BS EN 1364-1:2015

BSI Standards Publication

Fire resistance tests for non-loadbearing elements

Part 1: Walls

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National foreword

This British Standard is the UK implementation of EN 1364-1:2015. It supersedes BS EN 1364-1:1999 which is withdrawn.

The UK participation in its preparation was entrusted to Technical Committee FSH/22/-/7, Non loadbearing separating elements.

A list of organizations represented on this committee can be obtained on request to its secretary.

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

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Compliance with a British Standard cannot confer immunity from legal obligations.

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Fire resistance tests for non-loadbearing elements - Part 1: Walls

Essais de résistance au feu des éléments non porteurs - Partie 1 : Murs

Feuerwiderstandsprüfungen für nichttragende Bauteile - Teil 1: Wände

This European Standard was approved by CEN on 30 April 2015.

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European foreword

This document (EN 1364-1:2015) has been prepared by Technical Committee CEN/TC 127 "Fire safety in buildings", the secretariat of which is held by BSI.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by January 2016, and conflicting national standards shall be withdrawn at the latest by January 2016.

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 1364-1:1999.

This European Standard has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association.

The main changes with respect to the previous edition are listed below:

a) locations of thermocouples are modified in line with the definitions in EN 1363-1;

b) additional deflections measurements for larger constructions;

c) additional thermocouples on glazed constructions;

d) additional rules in the field of direct application for glazed constructions (Annex A);

e) rules for testing non-loadbearing external and internal walls designed to span horizontally (Annex B).

EN 1364 ‘Fire resistance tests for non-loadbearing elements’ consists of the following:

Part 1: Walls;

Part 2: Ceilings;

Part 3: Curtain walling - Full configuration (complete assembly);

Part 4: Curtain walling - Part configuration;

Part 5: Air transfer grilles.

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

The purpose of this test is to measure the ability of a representative specimen of a non-loadbearing wall to resist the spread of fire from one side to another.

It is applicable to non-loadbearing walls, with and without glazing, non-loadbearing walls consisting almost wholly of glazing and other non-loadbearing internal and external non-loadbearing walls.

It is not applicable to curtain walls (external non-loadbearing walls suspended in front of the floor slab), unless explicitly permitted under EN 1364-3 or EN 1364-4 which should contain details of the methodology to be used.

For external fire exposure to a non-loadbearing external wall, the external fire exposure curve given in EN 1363-2 is used.

CAUTION — The attention of all persons concerned with managing and carrying out this fire resistance test is drawn to the fact that fire testing may be hazardous and that there is a possibility that toxic and/or harmful smoke and gases may be evolved during the test. Mechanical and operational hazards may also arise during the construction of the test elements or structures, their testing and disposal of test residues.

An assessment of all potential hazards and risks to health 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 non-loadbearing walls.

This European Standard is used in conjunction with EN 1363-1.

It is applicable to internal non-loadbearing walls (partitions), with and without glazing, non-loadbearing walls consisting almost wholly of glazing (glazed non-loadbearing walls) and other non-loadbearing internal and external non-loadbearing walls with and without glazing.

The fire resistance of external non-loadbearing walls can be determined under internal or external exposure conditions. In the latter case the external fire exposure curve given in EN 1363-2 is used.

It is not applicable to:

a) curtain walls (external non-loadbearing walls suspended in front of the floor slab), unless explicitly permitted under EN 1364-3 or EN 1364-4 which contain details of the methodology to be used.

b) non-loadbearing walls containing door assemblies that are tested according to EN 1634-1.

Specific requirements for testing glazed elements or non-loadbearing walls incorporating glazing are given in Annex A.

Specific requirements relating to the testing of non-loadbearing external and internal walls designed to span horizontally between two independently proven fire resisting vertical structural elements are given in Annex B.

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 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 and EN ISO 13943, together with the following, apply:

3.1
non-loadbearing wall (partition)
wall designed not to be subject to any load other than its self-weight

3.2
internal non-loadbearing wall (partition)
wall, with or without glazing, which provides fire separation

Note 1 to entry It may be exposed separately to a fire from either side.

3.3
external non-loadbearing wall
wall forming the external envelope of a building

Note 1 to entry It may be exposed separately to an internal or an external fire.

3.4
insulated non-loadbearing wall
wall, with or without glazing, which satisfies both the integrity and insulation criteria for the anticipated fire resistance period

3.5
uninsulated non-loadbearing wall
wall with or without glazing which satisfies the integrity and/or the radiation criteria for the anticipated fire resistance period, but which is not intended to provide insulation

Note 1 to entry Such a non-loadbearing wall may consist entirely of uninsulated fire resistant glazing.

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, fixing materials etc, capable of satisfying the appropriate fire resistance criteria

3.7
insulated glazing
fire resistant glazing which satisfies both the integrity and insulation criteria for the anticipated fire resistance period

3.8
uninsulated glazing
fire resistant glazing which satisfies the integrity and/or the radiation criteria for the anticipated fire resistance period but which is not intended to provide insulation

3.9
glazed elements
building elements with one or more (light transmissive) panes, that are built in a frame with fixings and seals and which cannot be opened

3.10
pane
single piece of monolithic or laminated glass, or an insulating glass unit (IGU)

3.11
glazing system
glass and glazing materials used in the fire test to glaze the glass into its framing system, e.g. glazing strips, beads and bead fixings, setting blocks, gaskets, sealant (see Figure 16)

3.12
butt-joint(ed) glazing
glazing configuration where adjoining panes are connected without the use of framing profiles at the glass to glass joint

3.13
framing system
frame profiles and fixings to the supporting structure

Note 1 to entry See one example in Figure 16.

3.14
aspect ratio
ratio of the height of a pane to its width

3.15
mullion
vertical framing member separating and supporting two adjacent panes of glass or panels

3.16
transom
horizontal framing member separating and supporting two adjacent panes of glass or panels

3.17
standard supporting construction
form of construction used to close off the furnace and to support the non-loadbearing wall being evaluated and which has known resistance to thermal distortion

3.18
plinth
form of standard supporting construction that reduces the height of the opening by raising the support base to accommodate the test specimen

3.19
overrun time
period of fire resistance beyond the intended classification period achieved in the test

Note 1 to entry The overrun time is expressed in minutes.

4 Test equipment

In addition to the test equipment specified in EN 1363-1, and if applicable in EN 1363-2, the following is required:

A test frame shall be provided, the rigidity of which shall be evaluated by applying an expansion force within the frame at mid-way between two opposite members of the frame, and measuring the increase in the internal dimensions at these positions. This evaluation shall be conducted in both directions of the frame and the increase of the internal dimension shall be measured.

The increase in the internal dimensions of the test frame shall not exceed 5 mm with an applied force of 25 kN. In case of testing with a free edge, this requirement does not apply for the horizontal dimension.

5 Test conditions

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

6 Test specimen

6.1 Size

If, in practice, the height or width of the construction is 3 m or smaller, then that dimension of the test specimen shall be tested at full size. If any dimension of the construction is greater than 3 m, then that dimension shall be tested at not less than 3 m when tested without a supporting construction or 2,8 m when tested with a supporting construction.

6.2 Number

The number of test specimens shall be as given in EN 1363-1. However, where information is required under different exposure conditions or where the construction is to be evaluated with and without glazing, additional tests shall be undertaken for each situation using separate test specimens.

6.3 Design

6.3.1 General

The test specimen shall be either:

a) fully representative of the construction intended for use in practice, including any surface finishes and fittings which are essential and may influence its behaviour in the test,

or,

b) be designed to obtain the widest applicability of the test result to other similar constructions.

NOTE The design features which influence fire performance that should be included to give the widest application can be derived from the field of direct application, Clause 13.

Guidance on testing glazed elements or non-loadbearing walls incorporating glazing is given in Annex A.

Guidance on testing non-loadbearing external and internal walls designed to span horizontally between two independently proven fire resisting vertical structural elements is given in Annex B.

6.3.2 Vertical joints

The test specimen shall contain as many full width boards or panels as possible. Where the test specimen can incorporate at least two full width boards or panels, the free edge shall be adjacent to a full width board or panel on the exposed face (see Figure 1, case A). When it is not possible to incorporate two full width boards or panels into the test specimen, the single full width board or panel shall be located in the centre of the specimen, with smaller boards or panels of equal width on each side. The smaller boards or panels shall not be less than 500 mm wide (see Figure 1, case B). Where the smaller boards or panels would be less than 500 mm wide, only one shall be used next to the free edge of the specimen (see Figure 1, case C).

The test specimen should be designed to obtain the widest applicability of the test result when considered in conjunction with the direct and extended field of application rules. Some design features which influence fire performance that should be included can be derived from the field of direct application, Clause 13.

The test specimen shall only contain a mixture of different designs providing this is representative of end use applications.

If the element incorporates vertical joints in practice, then the test specimen shall incorporate a vertical joint. This joint shall be located between 350 mm and 650 mm in from the free edge and shall be on the outer layer of the unexposed face (see Figure 1, case D). If these joints are not intended to be staggered, Figure 1, case A prevails.

6.3.3 Horizontal joints

If the element incorporates horizontal joints in practice, then the test specimen shall incorporate a horizontal joint. This joint shall be located between 350 mm and 650 mm in from the top edge and shall be on the outer layer on the unexposed face.

NOTE Test specimens can incorporate both horizontal and vertical joints in the same test. If large dimension boards or panels e.g. 3 m high are used in practice, then this will necessitate two tests for a 3 m x 3 m furnace: one test to evaluate the effect of joints and another to evaluate the full height board or panel. An alternative is to use a 4 m high (or more) furnace in which both the full height board or panel together with the joints at the specified locations can be incorporated in one test.

6.3.4 Restraint

The edges shall be restrained as in practice.

When the width of the element in practice is larger than the front opening of the furnace, one vertical edge shall be left unrestrained and there shall be a gap of 25 mm to 50 mm between the free edge of the test specimen and the test frame. This gap shall be packed with a resilient non-combustible material, e.g. mineral fibre, to provide a seal without restricting freedom of movement.

Any construction including any sealing of the free edge shall respect the following principles:

a) prevent as far as possible the leakage of hot gases from the furnace into the test specimen;

b) prevent as far as possible the leakage of gasses out of the test specimen;

c) have as minimal effect as possible on the deformations of the test specimen;

d) have as minimal effect as possible on the insulation rating of the test specimen.

6.4 Construction

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

6.5 Verification

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

7 Installation of test specimen

7.1 General

The test specimen shall be installed in the test frame and, if used, the supporting construction, as in practice.

The whole area of the test construction shall be exposed to the heating conditions.

7.2 Supporting construction

If the size of the test specimen is smaller than the opening in the test frame then it shall be installed in the test frame using one of the following approaches:

a) Where the height of the test specimen is smaller than the height of the test frame opening, then a plinth shall be provided to reduce the opening to the required height. The plinth shall possess sufficient stability for the test specimen and shall be selected from one of the rigid standard supporting constructions in EN 1363-1.

b) Where the width of the test specimen is smaller, a standard supporting construction shall be provided on the vertical sides of the opening selected from either the rigid or flexible standard supporting constructions given in EN 1363-1.

NOTE If the test specimen is mounted in a non-standard supporting construction, then the result will only be valid for non-loadbearing walls mounted in the construction as tested.

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. There shall be at least one for every 1,5 m^2 of the area of the plane parallel to the exposed surface area of the test construction. The plate thermometers shall be oriented so that side 'A' faces the back wall of the furnace.

9.1.2 Unexposed face thermocouples

9.1.2.1 General

For uninsulated non-loadbearing walls, glazed or unglazed, the temperature of the unexposed face is not required to be measured and no thermocouples are therefore required to be attached.

For walls with an anticipated insulation performance, thermocouples of the type specified in EN 1363-1 shall be attached to the unexposed face for the purpose of obtaining the average and the maximum surface temperatures. Examples of location of unexposed face thermocouples are given in Figures 2 to 15.

General rules for the attachment and exclusion of thermocouples given in EN 1363-1 shall apply.

Unexposed surface thermocouples may be placed on the test specimen at any angle and do not need to be parallel to the plane of the unexposed face.

9.1.2.2 Average temperature

a) Uniform non-loadbearing walls

For test specimens which are uniform with respect to their expected thermal insulation, the average temperature of the unexposed face shall be measured by means of five thermocouples, one located close to the centre of the specimen and one close to the centre of each quarter section. Some typical examples are shown in Figures 2, 4, 6 and 9.

b) Non-uniform non-loadbearing walls

For test specimens of non-uniform non-loadbearing walls, i.e. those which contain discrete areas ≥ 0,1 m^2 expected to exhibit different levels of insulation performance e.g. glazing, each discrete area shall be individually monitored for average temperature rise. The average temperature rise shall be measured by thermocouples distributed over each discrete area. One thermocouple shall be provided for every 1,5 m^2 or part thereof of the specimen. A minimum of two thermocouples for each discrete area shall be provided. A typical example is shown in Figure 12.

9.1.2.3 Maximum temperature

For determination of maximum temperature thermocouples shall be applied, as a minimum, to the unexposed face as follows:

a) at the top of the specimen at mid-width.

b) at the top of the specimen in line with a stud/mullion.

c) at the junction of a stud and a rail, or at the junction of horizontal and vertical joints in a non-loadbearing wall system.

d) at mid height of the fixed edge.

e) at mid height of the free edge, 150 mm in from the edge of test specimen.

f) at mid width, where possible, adjacent to a horizontal joint (positive pressure zone).

g) at mid height, where possible, adjacent to a vertical joint (positive pressure zone).

Thermocouples for evaluating insulation shall not be positioned closer than 100 mm from any discrete area that is not being evaluated for insulation.

If electrical installation boxes, such as socket boxes are tested, the arrangement of the thermocouples is given in Figures 10 and 11.

9.2 Pressure

Pressure measuring devices shall be located in accordance with EN 1363-1.

9.3 Deflection

Appropriate instrumentation shall be provided to determine a history of all significant deflection (i.e. greater than 5 mm) of the test specimen during the test.

One (1) deflection measurement shall be made at the centre of the test specimen.

For a test specimen with a width larger than 3 meter, additional measurements shall be made at mid-height at ¼ and ¾ of the width of the specimen. For a test specimen with a height larger than 3 meter, additional measurements shall be made at mid-width at ¼ and ¾ of the height. See Figures 2, 4, 6, 9 and 12.

The interval of measurement shall be adequate to present a history of movement during the test.

Guidance on the application of deflection measurement is given in EN 1363-1.

NOTE Measurement of deflection is a mandatory requirement although there are no performance criteria associated with it. The deflection of the test specimen may be important in determining the direct field of application and may also be important in determining the extended field of application of the test result.

9.4 Radiation

If radiation is to be measured, heat flux meter shall be positioned as described in EN 1363-2.

9.5 Impact

If performance under the impact test is required, this shall be carried out as described in EN 1363-2.

10 Test procedure

The test shall be carried out using the equipment and procedures in accordance with EN 1363-1 and if appropriate EN 1363-2.

11 Performance criteria

The criteria by which the performance of the test specimen is judged are given in EN 1363-1. However, failure under all criteria shall be disregarded within 150 mm of the free edge, unless in practice the free edge is unrestrained.

12 Test report

In addition to the items required by EN 1363-1, a reference that the test was carried out in accordance with EN 1364-1 shall also be included in the test report.

13 Field of direct application of test results

13.1 General

The results of the fire test are directly applicable to similar constructions where one or more of the changes listed below are made and the construction continues to comply with the appropriate design code for its stiffness and stability, except with respect to the construction types covered in Annex A and Annex B where specific direct field of application rules are given.

a) decrease in height;

b) increase in the thickness of the wall;

c) increase in the thickness of component materials;

d) decrease in linear dimensions of boards or panels but not thickness;

e) decrease in stud spacing;

f) decrease in distance of fixing centres;

g) increase in the number of horizontal joints, of the type tested, when tested with one joint not more than (500±150) mm from the top edge;

h) increase in the number of vertical joints, of the type tested;

i) the use of installations such as electrical sockets, switches, etc. when tested as illustrated in Figures 9, 10 and 11 with the installations not more than 500 mm from the top edge;

j) horizontal and/or vertical joints, of the type tested.

For framing systems or systems with visible profiles on the unexposed side, intended to be used for EI classification, no increase in width and depth is allowed in case no temperature measurements on the unexposed side of the profiles were made during the test.

The field of direct application for glazed elements or non-loadbearing walls incorporating glazing is given in Annex A.

The field of direct application for non-loadbearing external and internal walls designed to span horizontally between two independently proven fire resisting vertical structural elements is given in Annex B.

13.2 Extension of width

For test specimens tested without a supporting construction, the width of an identical construction may be increased if the specimen was tested at a minimum of nominally 3 m wide with one vertical edge without restraint.

For test specimens tested with a supporting construction, the width of an identical construction may be increased if the specimen was tested at a minimum of nominally 2,8 m wide with one vertical edge without restraint.

In case of EW classification, an increase in width of an identical construction is only allowed when the average unexposed surface temperature of any discrete area of the test specimen remains below 300 °C or the measured radiation remains below 6 kW/m^2. In any other case, no increase in width is allowed.

13.3 Extension of height

The height of the construction may be increased by 1,0 m under the following conditions:

a) minimum tested height is 3 m when tested without a supporting construction or 2,8 m when tested with a supporting construction

b) the maximum deflection of the test specimen was not in excess of 100 mm (see 9.3)

c) the expansion allowances are increased pro-rata

In case of EW classification, an increase in height of an identical construction is only allowed when the average unexposed surface temperature of any discrete area of the test specimen remains below 300 °C or the measured radiation remains below 6 kW/m^2. In any other case, no increase in height is allowed.

13.4 Supporting constructions

The following rules for the field of application apply.

13.4.1 Standard supporting constructions

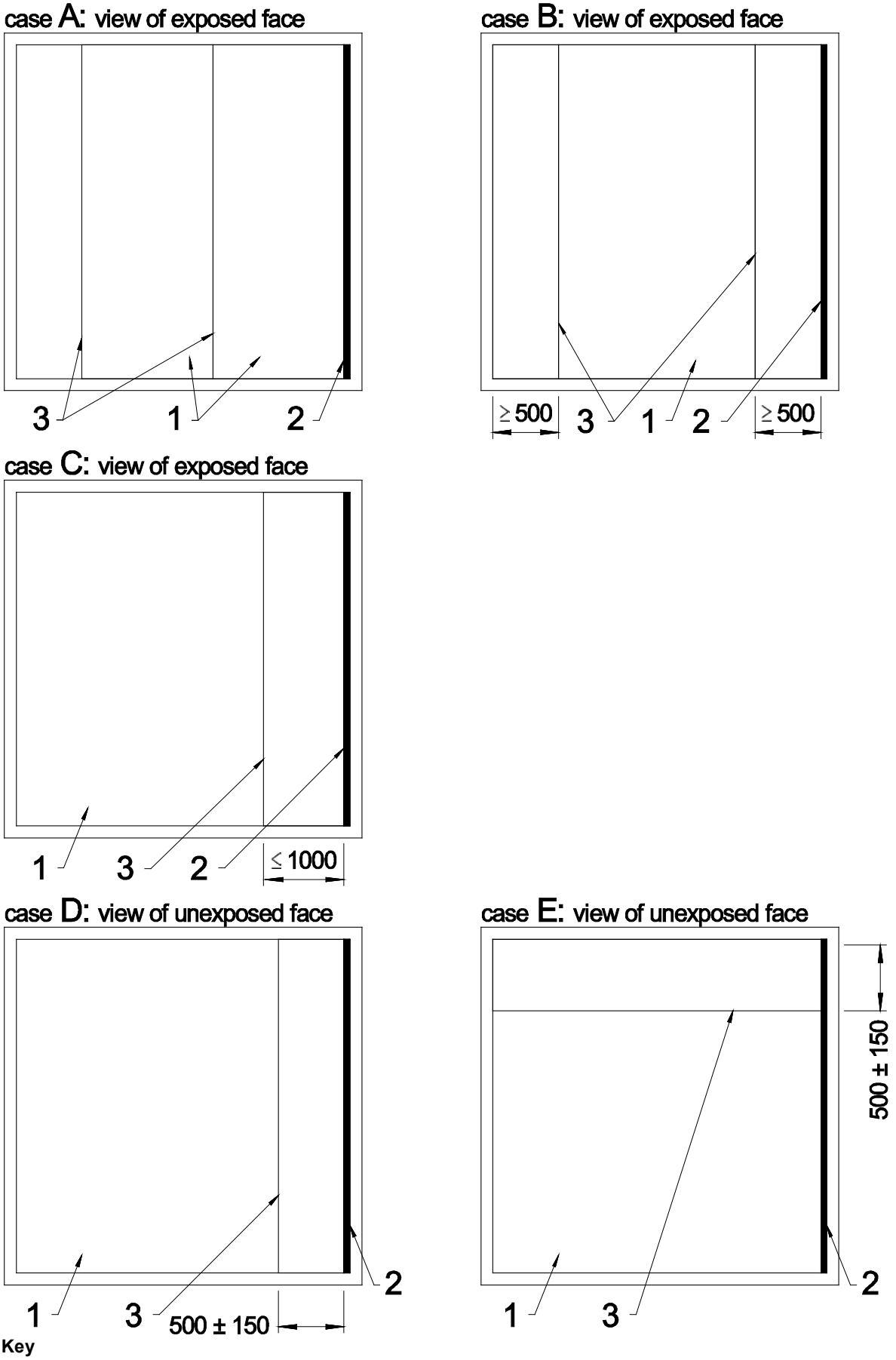
a) For specimens tested in the test frame without any supporting construction, the result is applicable to high density rigid supporting constructions with at least the same fire resistance as the test specimen.

b) For specimens tested with any standard supporting construction as defined in EN 1363-1, the result is applicable to any other supporting construction of the same type (flexible or rigid) that has the same or a greater classified fire resistance (thicker, denser, more layers of boards, as appropriate) than the one used in the test and the same horizontal and/or vertical orientation, i.e.:

- only vertical if the specimen was tested with the standard supporting construction fixed along the vertical edge (see Figure 17, b1);
- only horizontal if the specimen was tested with the standard supporting construction fixed along the horizontal edge (see Figure 17, b2);
- both if the specimen was tested with the standard supporting construction fixed along both the horizontal and the vertical edge (see Figure 17, b3).

13.4.2 Non-standard supporting constructions

The result of a test on a non-loadbearing wall tested in a non-standard supporting construction is only applicable to that construction.

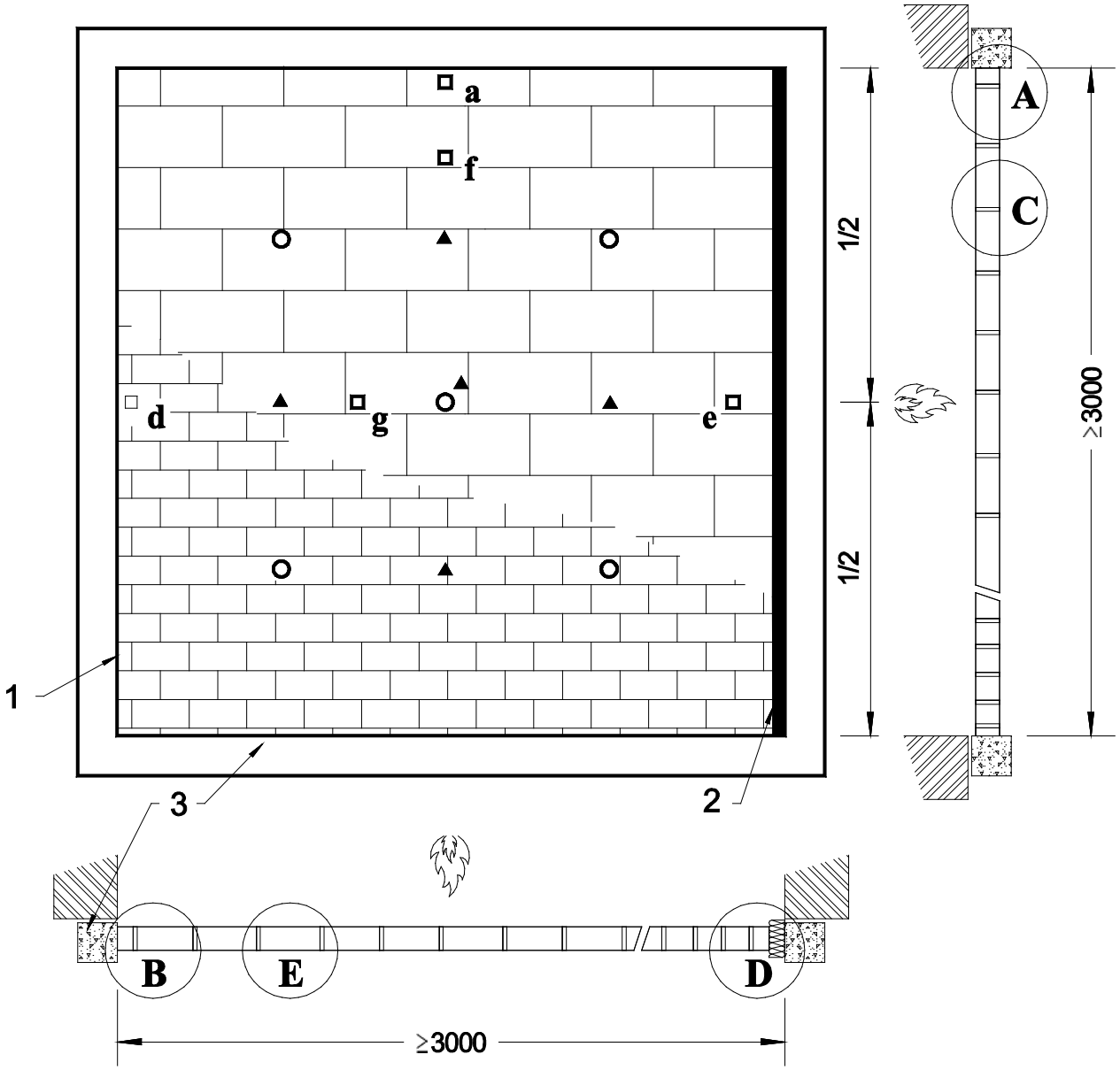


Key

1 full size panel/board
2 free edge
3 vertical / horizontal joint

Figure 1 — Position of free edge and joints (see 6.3.2 and 6.3.3 and A.2)

Dimensions in mm



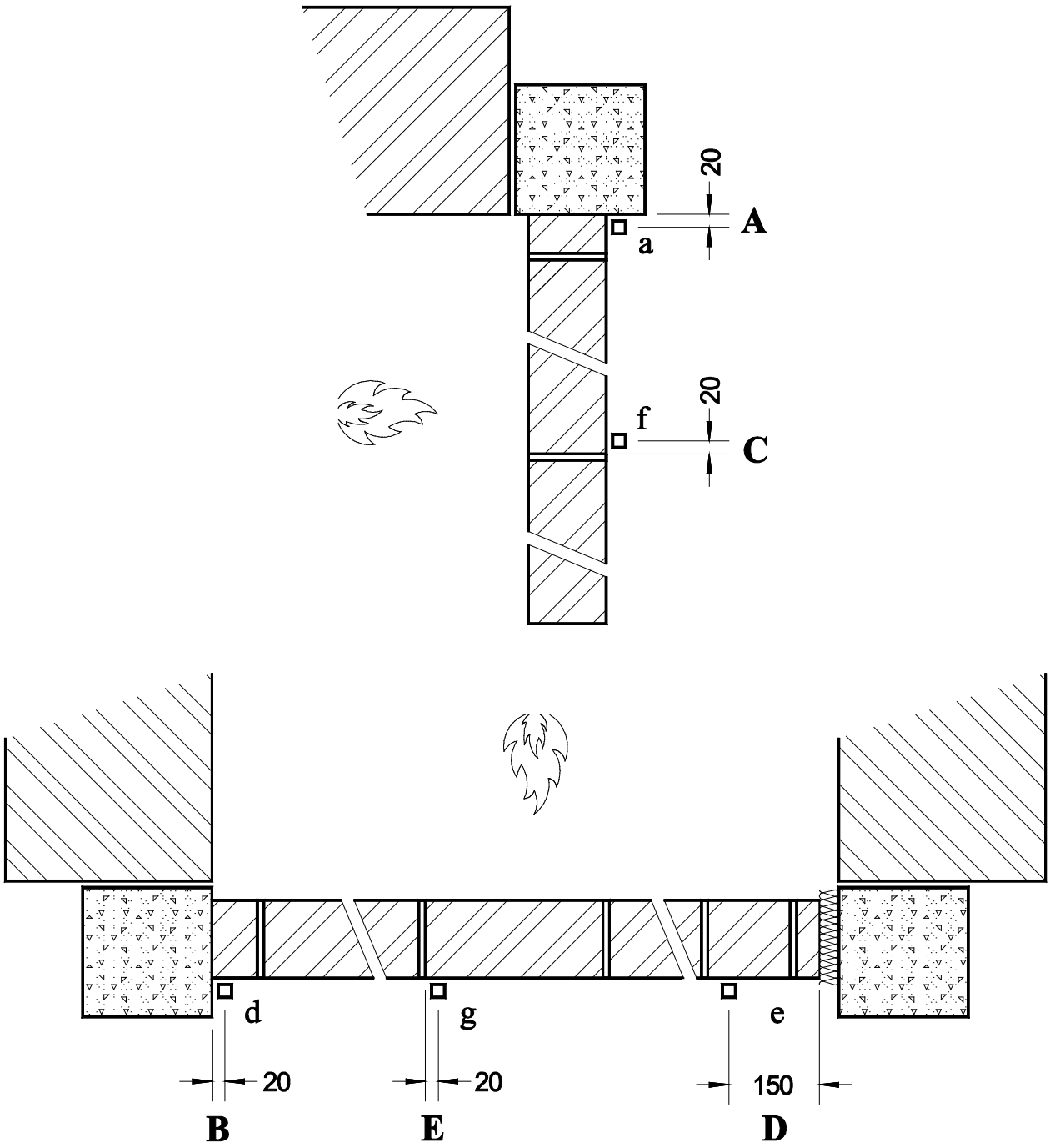
Key

- ○ positions for thermocouples for average temperature rise
- □ positions for thermocouples for maximum temperature rise (letters refer to thermocouples denoted by letter in 9.1.2.3)
- ▲ positions for deflection measurement
- 1 fixed edge
- 2 free edge
- 3 test frame

A, B, C, D and E see Figure 3

Figure 2 — Example of unexposed thermocouple positions and deflection measurement positions for masonry walls

Dimensions in mm

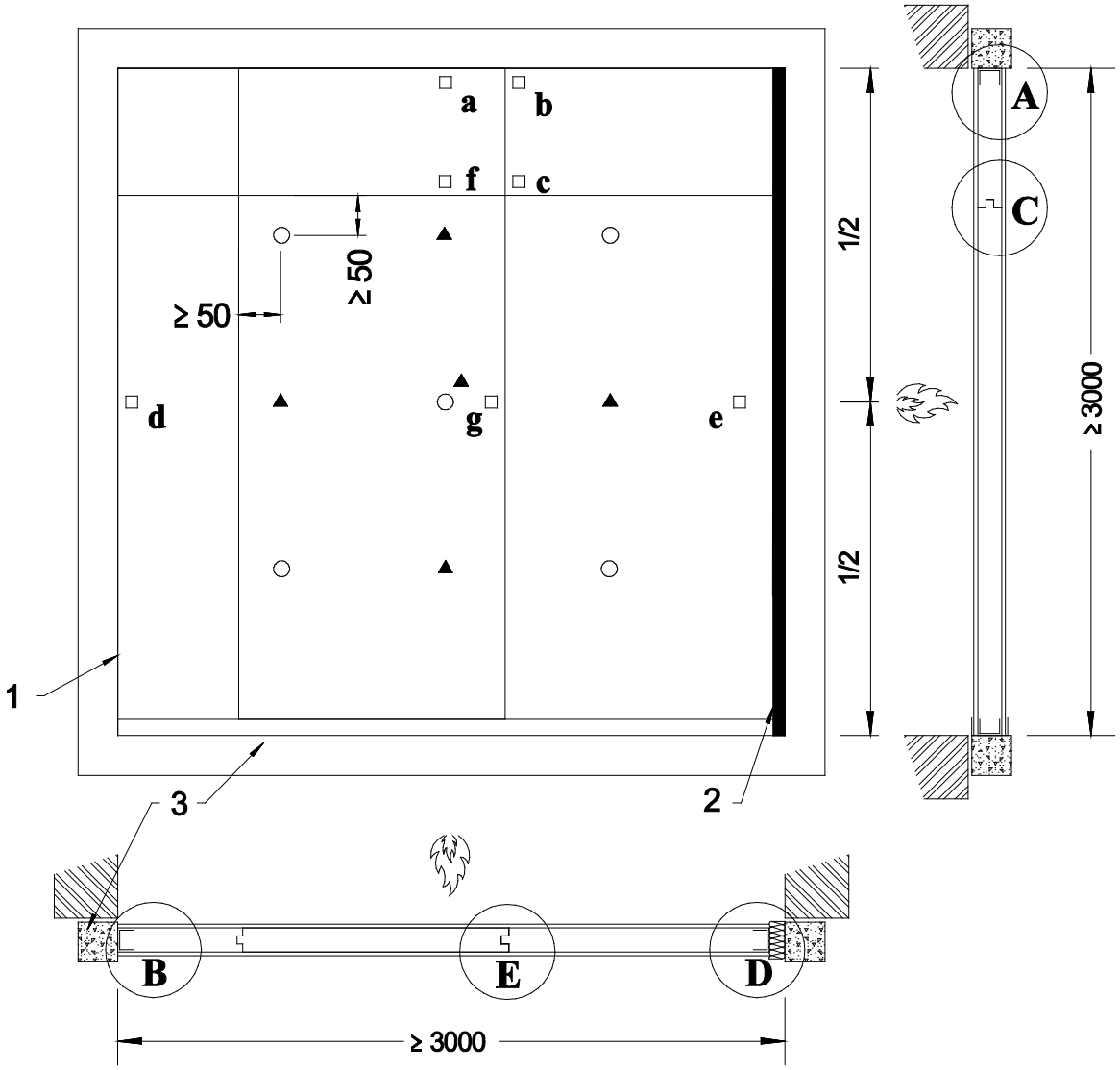


Key

□ positions for thermocouples for maximum temperature rise
(letters refer to thermocouples denoted by letter in 9.1.2.3)
For overall location of thermocouples see Figure 2

Figure 3 — Example of unexposed thermocouple positions for masonry walls

Dimensions in mm



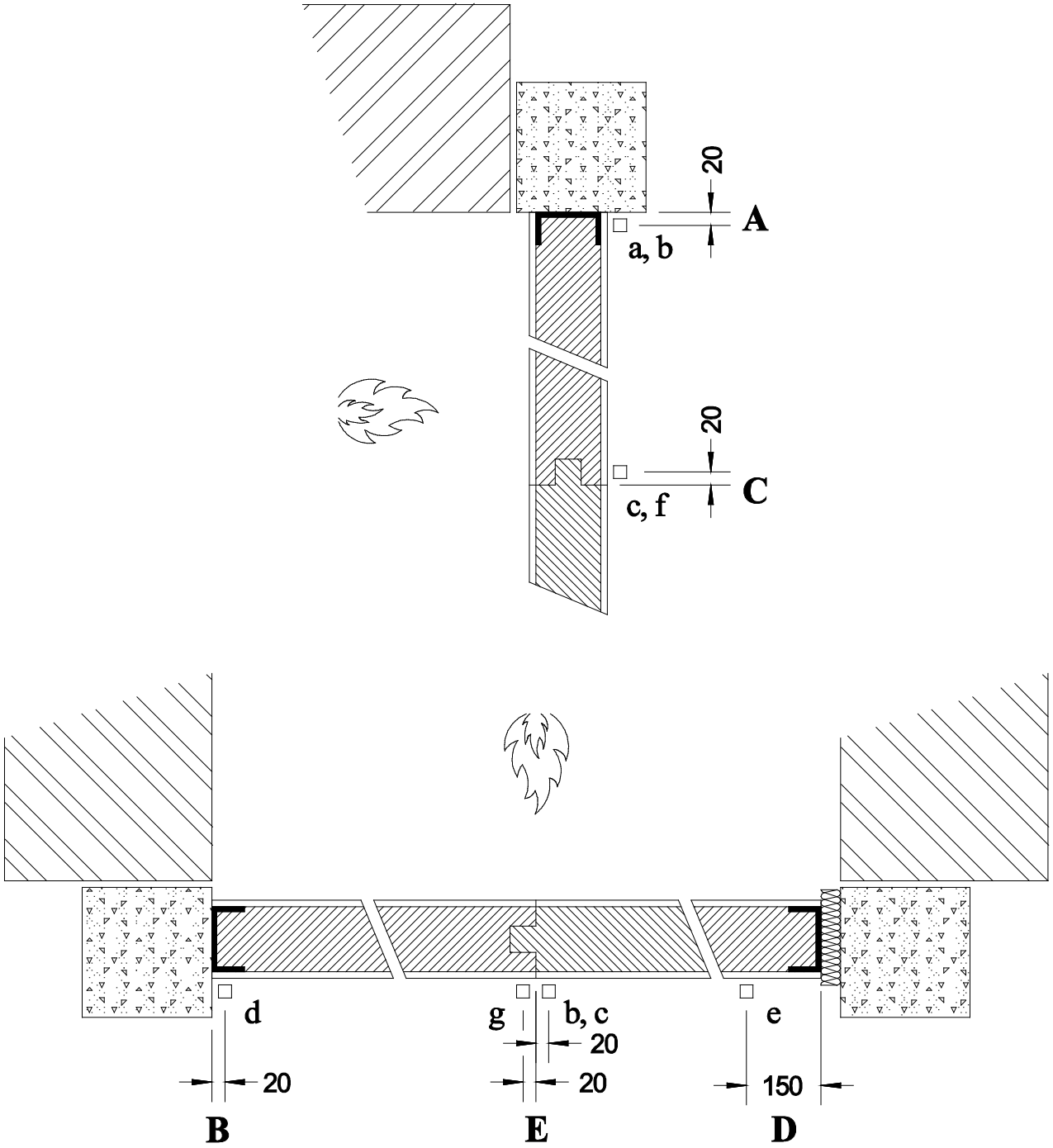
Key

- ○ positions for thermocouples for average temperature rise
- □ positions for thermocouples for maximum temperature rise (letters refer to thermocouples denoted by letter in 9.1.2.3)
- ▲ positions for deflection measurements
- 1 fixed edge
- 2 free edge
- 3 test frame

A, B, C, D and E see Figure 5

Figure 4 - Example of unexposed thermocouple positions and deflection measurement positions for walls made of prefabricated panels

Dimensions in mm

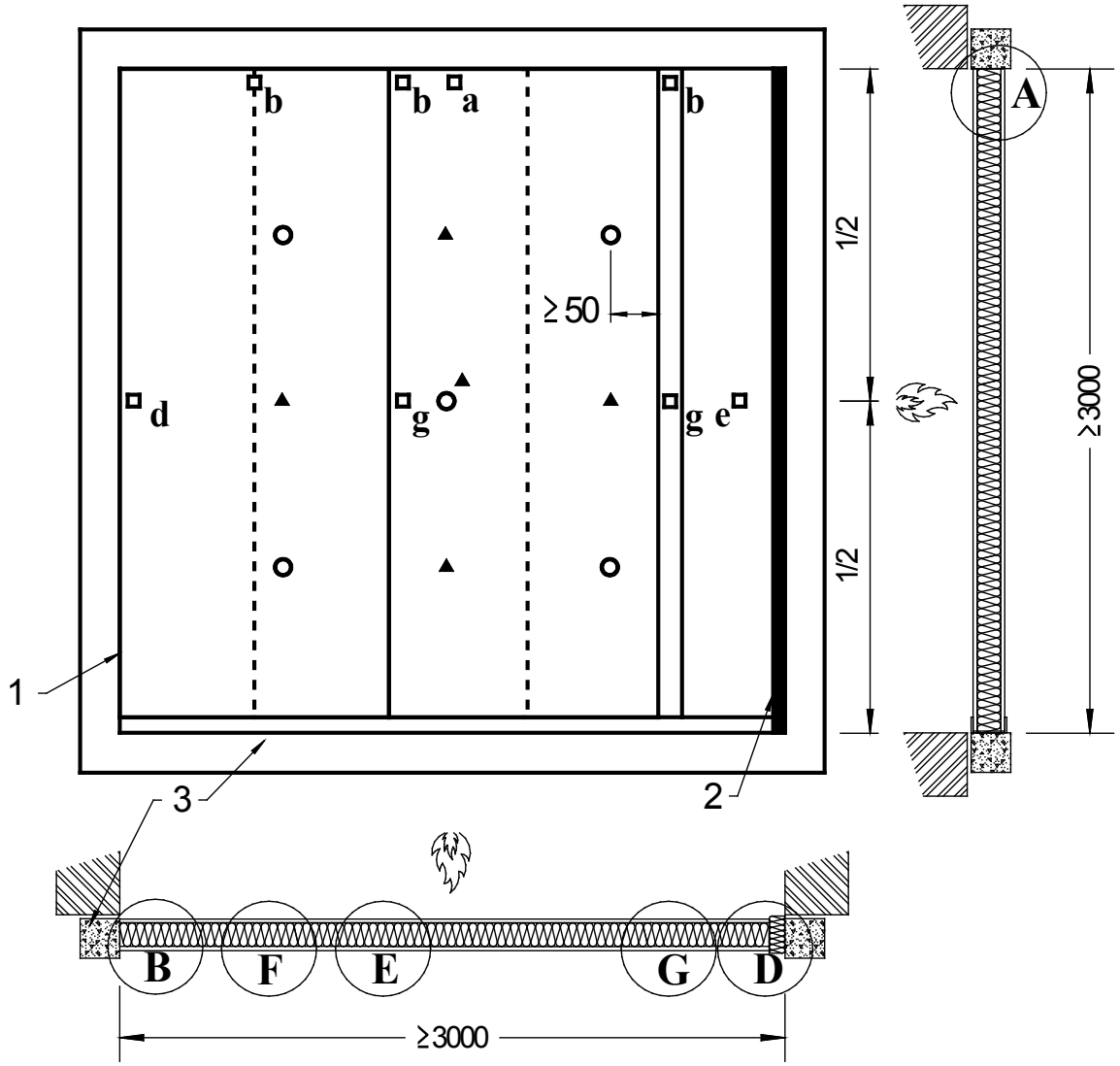


Key

□ positions for thermocouples for maximum temperature rise (letters refer to thermocouples denoted by letter in 9.1.2.3) for overall location of thermocouples see Figure 4

Figure 5 - Example of unexposed thermocouple positions for walls made of prefabricated panels

Dimensions in mm



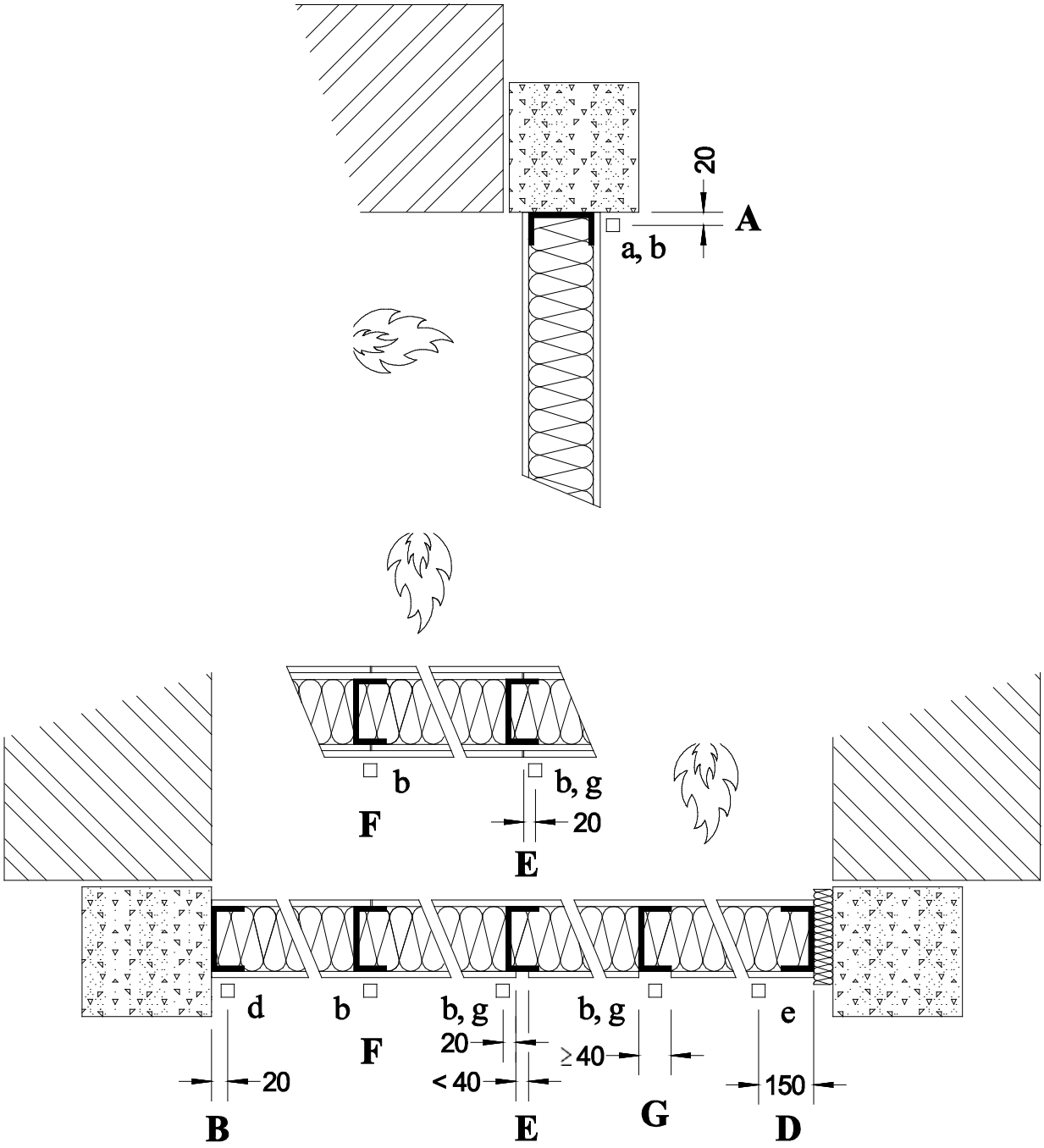
Key

- ○ positions for thermocouples for average temperature rise
- □ positions for thermocouples for maximum temperature rise (letters refer to thermocouples denoted by letters in 9.1.2.3)
- ▲ positions for deflection measurements
- 1 fixed edge
- 2 free edge
- 3 test frame

A, B, D, E, F and G see Figures 7 and 8

Figure 6 - Example of unexposed thermocouple positions and deflection measurement positions for hollow panel walls with metal or timber framework

Dimensions in mm

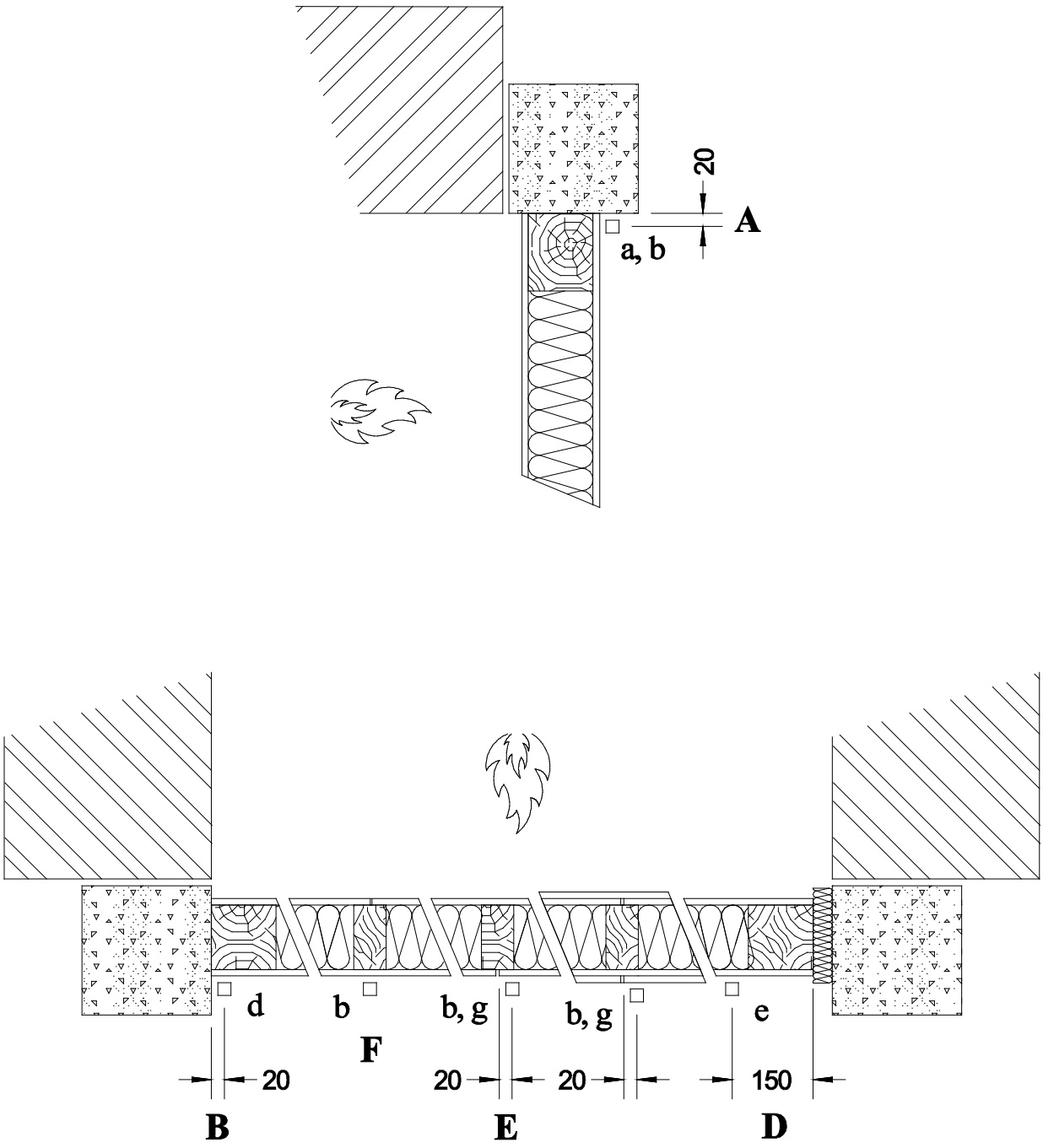


Key

□ positions for thermocouples for maximum temperature rise
(letters refer to thermocouples denoted by letter in 9.1.2.3)
for overall location of thermocouples see Figure 6

Figure 7 - Example of unexposed thermocouple positions for hollow walls with metal framework

Dimensions in mm

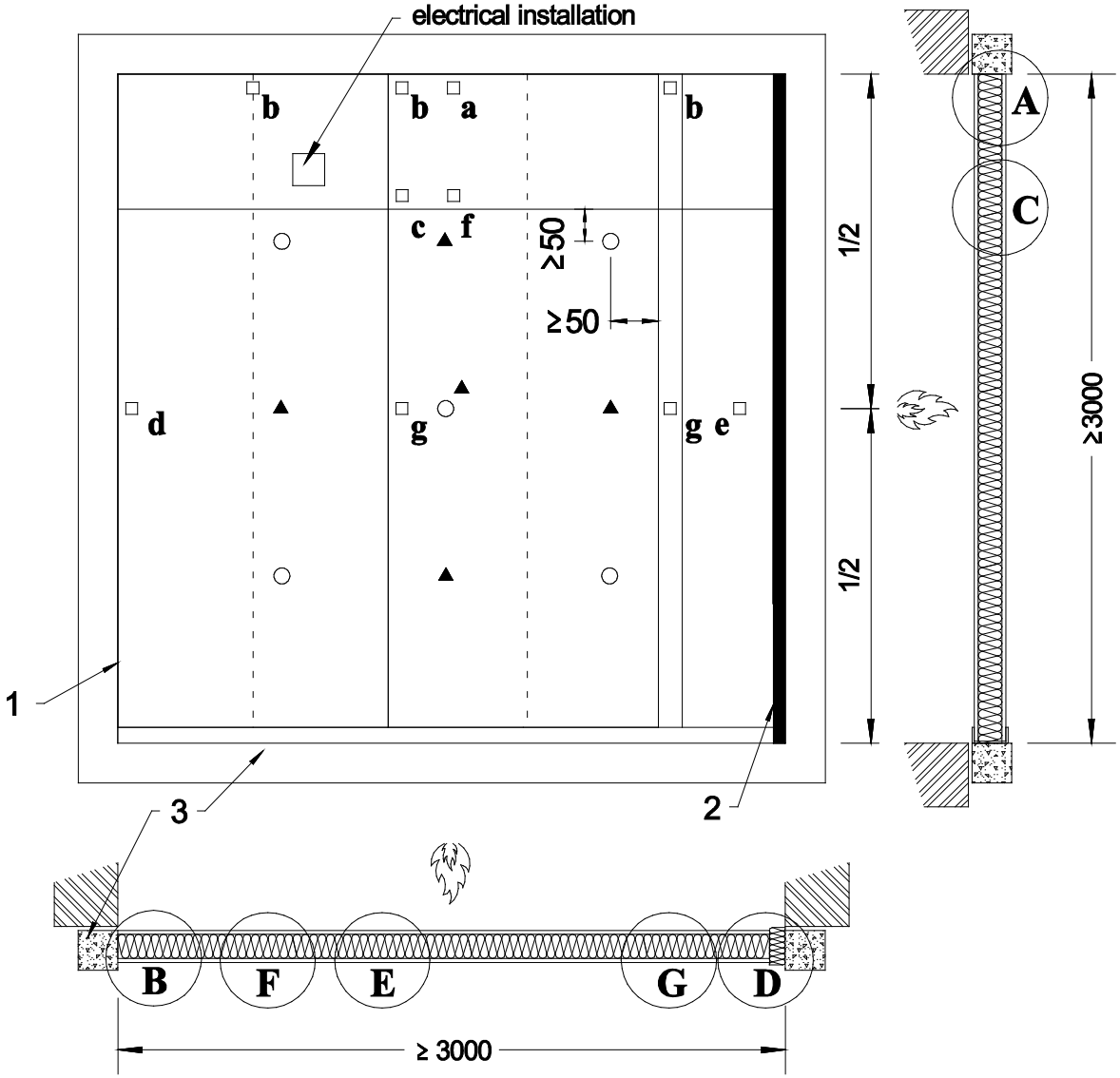


Key

□ positions of thermocouples for maximum temperature rise
letters refer to thermocouples denoted by letter in 9.1.2.3)
for overall location of thermocouples see Figure 6

Figure 8 - Example of unexposed thermocouple positions for walls with timber framework

Dimensions in mm



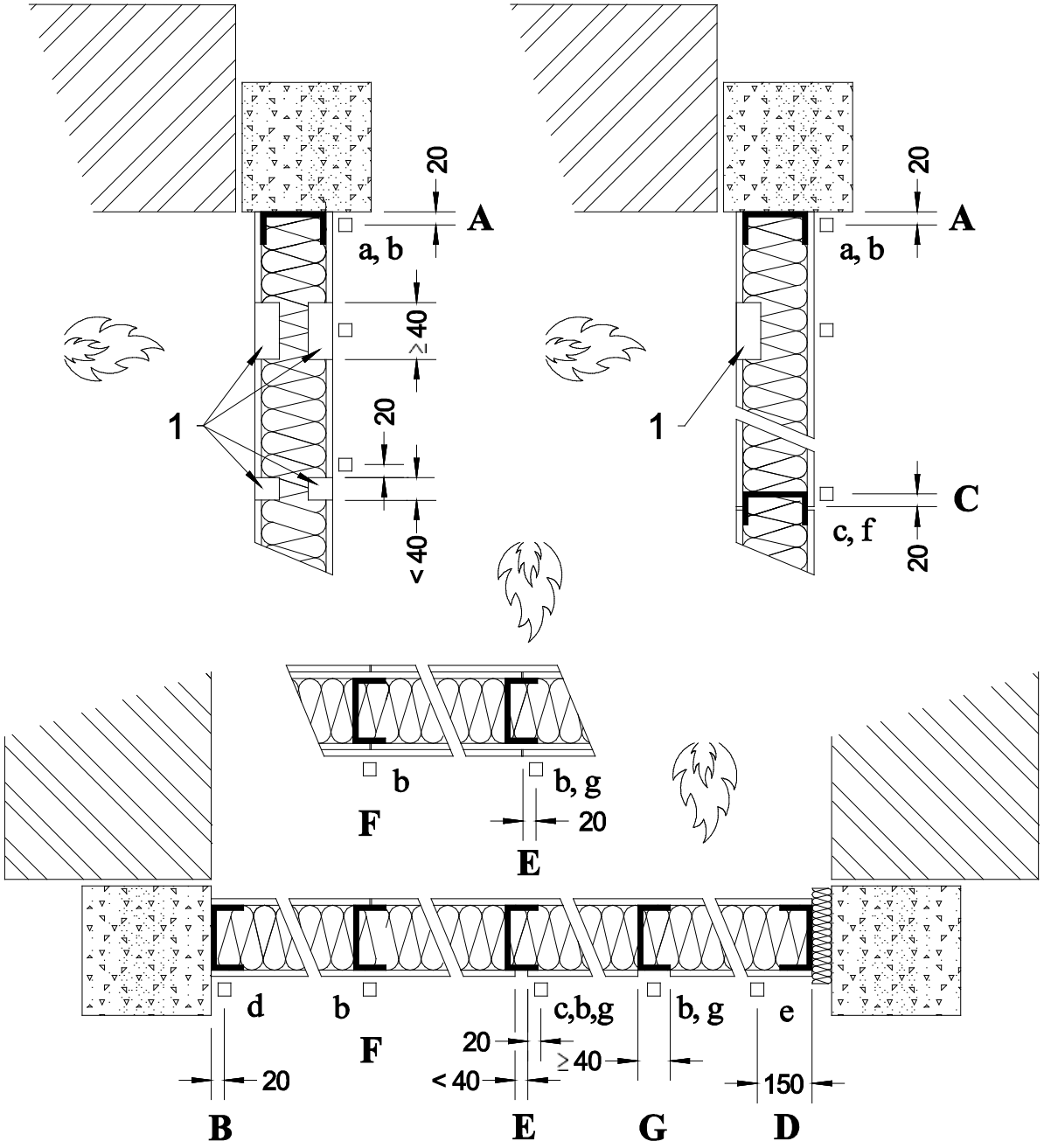
Key

- ○ positions for thermocouples for average temperature rise
- □ positions for thermocouples for maximum temperature rise (letters refer to thermocouples denoted by letter in 9.1.2.3)
- ▲ positions for deflection measurements
- 1 fixed edge
- 2 free edge
- 3 test frame

A, B, C, D, E, F and G see Figures 10 and 11

Figure 9 - Example of unexposed thermocouple positions and deflection measurement positions for hollow panel walls with metal or timber framework incorporating horizontal joints and electrical installations

Dimensions in mm



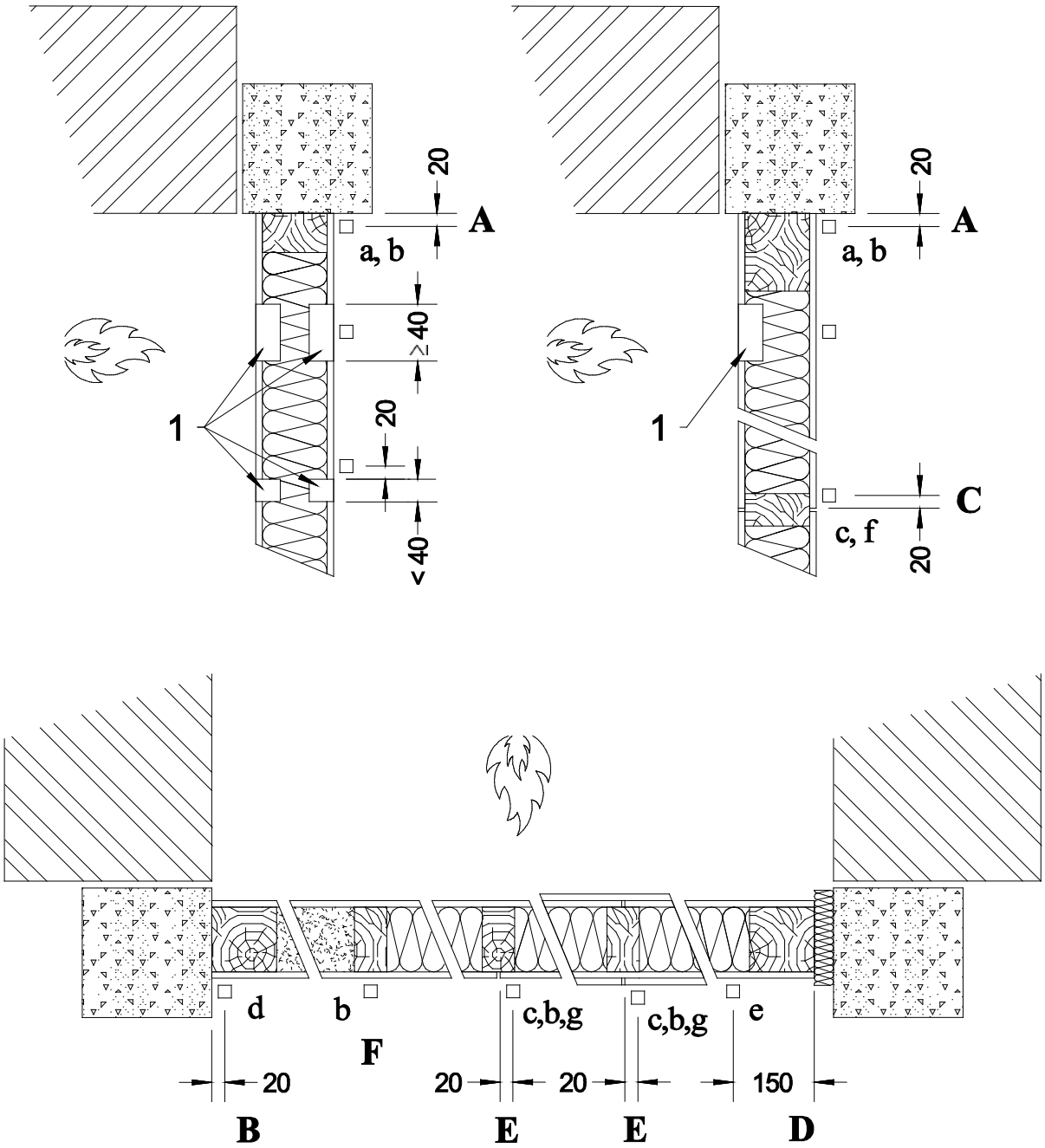
Key

□ positions of thermocouples for maximum temperature rise
(letters refer to thermocouples denoted by letter in 9.1.2.3)

1 electrical installation
for overall location of thermocouples see Figure 9

Figure 10 - Example of unexposed thermocouple positions for hollow panel walls with metal framework incorporating horizontal joints and electrical installations

Dimensions in mm



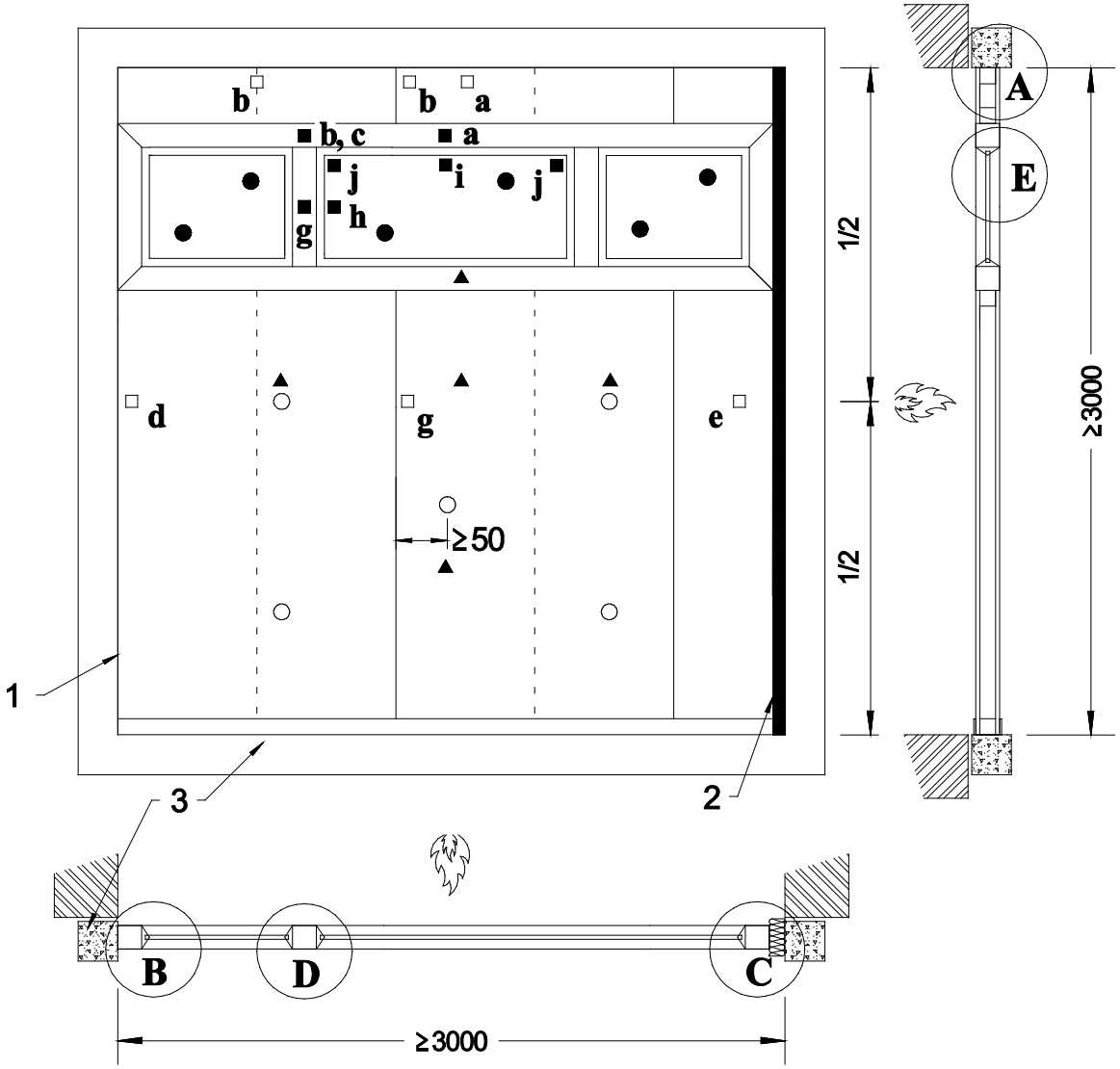
Key

□ positions of thermocouples for maximum temperature rise
(letters refer to thermocouples denoted by letter in 9.1.2.3)

1 electrical installation
for overall location of thermocouples see Figure 9

Figure 11 - Example of unexposed thermocouple positions for hollow panel walls with timber framework incorporating horizontal joints and electrical installations

Dimensions in mm



Key

○ positions of thermocouples for average temperature rise of the non-loadbearing wall (see 9.1.2.2)

● positions of thermocouples for average temperature rise of the glazing (see A 3.2)

□ positions of thermocouples for maximum temperature rise of the non-loadbearing wall (see 9.1.2.3)

■ positions of thermocouples for maximum temperature rise of the glazing (see A 3.3)

▲ positions for deflection measurements

1 fixed edge

2 free edge

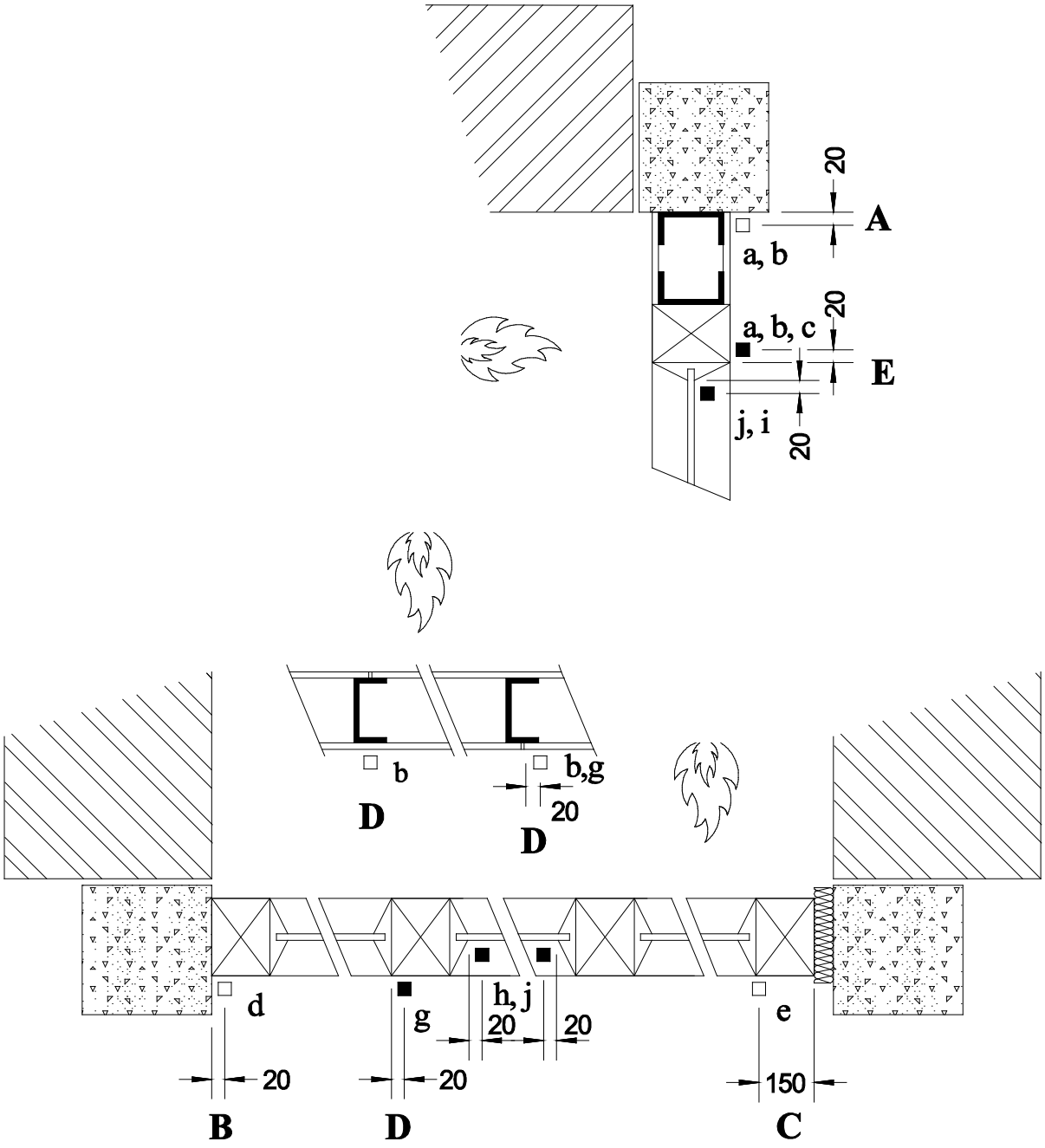
3 test frame

A, B, C, D and E see Figure 13

NOTE This figure shows the example of a lightweight partition wall incorporating glazing

Figure 12 - Example of unexposed thermocouple positions and deflection measurement positions for 2 discrete areas; i.e. a non-loadbearing wall with an area of insulated glazing

Dimensions in mm



Key

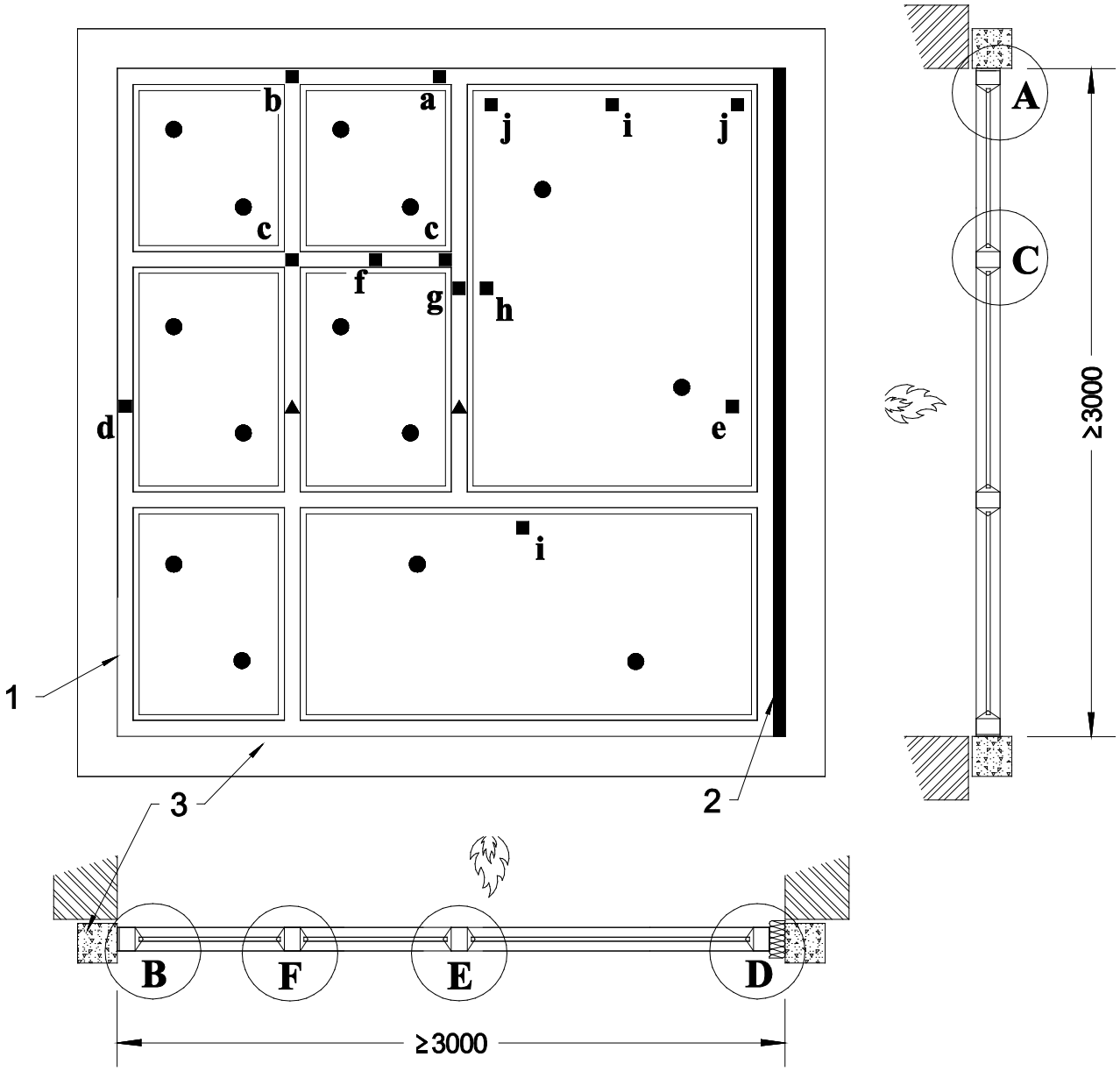
□ positions for thermocouples for maximum temperature rise of the non-loadbearing wall (see 9.1.2.3)

■ positions for thermocouples for maximum temperature rise of the glazing (see A 3.3)
for overall location of thermocouples see Figure 12

NOTE This figure shows the example of a lightweight partition wall incorporating glazing

Figure 13 - Example of unexposed thermocouple positions for a non-loadbearing wall with area of insulated glazing

Dimensions in mm



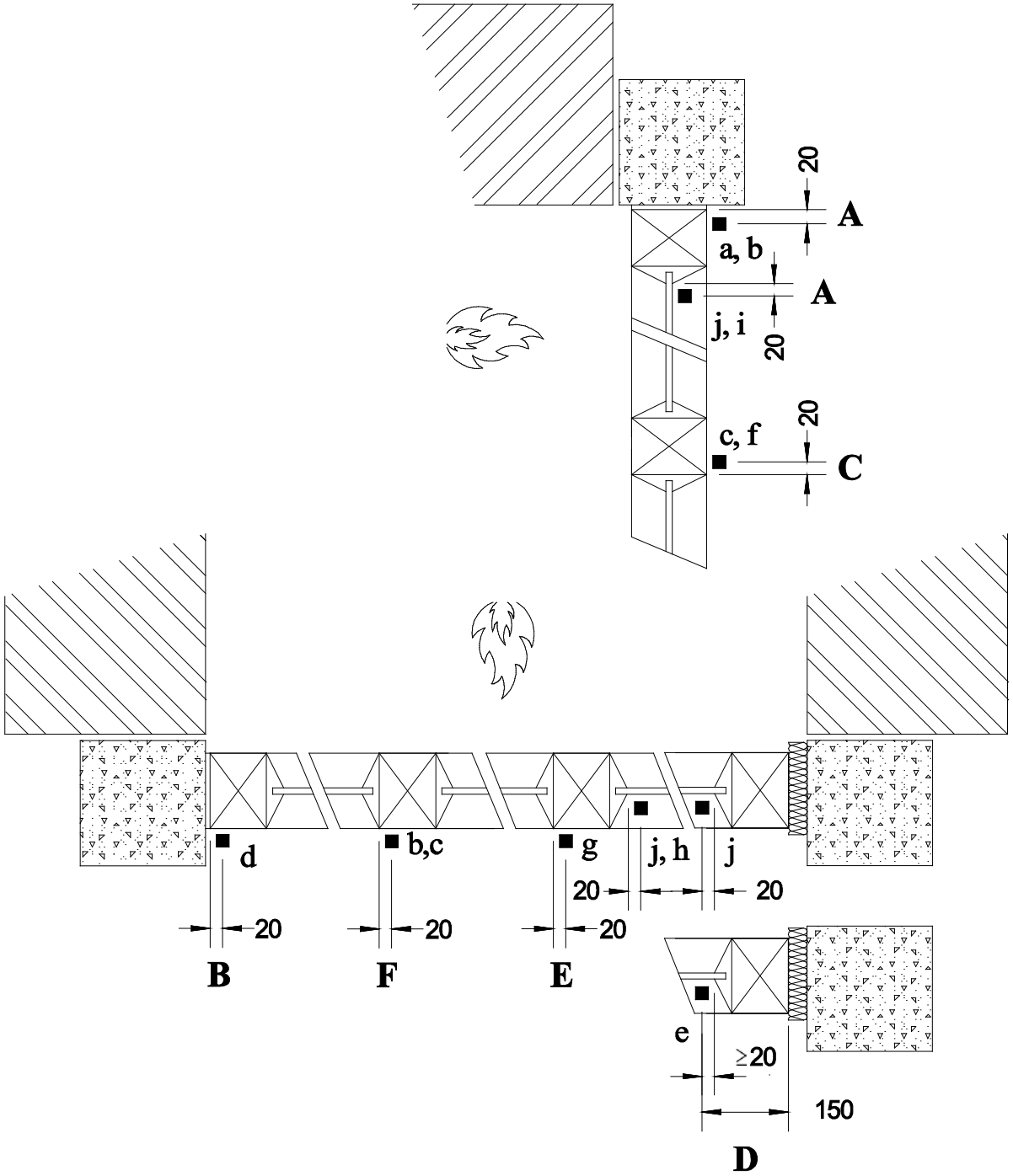
Key

- ● positions for thermocouples for average temperature rise (see A 3.2)
- ■ positions for thermocouples for maximum temperature rise (see A 3.3)
- ▲ positions for deflection measurements

1 fixed edge
2 free edge
3 test frame
For A, B, C, D, E and F, see Figure 15.

Figure 14 - Example of unexposed thermocouple positions and deflection measurement positions for fully glazed walls

Dimensions in mm

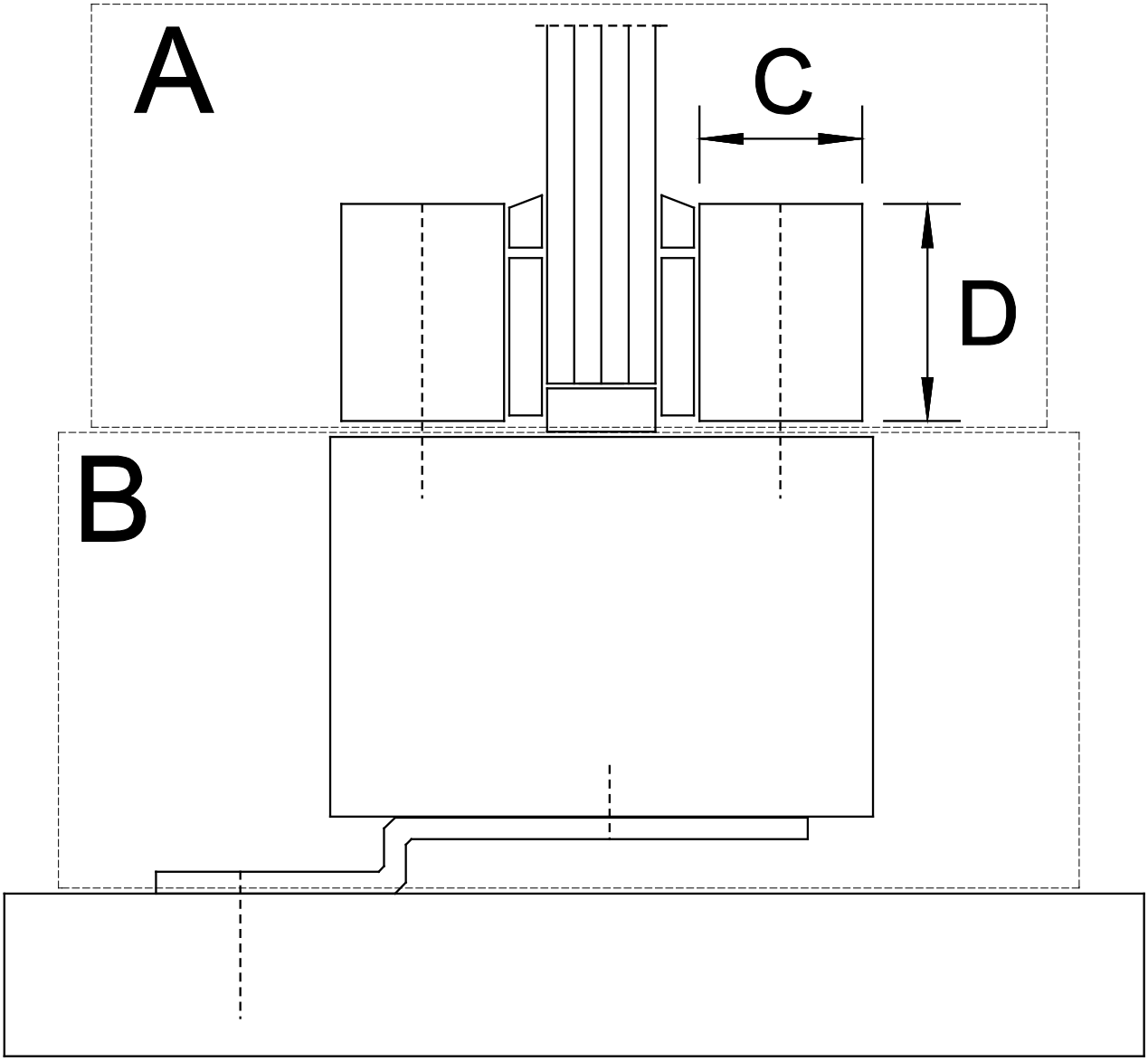


Key

- positions for thermocouples for maximum temperature rise (see A.3.3)
  for overall location of thermocouples see Figure 14

Figure 15 - Example of unexposed thermocouple positions for fully glazed walls

Dimensions in mm

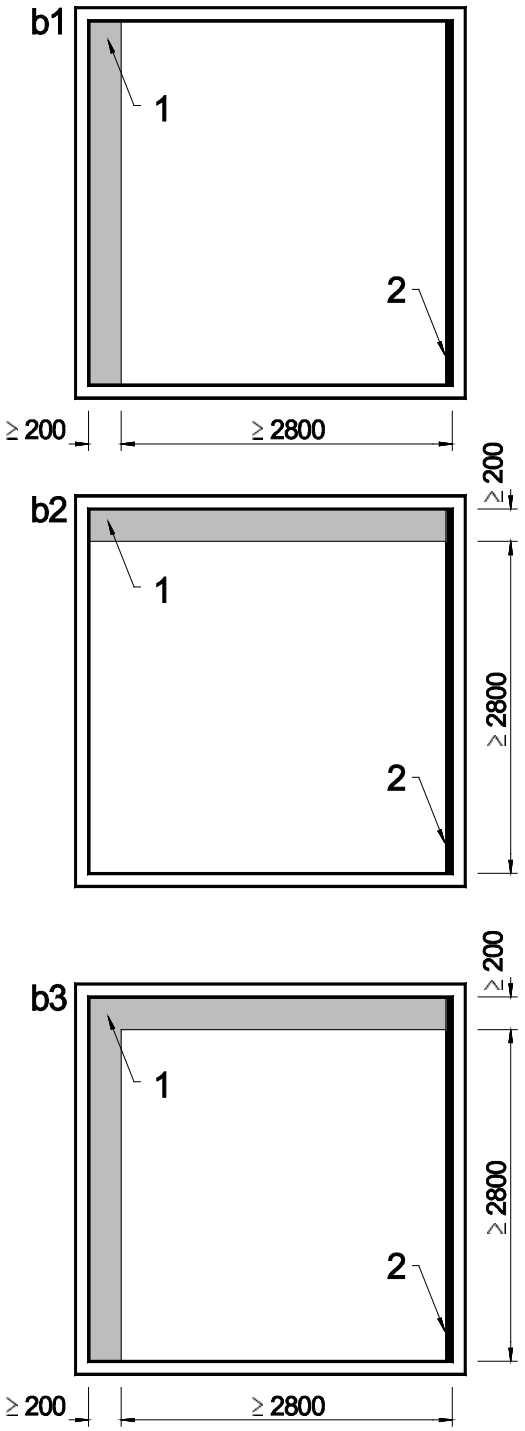


Key

A glazing system
B framing system
C depth of glazing bead
D height of glazing bead

Figure 16 - Glazing system and framing system (see Annex A.4.2.2 and A.4.2.3)

Dimensions in mm



Key

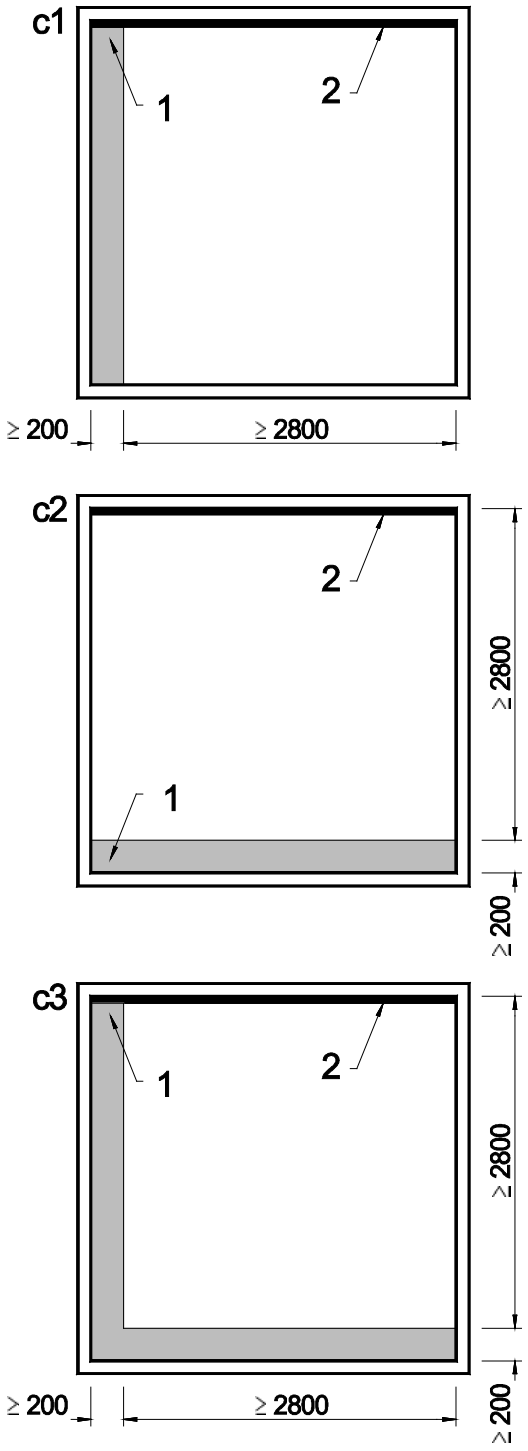
1 standard supporting construction

2 free edge

b1–b3: test specimen with vertical free edge

Figure 17 - Standard supporting construction and vertical free edge (see 13.4.1, A.4.2.4.1 and A.4.2.4.2)

Dimensions in mm



Key

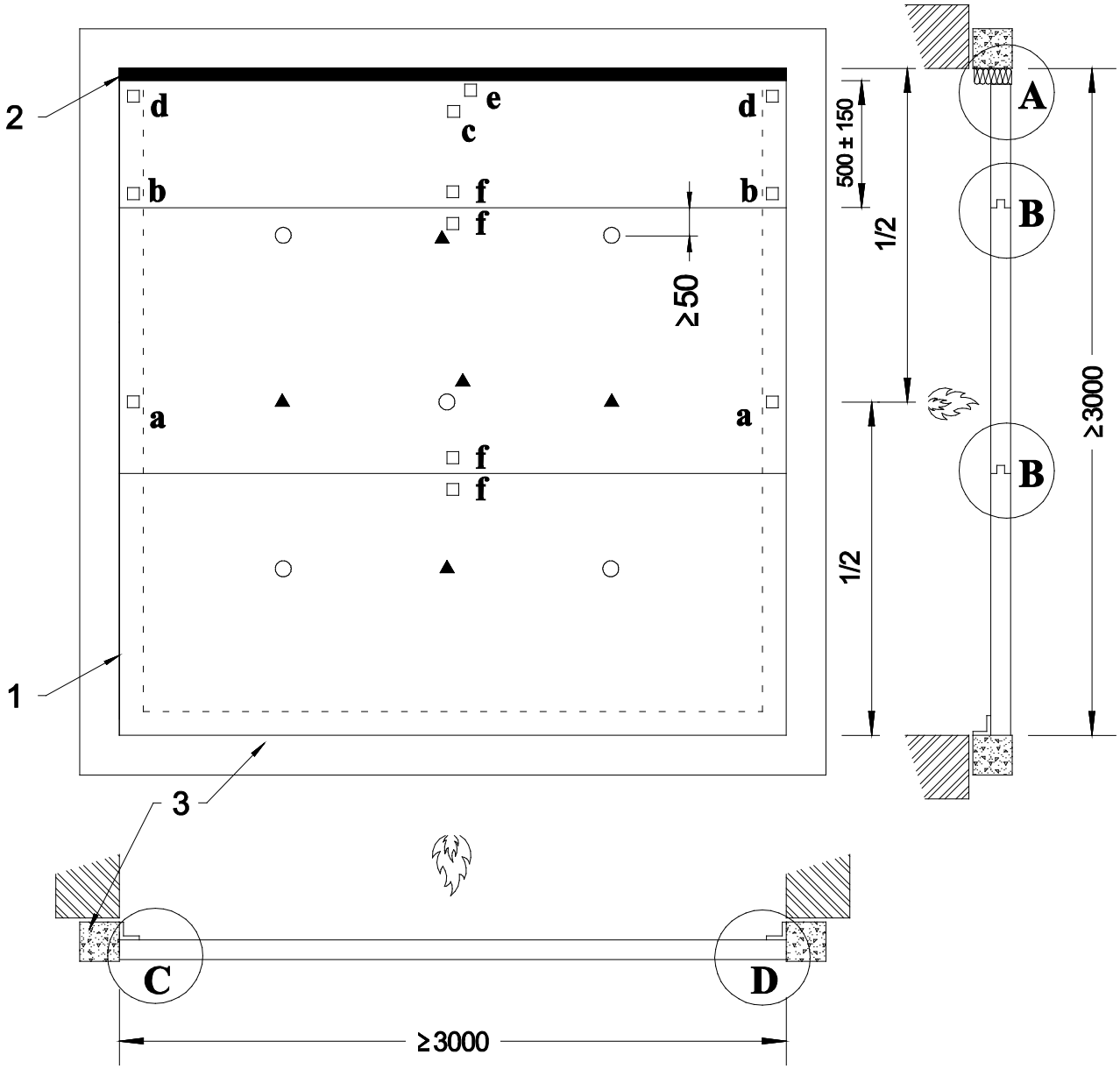
1 standard supporting construction

2 free edge

c1–c3: test specimen with horizontal free edge

Figure 18 - Standard supporting construction and horizontal free edge (see B.2.4)

Dimensions in mm



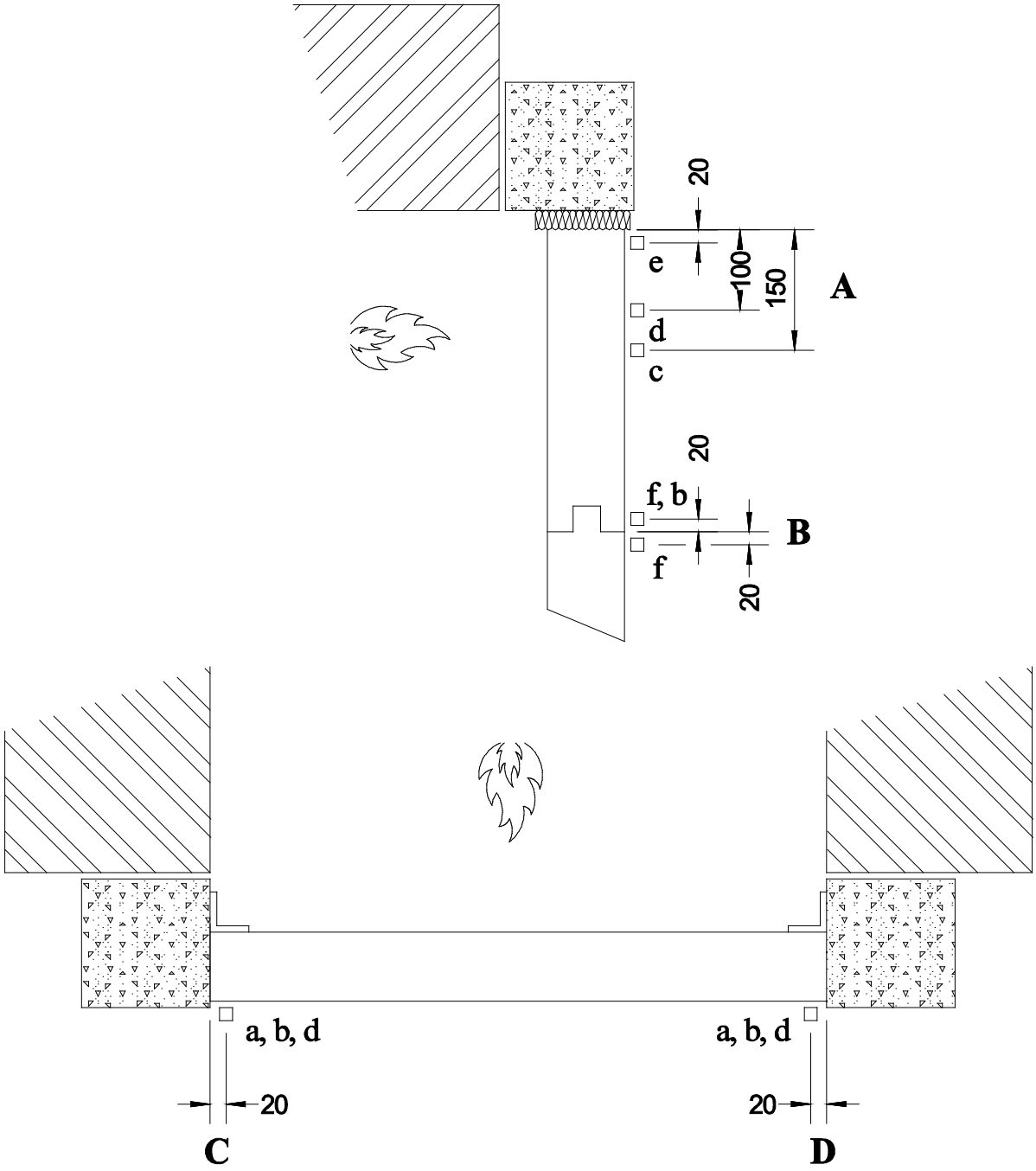
Key

- ○ positions for thermocouples for average temperature rise
- □ positions for thermocouples for maximum temperature rise
  (letters refer to thermocouples denoted by letters in Annex B)
- ▲ positions for deflection measurements
- 1 fixed edge
- 2 free edge
- 3 test frame

  A, B, C and D see Figure 20

Figure 19 - Example of unexposed thermocouple positions and deflection measurement positions for walls with horizontally spanning prefabricated panels (see B.3)

Dimensions in mm



Key

- ○ positions for thermocouples for average temperature rise
- □ positions for thermocouples for maximum temperature rise

for overall location of thermocouples see Figure 19

Figure 20 - Example of unexposed thermocouple positions for walls with horizontally spanning prefabricated panels

Annex A
(normative)

Specific requirements for testing glazed elements or non-loadbearing walls incorporating glazing

A.1 General

A non-loadbearing wall may contain one pane, a substantial number of such panes or it may consist almost entirely of panes. These may be small framed units or large panes with substantial frames attached to masonry or similar surrounds. Under fire conditions the separating element is expected to remain a satisfactory fire barrier and this requirement applies to glazed and unglazed parts of the system.

The fire resistance of a glazed system is a function of the nature of the glass, the size and aspect ratio of the panes, the characteristics of the framing members, the method of retention and the expansion provisions.

If the objective of a fire test is to obtain information on a specific system for a particular end use then the specific construction is used for the test specimen. However, if the intention is to obtain data for a wider application to other similar constructions then a single test may justify this depending on the inclusion of certain design features in the test specimen. The applicability of the result to other similar constructions is given in A.4.

A.2 Test specimen design

The test specimen shall be designed to obtain the widest applicability of the test result when considered in conjunction with the direct and extended field of application rules.

Asymmetrical test specimens which are required to be fire resisting from both sides shall be tested from each side unless it can be determined which direction is the worst case. If this can be established e.g. by using previously existing test data according to European Standards then only the worst case needs to be tested.

The following features can only be incorporated in similar constructions provided they were included in the test specimen.

a) non-glazed panels;

b) junction(s) between a transom and a mullion (‘+’);

c) junction(s) of mullions terminating at a transom (‘T’);

d) junction(s) between transom(s) and mullions(s) where mullion(s) is/are full height and interrupt(s) transoms;

e) special jointing systems between glazed elements or between glazed elements and other constructions;

f) other constructional features to be evaluated e.g. structures present for safety or security reasons such as crowd barriers, grilles, etc.

The test specimen shall not contain mixtures of different types of construction (e.g. different types of glass or different types of framing, etc.) unless this is fully representative of the construction in practice.

For framed systems, the largest glass pane shall be located in between two free mullions, or next to the mullion on the free edge.

For butt-jointed systems, the design of the test specimen shall include at least 2 vertical joints, as given in Figure 1, Case A or Case B.

A.3 Test specimen instrumentation

A.3.1 General

If the test specimen consists entirely of uninsulated glazing it shall be treated as an uninsulated non-loadbearing wall and no unexposed surface thermocouples need to be attached. It shall only be evaluated with respect to the integrity criteria, and, where required, radiation.

If the test specimen has one or more discrete panes of uninsulated glazing, it shall be treated as a partly insulated construction. If the insulated part is required to provide thermal insulation, the appropriate number of thermocouples shall be provided. No thermocouples are required to be placed on the uninsulated glass.

If all of the test specimen is made using insulating glass (and frames), it shall be treated as a fully insulated non-loadbearing wall and its performance judged on the basis of compliance with the criteria of integrity and insulation.

Thermocouples of the type specified in EN 1363-1 shall be attached to the unexposed face for the purpose of obtaining the average and the maximum surface temperatures. General rules for the attachment and exclusion of thermocouples given in EN 1363-1 shall apply, subject to the following rules.

A.3.2 Average temperature rise

A.3.2.1 Fully glazed test specimen

For the purposes of measuring the average temperature rise, one thermocouple shall be provided for every 1,5 m^2 or part thereof of the specimen. A minimum of two thermocouples for each pane of glass shall be provided. The two thermocouples shall be positioned at the centre of two quarters of each pane diagonally opposite each other. Any additional thermocouples shall be evenly distributed over the surface of the pane. A typical example is shown in Figure 14.

A.3.2.2 Partly glazed test specimen

For partly glazed test specimens, i.e. those which contain different discrete areas, each discrete area shall be individually monitored for average temperature rise as in A.3.2.1. A typical example is shown in Figure 12.

A.3.3 Maximum temperature rise

Additional thermocouples shall be attached to the framing members and panes (see Figures 12 to 15) to judge compliance with the maximum temperature rise criterion as follows:

a) at the top horizontal framing member at mid width of the specimen;

b) at the top horizontal framing member in line with a mullion;

c) at each type of junction (e.g. ‘T’- or ‘+’-junction) of a mullion and a transom;

d) at the vertical framing member on fixed edge at mid height of the specimen;

e) at mid height of the free edge, 150 mm in from the edge;

f) at mid width of a transom (in the positive pressure zone);

g) at mid height of a mullion (in the positive pressure zone);

h) at mid-height of the pane with the largest area, 20 mm from the vertical framing member or the joint. If the largest pane is not the tallest pane, then another thermocouple shall be placed at mid-height of the tallest pane, 20 mm from the vertical framing member or the joint;

i) at mid-width of the pane with the largest area, 20 mm from the horizontal framing member or the joint at the top edge of the pane. If the largest pane is not the widest pane, then another thermocouple shall be placed at mid-width of the widest pane, 20 mm from the horizontal framing member or the joint at the top edge of the pane;

j) in the top corners of the pane with the largest area, and, additionally in the top corners of the highest placed pane with the largest area, if this is not the same pane, each 20 mm from the horizontal and vertical framing members or the joint.

Non-glazed panels incorporated in a glazing system shall be handled as a corresponding pane.

A.3.4 Radiation measurement

When there is a requirement to establish the radiation from the unexposed face of the glazing, provision shall be made to measure the radiation from the unexposed face as given by EN 1363-2.

A.3.5 Deflection measurement

Appropriate instrumentation shall be provided to determine a history of all significant deflection (i.e. greater than 5 mm) of the test specimen during the test.

Measurements shall be made at the centre of the test specimen, and at mid-height of the test specimen at each mullion, see Figure 14, or near (20 mm distance) each vertical joint as applicable.

The interval of measurement shall be adequate to present a history of movement during the test.

Guidance on the application of deflection measurement is given in EN 1363-1.

NOTE Measurement of deflection is a mandatory requirement although there are no performance criteria associated with it. The deflection of the test specimen may be important in determining the direct field of application and may also be important in determining the extended field of application of the test result.

A.4 Field of direct application of test results

A.4.1 General

The test results are directly applicable to similar constructions where one or more of the changes in this A.4 are made and the construction continues to comply with the appropriate design code for its stiffness and stability. Other changes are not permitted.

The result of a test on a specimen with mixtures of different types of construction (e.g. different types of glass or different types of framing, etc.) is only applicable to that tested.

A.4.2 Field of direct application rules not requiring overrun time

A.4.2.1 Glazed element

A.4.2.1.1 Installation angle

Test results on vertical glazed elements cover glazed elements sloped to a maximum angle of ± 10° from the vertical plane, provided the height of the glazed element is not larger than the maximum height tested.

A.4.2.1.2 Height of the glazed element

Test results cover rectangular glazed elements with a height increase of 10 % subject to a maximum increase of 0,3 m, above the height tested, provided that:

a) the maximum deflection (see Figure 14) of the test specimen did not exceed 100 mm;

b) the allowances for thermal expansion of the construction are increased pro-rata.

In case of elements intended to be classified for EW, the following additional provisions apply:

- the average temperature of the unexposed face of the glazed element as well as the average temperature of the unexposed face of the non-glazed area of the test specimen (see Figures 12 or 14) remained below 300 °C, or
- the heat radiation measured from the test specimen did not exceed 12,3 kW/m².

A.4.2.1.3 Width of the glazed element

Test results cover rectangular glazed elements of greater width by replication of the tested glazed element or parts thereof, provided:

a) the framing system is identical to the one tested;

b) the width of the specimen in the test was 2,8 m or greater with one vertical edge unrestrained;

c) the mullions within and/or connection joints between glazed elements have been tested.

In case of elements intended to be classified for EW, the following additional provisions apply:

- the average temperature of the unexposed face of the glazed element as well as the average temperature of the unexposed face of the non-glazed area of the test specimen (see Figures 12 or 14) remained below 300 °C, or
- the heat radiation measured from the complete and fully glazed test element with minimum size of 2,8 x 2,8 m did not exceed 12,3 kW/m².

A.4.2.2 Glazing system (see Figure 16)

A.4.2.2.1 Linear dimensions

The linear dimensions of panes may be decreased from the dimensions tested. Height and width may be considered independently.

A.4.2.2.2 Aspect ratio

If both portrait and landscape aspect ratio rectangular panes have been tested, then the height of the landscape pane may be increased and/or the width of the portrait pane may be increased, subject to:

- the area of the pane after increasing the linear dimensions shall be less or equal to the average area of the largest tested landscape and portrait panes, i.e $A \leq ½ * (A_{portrait,\ max} + A_{landscape,\ max})$, in which

A	area of assessed glass pane;
$A_{portrait,\ max}$	maximum area of tested glass pane oriented in “portrait” format
$A_{landscape,\ max}$	maximum area of tested glass pane oriented in “landscape” format

- all panes were tested in an identical framing and glazing system,
- the largest tested width as well as the largest tested height is not exceeded.

A.4.2.2.3 Glazing beads

Test results on 'clip-on' beads cover screwed-on glazing beads, applied with the same or smaller centre to centre distance.

Test results on timber beads fixed by nails/pins cover screw fixing of at least the same length, applied with the same or smaller centre to centre distance.

Test results for applications intended for EI classification on sloped or chamfered bead profiles also cover a flat bead of the same height (D in Figure 16), but not vice versa, and also cover a bead depth that is at least the same as tested (C in Figure 16).

Test results for applications intended for E and/or EW classification on non-combustible bead profiles also cover a bead depth that is at least the same as tested (C in Figure 16) with the height remaining the same as tested (D in Figure 16).

A.4.2.3 Framing system (see Figure 16)

The distance between mullions and/or transoms may be decreased from that tested.

The distance between fixing centres may be decreased from that tested.

The cross sectional dimensions of the frame profiles may be increased from the dimensions tested, under the following restrictions:

- For combustible framing intended to be used for E and/or EW classification, the depth of the frame profiles on the unexposed side is as tested.

- For framing systems intended to be used for EI classification, no increase in width is allowed in case no temperature measurements on the unexposed side of the profiles were made during the test.

A.4.2.4 Supporting constructions

A.4.2.4.1 General

For specimens tested in the test frame without any supporting construction, the result is applicable to high density rigid supporting constructions with at least the same fire resistance as the test specimen.

A.4.2.4.2 Standard supporting constructions

Test results obtained with flexible standard supporting constructions may be applied to high density rigid supporting constructions (in accordance with EN 1363-1) with at least the same fire resistance classification and an overall thickness equal to or greater than that of the element used in the tests.

Test results obtained with low density rigid standard supporting constructions may be applied to high density supporting constructions (in accordance with EN 1363-1) with at least the same fire resistance classification and an overall thickness equal to or greater than that of the element used in the tests.

Test results obtained with flexible standard supporting constructions do not cover sandwich panel constructions and flexible supporting constructions where the lining does not cover the studs on both sides.

Test results obtained with flexible standard supporting constructions cover alternative flexible constructions of the same fire resistance classification provided:

1) the construction is of a stud and board type construction, classified in accordance with EN 13501-2;

2) the construction has an overall thickness not less than the minimum thickness of the appropriate range given in EN 1363-1 for the standard flexible wall used in the test;

3) the number of board layers and the overall board layer thickness is equal or greater than that tested;

4) flexible wall constructions with timber studs are constructed with at least the same number of layers given in EN 1363-1 on the faces and at the interface between the glazed element and the supporting construction.

If the specimen was tested with a flexible standard supporting construction fixed along the vertical and/or horizontal edge (see Figure 17), the permitted flexible supporting constructions can only be interfaced along its tested edge-types (vertical and/or horizontal). The permitted rigid supporting constructions can be interfaced with all edge-types of the glazed element.

A.4.2.4.3 Non-standard supporting construction

The result of a test of fire resistant glazing tested in non-standard supporting constructions is only applicable to that construction.

A.4.3 Field of direct application rules requiring overrun time

A.4.3.1 General

For some rules to be applicable an overrun time in the fire test result compared to the intended classification period is required. The required overrun time is shown in Table A.1.

Table A.1 — Overrun time

Intended classification period (min)	Overrun time A (min)	Overrun time B (min)
≤ 20	not applicable	≥ 3
30, 45 and 60	≥ 3 and < 6	≥ 6
≥ 90	≥ 5% and < 10% of the intended classification period	≥ 10 % of the intended classification period

NOTE The rules given in A.4.3 may be used in addition to the rules in A.4.2.

A.4.3.2 Dimensions of the glazed element

A.4.3.2.1 Height

The test result of the glazed element covers the height up to a maximum of the tested height multiplied by a factor of 1,1 provided overrun time A is achieved. This is irrespective of the measured deflections.

The test result of the glazed element covers the height up to a maximum of the tested height multiplied by a factor of 1,2 provided overrun time B is achieved. This is irrespective of the measured deflections.

In case of elements intended to be classified for EW, the following additional provisions apply:

- the average temperature of the unexposed face of the glazed element as well as the average temperature of the unexposed face of the non-glazed area of the test specimen (Figure 12 or 14) remained below 300 °C, or

- the heat radiation measured from the complete and fully glazed element did not exceed 12,3 kW/m².

A.4.3.2.2 Width

The replication of the glazed element is covered based on rules described in A.4.2.1.3.

For glazed elements tested with a width smaller than 2,8 meter, the following rules apply.

The test result of the glazed element covers the width up to a maximum of the tested width multiplied by a factor of 1,1 provided overrun time A is achieved. This is irrespective of the measured deflections.

The test result of the glazed element covers the width up to a maximum of the tested width multiplied by a factor of 1,2 provided overrun time B is achieved. This is irrespective of the measured deflections.

In case of elements intended to be classified for EW, the following additional provisions apply:

- the average temperature of the unexposed face of the glazed element as well as the average temperature of the unexposed face of the non-glazed area of the test specimen (Figure 12 or 14) remained below 300 °C, or

- the heat radiation measured from the complete and fully glazed element did not exceed 12,3 kW/m².

A.4.3.3 Dimensions and area of individual rectangular glass panes

The test result of a pane covers dimensions up to a maximum of the tested dimensions multiplied by a factor 1,1 in width and/or height, provided overrun time A is achieved and the maximum tested area multiplied by a factor 1,1 is not exceeded.

The test result of a pane covers dimensions up to a maximum of the tested dimensions multiplied by a factor 1,2 in width and/or height, provided overrun time B is achieved and the maximum tested area multiplied by a factor 1,21 is not exceeded.

In case of elements intended to be classified for EW, the following additional provisions apply:

- the average temperature of the unexposed face of the glazed element as well as the average temperature of the unexposed face of the non-glazed area of the test specimen (see Figure 12 or 14) remained below 300 °C, or

- the heat radiation measured from the complete and fully glazed element did not exceed 12,3 kW/m².

In order to accommodate the increase in glass dimensions, it is permitted to increase the distance between mullions and/or transoms.

A.4.3.4 Aspect ratio

The calculation of permitted aspect ratio as defined in A.4.2.2.2 shall be conducted after any increase in glass dimensions based on overrun time has been established; i.e. $A \leq ½ * (A_{portrait,\ extended} + A_{landscape,\ extended})$, in which

A	area of assessed glass pane;
$A_{portrait,\ extended}$	extended area of glass pane oriented in “portrait” format
$A_{landscape,\ extended}$	extended area of glass pane oriented in “landscape” format

A.4.3.5 Area of individual circular, triangular and four side non-rectangular glass panes

The test result from individual circular, triangular and four sided non rectangular glass panes covers the area up to a maximum of the tested area multiplied by a factor 1,1 provided overrun time A is achieved.

The test result from individual circular, triangular and four sided non rectangular glass panes covers the area up to a maximum of the tested area multiplied by a factor 1,2 provided overrun time B is achieved.

The pane shall be of the same orientation and shape (including maintaining internal angles) as the tested pane.

In order to accommodate the increase in glass area, it is permitted to increase the distance between mullions and/or transoms.

Annex B
(normative)

Specific requirements for testing non-loadbearing external and internal walls designed to span horizontally between two independently proven fire resisting vertical structural elements

B.1 General

The boundary and restraint conditions of these products vary considerably in practice and consequently the way they are tested needs to reflect this. A non-loadbearing wall which is fixed to vertical constructions such as columns or solid walls will behave differently to non-load bearing walls fixed to floor slabs. Therefore, it is necessary to give instructions how to perform a fire test and apply the rules for direct field of application for such constructions.

B.2 Test specimen

B.2.1 Size

If, in practice, the height or width of the construction is 3 m or smaller, then that dimension of the test specimen shall be tested at full size. If any dimension of the construction is greater than 3 m, then that dimension shall be tested at not less than 3 m when tested without a supporting construction or 2,8 m when tested with a supporting construction.

B.2.2 Number

The number of test specimens shall be as given in EN 1363-1. However, where information is required under different exposure conditions or where the construction is to be evaluated with and without glazing, additional tests shall be undertaken for each application using separate test specimens.

B.2.3 Design

The test specimen shall be either:

a) fully representative of the construction intended for use in practice, including any surface finishes and fittings which are essential and may influence its behaviour in the test,

or,

b) be designed to obtain the widest applicability of the test result to other similar constructions.

The design features which influence fire performance that should be included to give the widest application can be derived from the field of direct application.

The test specimen shall incorporate at least one horizontal joint. One horizontal joint shall be located between 350 mm and 650 mm in from the top edge (see Figure 19).

B.2.4 Boundary and Restraint conditions

When, in practice the test specimen is not larger than the front opening of the furnace, then the edges of the test specimen shall be restrained as in practice. Where, in practice the height of the construction is larger than the front opening of the furnace, the top horizontal edge shall be left unrestrained and there shall be a gap of 25 mm to 50 mm between the free edge of the test specimen and the test frame (see Figure 18). This gap shall be packed with a resilient non-combustible material, e.g. mineral fibre, to

provide a seal without restricting freedom of movement. The remaining edges shall be installed as in practice.

Any construction including any sealing of the free edge shall respect the following principles:

a) prevent as far as possible the leakage of hot gases from the furnace into the test specimen;

b) prevent as far as possible the leakage of gasses out of the test specimen;

c) have as minimal effect as possible on the deformations of the test specimen;

d) have as minimal effect as possible on the insulation rating of the test specimen.

In some cases sandwich panels are installed without mechanical fixings to top and bottom, in order to avoid buckling due to differential temperatures on the inside and outside. In these cases the installation shall be as in practice.

B.3 Test specimen instrumentation

The instrumentation of the test specimen shall be as per Clause 9; however for the determination of maximum temperature thermocouples shall be applied to the unexposed face as follows, see Figure 19:

a) at both vertical edges of the specimen at mid-height;

b) at both vertical edges, above the highest joint between the panels;

c) at mid width of the free edge, 150 mm in from the edge of the test specimen;

d) in both top corners, 100 mm in from the free edge of the test specimen;

e) if in practice the top edge is unrestrained, an additional thermocouple shall be placed at mid width of the top edge, 20 mm in from the edge of the test specimen;

f) at mid width, above and below the highest and the lowest joint between the panels.

Thermocouples for evaluating insulation shall not be positioned closer than 100 mm from any discrete area that is not being evaluated for insulation.

B.4 Test procedure

The test shall be carried out using the equipment and procedures in accordance with EN 1363-1 and if appropriate EN 1363-2.

B.5 Performance criteria

The criteria by which the performance of the test specimen is judged are given in EN 1363-1. However, failure under the integrity criterion shall be disregarded within 150 mm of the horizontal free edge. In case this free edge is the end-use application in practice, than the performance criteria shall apply to this part.

B.6 Field of direct application of test results

B.6.1 General

The results of the fire test are directly applicable to similar constructions where one or more of the changes listed below are made and the construction continues to comply with the appropriate design code for its stiffness and stability:

a) decrease in height and/or width of the wall;

b) increase in the number of horizontal joints, of the type tested, when tested with one joint at a location with an overpressure of minimum 15 Pa;

c) decrease in distance of fixing centres;

d) increase in the thickness of the wall;

e) decrease in linear dimensions of boards or panels but not thickness;

f) increase in the number of vertical joints, of the type tested, when tested with one joint at mid-width of the test specimen with an overpressure of minimum 15 Pa.

B.6.2 Supporting constructions

For specimens tested in the test frame without any supporting construction, the result is applicable to high density rigid supporting constructions with at least the same fire resistance as the test specimen.

B.6.3 Extension of width

The width of the construction may be increased by 1,0 m under the following conditions:

a) minimum tested width is 3 m;

b) the maximum deflection of the test specimen was not in excess of 100 mm (see 9.3);

c) the expansion allowances are increased pro-rata.

B.6.4 Extension of height

For constructions with single wall elements between two vertical structural elements, where the self load is carried by the fixings at both sides to the vertical structural elements, the height of the construction with the same element height as tested may be increased under the following condition:

- the height of the wall may be extended by up to a third of the tested height.

For constructions with single wall elements between two vertical structural elements, where the self load is carried by the floor and the wall elements are supported by the vertical edges, the height of the construction may be increased under the following condition:

- the height may be increased by 1 meter in addition to the tested height, provided that the lower elements can carry the load of the elements above.

Bibliography

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

[2] EN 1364-4, *Fire resistance tests for non-loadbearing elements - Part 4: Curtain walling - Part configuration*

[3] EN 1634-1, *Fire resistance and smoke control tests for door and shutter assemblies, openable windows and elements of building hardware - Part 1: Fire resistance test for door and shutter assemblies and openable windows*

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