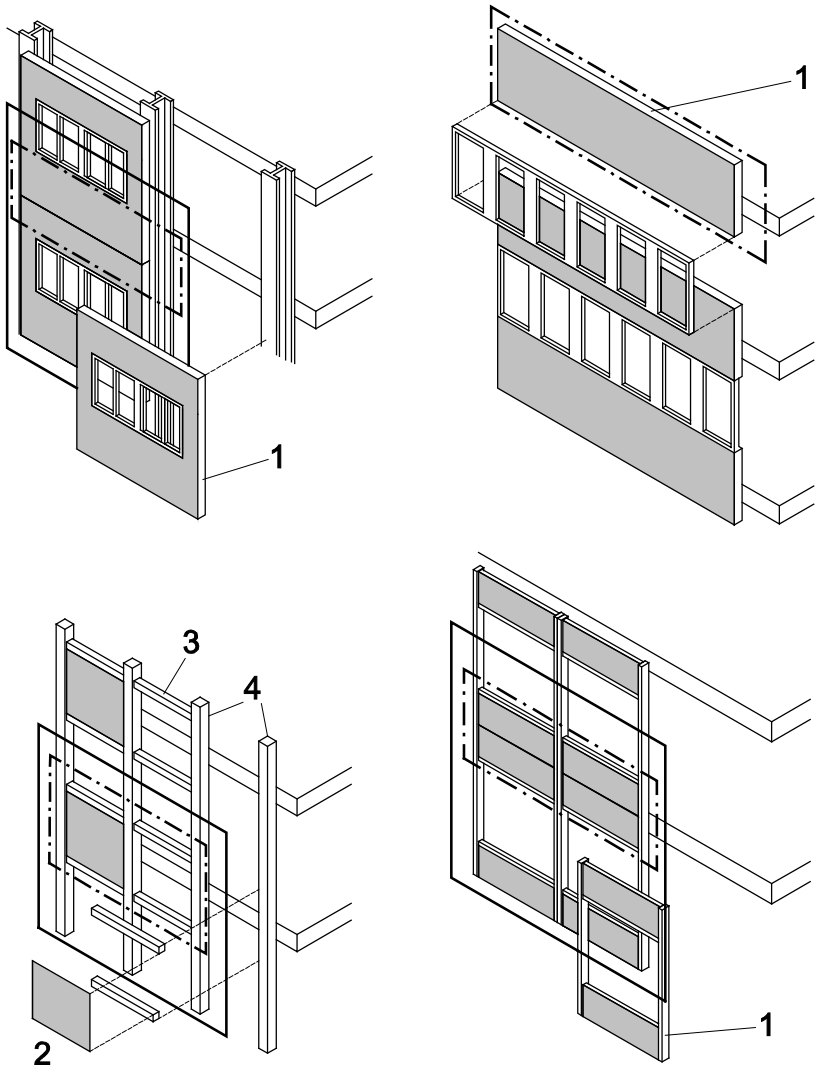
A.3.5 Fixing of the framing system

Although no acceptance criterion is specified for the temperature rise of fixings, this information can be used to assess their loadbearing capacity. For fixings made of Aluminium and Aluminium alloys EN 1999-1-2 contains information on the temperature dependence of the strength of Aluminium and Aluminium alloys that may be used to assess the test results as a basis for a proper design of the fixings.

A.4 Fire from the outside

If the curtain walling is to be tested for external exposure, a fully representational three-dimensional construction is not necessary (only the framing and the spandrel panel without supporting floor, perimeter seal and fixing of the framing system), as the perimeter seal and the fixing will not be subjected to heat..

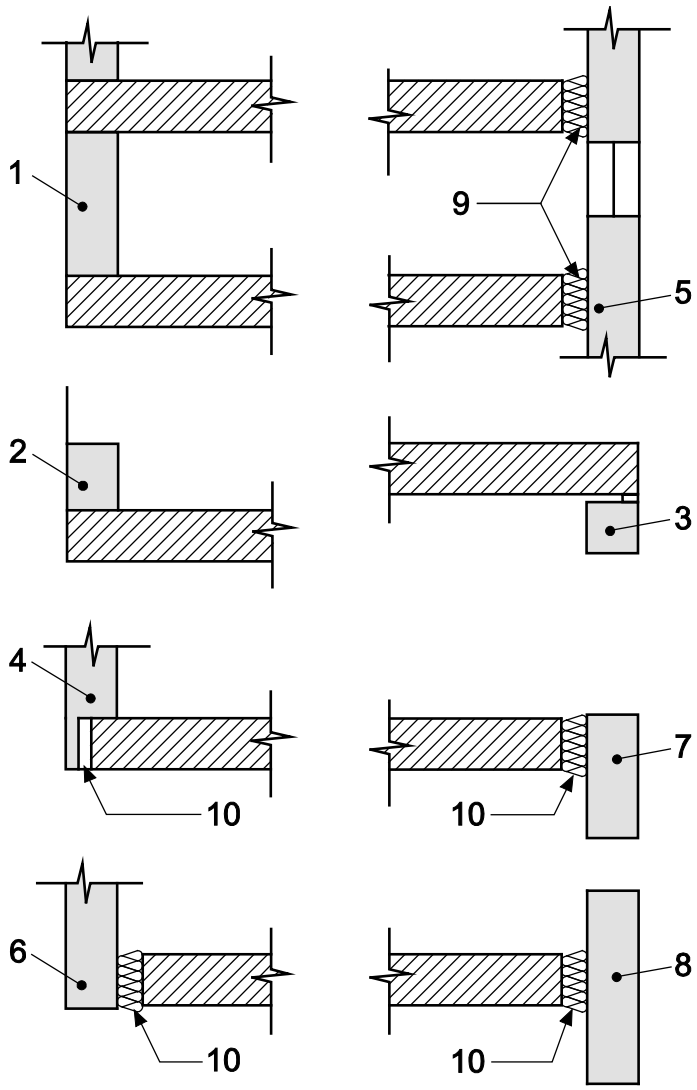
For the purpose of assessing the fire resistance of a curtain walling with the exposure from the outside, a test result on a test in accordance with EN 1364-1 may be acceptable (see Clause 13).



Key

▭	full configuration test specimen (EN 1364–3)
▭	part configuration test specimen (EN 1364–4)
1	pre-fabricated elements of the curtain walling
2	spandrel panel
3	transom
4	mullion

Figure A.1 — Appropriate test method for different wall configurations



Key

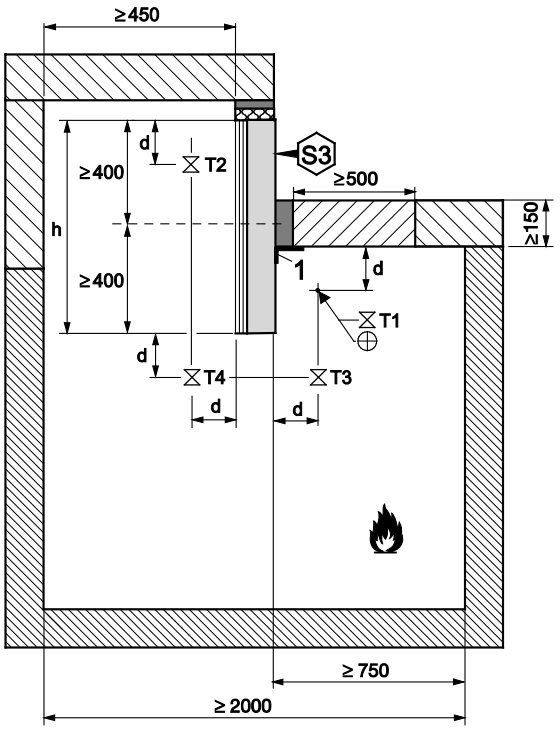
Item	Type of external wall	Component	Standard
1	external wall between floors	complete wall (full scale)	EN 1364–1
2	external wall between floors	spandrel, placed completely on the floor	EN 1364–1
3	external wall between floors	spandrel (downstand), hung up below the floor	EN 1364–1
4	external wall partially between floors	spandrel (upstand), placed partly on the floor	EN 1364–4
5	curtain walling type B	complete wall (full scale)	EN 1364–3
6	curtain walling type A or B	spandrel (upstand) placed in front of the floor	EN 1364–4
7	curtain walling type A or B	spandrel (downstand) placed in front of the floor	EN 1364–4
8	curtain walling type A or B	spandrel (combination of items 6 and 7)	EN 1364–4
9	curtain walling type B	perimeter seal	EN 1364–3 or EN 1364–4
10	curtain walling type A or B	perimeter seal	EN 1364–4

Figure A.2 — Appropriate test method depending on the type of external wall / curtain walling (component)

Annex B
(normative)

Standard configurations

Dimensions in millimetres

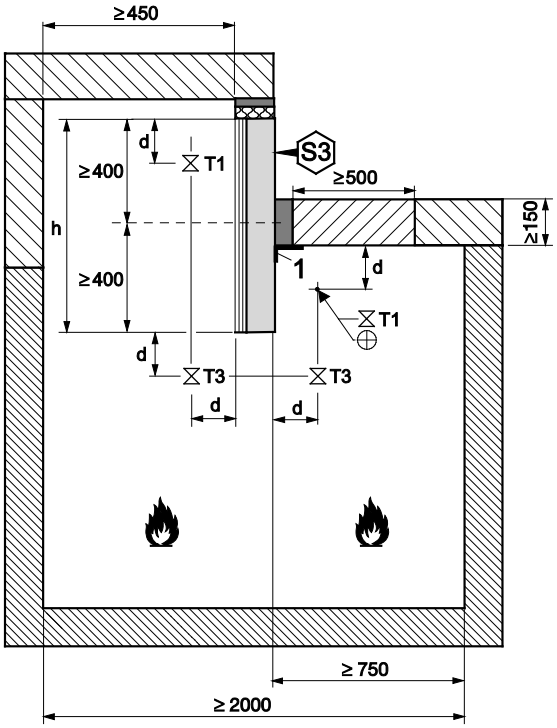


Key

	furnace wall
	furnace closure
	supporting floor
	part of curtain walling (spandrel panel - combination upstand / downstand)
	perimeter seal
	mineral wool packing with optional intumescent material (dark area) according to 7.3
1	fixing of the framing system (example position and simplified)
h	height of test specimen, minimum 800 mm (depending on national requirements)
⧖ T1, T3	plate thermometers for furnace control (internal exposure)
⧖ T2, T4	additional plate thermometers for information (external exposure)
⊕	pressure measurement for furnace control
d	distance of plate thermometer d = (100 ± 50) mm
S3	surface 3

Figure B.1 — Standard configuration 1

Dimensions in millimetres

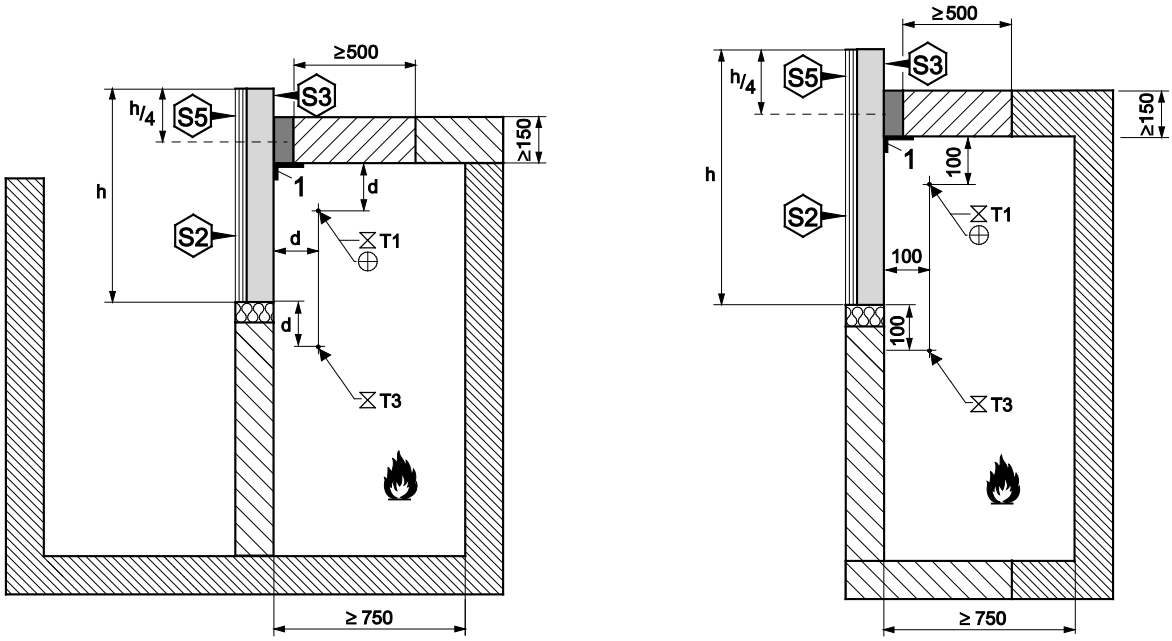


Key

	furnace wall
	furnace closure
	supporting floor
	part of curtain walling (spandrel panel - combination upstand / downstand)
	perimeter seal (not part of the test)
	mineral wool packing with optional intumescent material (dark area) according to 7.3
h	height of test specimen, minimum 800 mm (depending on national requirements)
⧖T1, T3	plate thermometers for furnace control (external exposure)
⊕	pressure measurement for furnace control
d	distance of plate thermometers d = (100 ± 50) mm
S3	surface 3

Figure B.2 — Standard configuration 2

Dimensions in millimetres



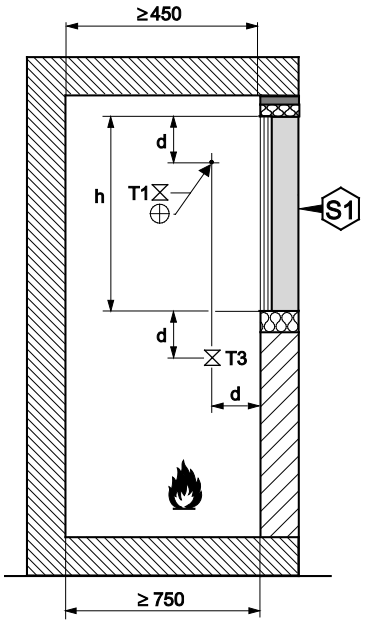
Floor furnace Wall furnace

Key

	furnace wall
	furnace closure
	supporting floor
	part of curtain walling (spandrel panel - combination upstand / downstand)
	perimeter seal
	mineral wool packing
1	fixing of the framing system (example position and simplified)
h	height of test specimen
⧖T1, T3	plate thermometers for furnace control
⊕	pressure measurement for furnace control
d	distance of plate thermometers d = (100 ± 50) mm
S2, S3, S5	surfaces 2, 3 and 5

Figure B.3 — Standard configuration 3

Dimensions in millimetres

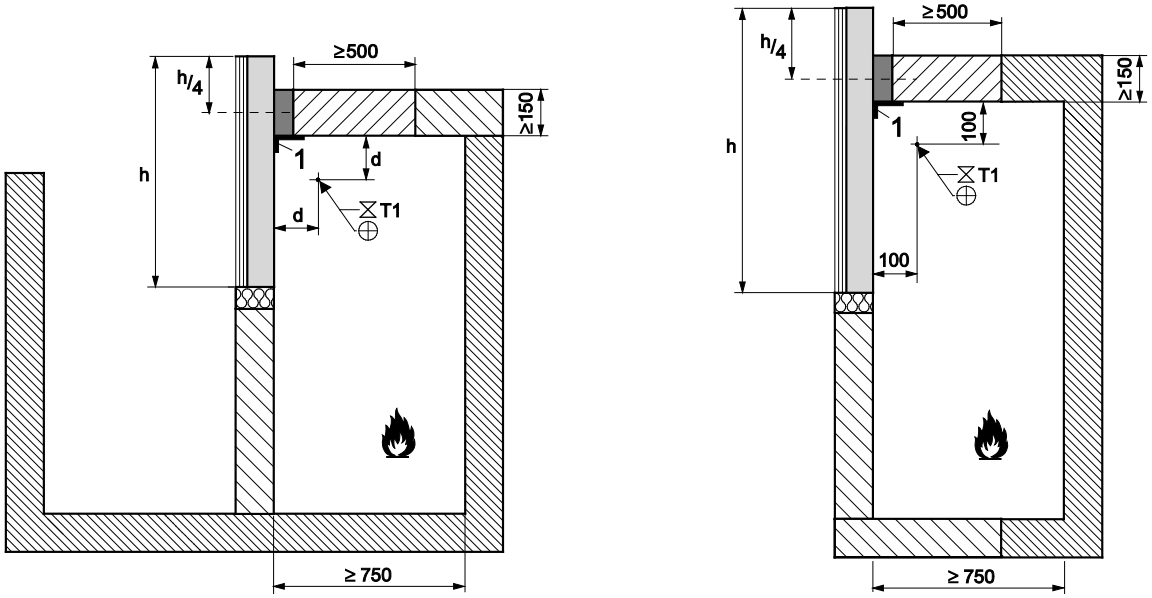


Key

	furnace wall
	furnace closure
	part of curtain walling (spandrel panel - combination upstand / downstand)
	mineral wool packing
	mineral wool packing with optional intumescent material (dark area) according to 7.3
h	height of test specimen
⧖T1, T3	plate thermometers for furnace control
⊕	pressure measurement for furnace control
d	distance of plate thermometers d = (100 ± 50) mm
S1, S3	surfaces 1 and 3

Figure B.4 — Standard configuration 4

Dimensions in millimetres



Floor furnace Wall furnace

Key

furnace wall

furnace closure

supporting floor

part of curtain walling (spandrel panel – combination upstand / downstand)

perimeter seal

mineral wool packing

1 fixing of the framing system (example position and simplified)

h height of test specimen, minimum 800 mm

⧖T1 plate thermometers for furnace control

⊕ pressure measurement for furnace control

d distance of plate thermometers d = (100 ± 50) mm

Figure B.5 — Standard configuration 5

Annex C
(normative)

Radiation calculation

The following Formulae (C.1) to C.3 shall only be applied to a test specimen of a curtain walling type A with the same fire resistant translucent or transparent spandrel panel in the entire spandrel area.

According to EN 13501-2, the radiation classification shall be given only by the time for which the measured radiation does not exceed the maximum value W_{max} = 15 kW/m^2. On this basis, the same value W_{max} shall be used as the maximum radiation intensity allowed for determination of the maximum upstand area covered by the test results, based on a test using either standard configuration 1 or 2 according to Annex B.

The calculation shall only be used for rectangular fire resistant translucent or transparent spandrel panels.

The maximum upstand area covered may be determined using the following procedure, subject to other restrictions resulting from the rules given in 13.1, and provided that the mean unexposed face temperature remained below 300° C:

— W_{calc} is calculated according to the mathematical functions given in Formulae (C.1) to (C.3) for several values of h_{calc} and w_{calc};

— The set of values for h_{calc} and w_{calc} for which W_{calc} is equal to or smaller than W_{max} = 15 kW/m^2 are the dimensions of the upstand area covered.

Figure C.1 illustrates the results of such calculations for a width of 3000 mm and heights from 500 to 800 mm in the test and a measuring distance of 1000 mm. The values for the height of the upstand covered by a test with these dimensions may be taken out of the diagram depending on the result for W_0 achieved, provided the upstand is not wider than 3 m in practice. Figure C.2 provides results for a width of 9 m and 20 m in practice.

$$W_{calc} = W_0 \times \left[\frac{\varphi_{calc}}{\varphi_0} \right] \leq W_{\max} \tag{C.1}$$

with

$$\varphi_0 = \frac{2}{\pi}\left[\frac{w_0}{\sqrt{w_0^2 + 4d^2}} \times \arctan\left(\frac{h_0}{\sqrt{w_0^2 + 4d^2}} \right) + \frac{h_0}{\sqrt{h_0^2 + 4d^2}} \times \arctan\left(\frac{w_0}{\sqrt{h_0^2 + 4d^2}} \right) \right] \tag{C.2}$$

$$\varphi_{calc} = \frac{2}{\pi}\left[\frac{w_{calc}}{\sqrt{w_{calc}^2 + 4d^2}} \times \arctan\left(\frac{h_{calc}}{\sqrt{w_{calc}^2 + 4d^2}} \right) + \frac{h_{calc}}{\sqrt{h_{calc}^2 + 4d^2}} \times \arctan\left(\frac{w_{calc}}{\sqrt{h_{calc}^2 + 4d^2}} \right) \right] \tag{C.3}$$

where

W_{calc} is the calculated radiation for a upstand area of dimensions h_{calc} and w_{calc};

W_0 is the measured radiation from the test specimen (upstand, S3) at the time of classification;

φ_0 is the configuration factor for tested test specimen (upstand);

φ_{calct} is the configuration factor of the upstand area of dimensions h_{calc} and w_{calc};

d is the distance between test specimen and sensor (normally 1 m as required by EN 1363-2);

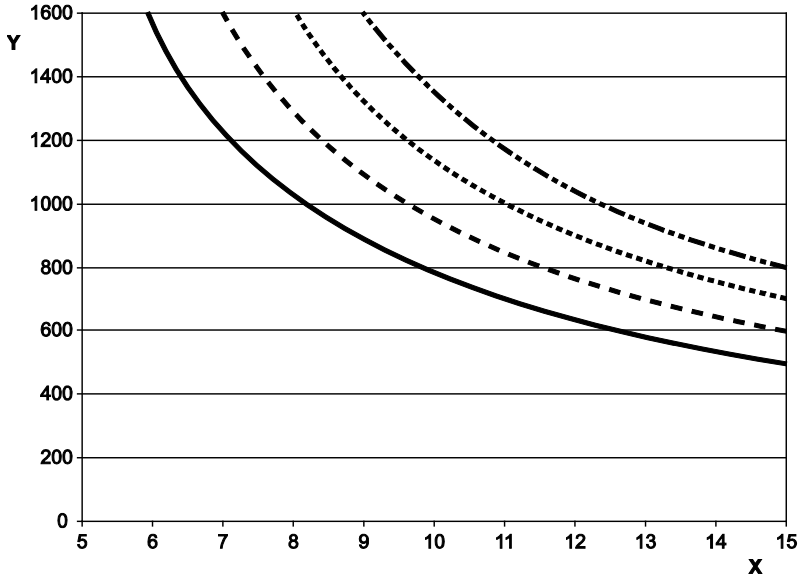
w_o, h_o is the width and height of the heated area of the upstand area;

w_{calc}, h_{calc} is the width and height of the upstand area chosen for calculation;

NOTE Source: VDI-Wärmeatlas.

In any case the final calculated radiation value W_{calc} for the selected dimensions shall be equal or less than W_{max} = 15 kW/m^2. This may limit the field of application according to 13.1.4.4.2 for the size of the spandrel area or the W-classification will be lost.

The relevant calculation shall be provided in the test report.

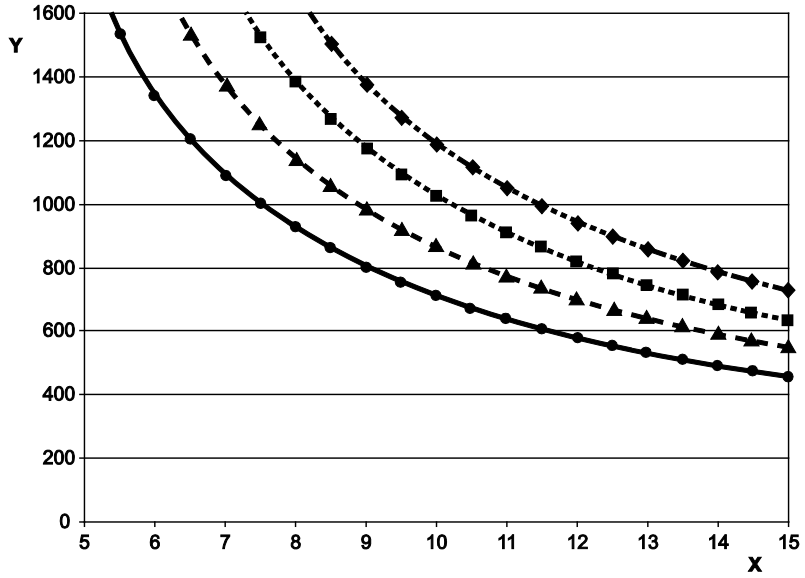


Key

X W_0 [kW/m^2]

Y upstand height covered [mm]

Figure C.1 — Calculation results for an upstand width of 3 m in practice



Key

X W_0 [kW/m^2]

Y upstand height covered [mm]

Figure C.2 — Calculation results for an upstand width of 9 m and 20 m in practice

Annex D
(normative)

Field of direct application of test results for unitised construction

D.1 Rules for curtain walling type A

D.1.1 General

The rules given in D.1.2 to D.1.4 shall not be used for curtain walling constructions with glued infill panels (e.g. Structural Sealant Glazing Systems – SSGS).

D.1.2 Exposure conditions

The rules given in 13.1.1.2 apply.

D.1.3 Rules for the complete construction

D.1.3.1 Width of the curtain walling

The rules given in 13.1.2.1 apply.

D.1.3.2 Direction of fire exposure

The rules given in 13.1.2.5 apply.

D.1.4 Spandrel panels

D.1.4.1 Position in relation to the floor

The rules given in 13.1.4.1 apply.

D.1.4.2 Opaque (non-translucent/non-transparent) infill panels

The rules given in 13.1.4.2 apply.

D.1.4.3 Sandwich panels

The rules given in 13.1.4.3 apply.

D.1.4.4 Translucent or transparent infill panels

The rules given in 13.1.4.4 apply.

D.2 Rules for curtain walling type B

The related rules given in EN 1364-3 apply, subject to the restrictions given in the scope of this part of the standard.

Bibliography

[1] EN 1279-1, *Glass in Building - Insulating glass units - Part 1: Generalities, dimensional tolerances and rules for the system description*

[2] EN 1364-1, *Fire resistance tests for non-loadbearing elements - Part 1: Walls*

[3] EN 1999-1-2, *Eurocode 9 — Design of aluminium structures — Part 1-2: Structural fire design*

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