BS EN 15254-4:2018

BSI Standards Publication

Extended application of results from fire resistance tests - Non-loadbearing walls

Part 4: Glazed constructions

bsi.

EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

EN 15254-4

December 2018

ICS 13.220.50; 91.060.10

Supersedes EN 15254-4:2008+A1:2011

English Version

Extended application of results from fire resistance tests - Non-loadbearing walls - Part 4: Glazed constructions

Extension du champ d'application des résultats des essais de résistance au feu - Éléments non-porteurs - Partie 4 : Constructions vitrées

Erweiterter Anwendungsbereich der Ergebnisse von Feuerwiderstandsprüfungen - Nichttragende Wände - Teil 4: Verglaste Konstruktionen

This European Standard was approved by CEN on 28 September 2018.

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

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Ref. No. EN 15254-4:2018: E

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European foreword

This document (EN 15254-4:2018) 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of an identical text or by endorsement, at the latest by June 2019, and conflicting national standards shall be withdrawn at the latest by June 2019.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN shall not be held responsible for identifying any or all such patent rights.

This document supersedes EN 15254-4:2008+A1:2011.

Relevant changes compared to the previous edition EN 15254-4:2008+A1:2011 include:

a) Replacement of the term “glass product group” by “glass product range”;

b) Deletion of aspects now covered in the direct field of application (DIAP) of standard EN 1364-1:2015;

c) Modification of exchange rules for fire resistant glass;

d) Additional rule for decrease in dimensions for fire resistant glazed elements with classification EW;

e) Editorial review of the standard.

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

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, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.

1 Scope

This document provides guidance and, where appropriate, defines procedures for variations of certain parameters and factors associated with the design of fire resistant glazed elements which have been tested in accordance with EN 1364-1:2015, and classified according to EN 13501-2.

Extended application of fire resistant glazed elements is based on test evidence.

This standard only applies to vertically installed fire resistant glazed elements.

This standard does not apply to door sets and openable windows according to EN 1634-1 and does not apply to curtain walling – full configuration or curtain walling – part configuration according to EN 1364-3 and EN 1364-4.

Glass block assemblies and paver units and channel-shaped glass as defined in EN 1051-1 and EN 572-7 are excluded. There is currently insufficient information available to enable rules for extended application to be developed for these products.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

EN 1279-1, *Glass in building — Insulating glass units — Part 1: Generalities, system description, rules for substitution, tolerances and visual quality*

EN 1363-1, *Fire resistance tests — Part 1: General Requirements*

EN 1363-2, *Fire resistance tests — Part 2: Alternative and additional procedures*

EN 1364-1:2015, *Fire resistance tests for non-loadbearing elements — Part 1: Walls*

EN 1995-1-2, *Eurocode 5: Design of timber structures — Part 1-2: General — Structural fire design*

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 15269-2, *Extended application of test results for fire resistance and/or smoke control for door, shutter and openable window assemblies, including their elements of building hardware — Part 2: Fire resistance of hinged and pivoted steel doorsets*

EN 15269-3, *Extended application of test results for fire resistance and/or smoke control for door, shutter and openable window assemblies, including their elements of building hardware — Part 3: Fire resistance of hinged and pivoted timber doorsets and openable timber framed windows*

EN 15269-5, *Extended application of test results for fire resistance and/or smoke control for door, shutter and openable window assemblies, including their elements of building hardware — Part 5: Fire resistance of hinged and pivoted, metal framed, glazed doorsets and openable windows*

EN 15725, *Extended application reports on the fire performance of construction products and building elements*

EN ISO 12543-1, *Glass in building — Laminated glass and laminated safety glass — Part 1: Definitions and description of component parts (ISO 12543-1)*

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 13501-2, EN ISO 13943, EN ISO 12543-1, EN 1279-1 and EN 1364-1:2015, together with the following apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- IEC Electropedia: available at http://www.electropedia.org/
- ISO Online browsing platform: available at http://www.iso.org/obp

3.1
charring rate
rate at which a test specimen responds to heat evidenced by the formation of a carbonaceous residue

[SOURCE: ISO 17493:2016, 3.1, modified]

NOTE Calculated as described in EN 1995-1-2.

3.2
resistance to fire classification
resistance to fire classification of the glazed element with respect to integrity E, radiation W and insulation I in accordance with EN 13501-2

3.3
fire resistant glass
glass
glass product, (i.e. monolithic glass, laminated glass, insulating glass units), that when used in a glazed assembly, can have its performance determined and classified in accordance with EN 13501-2

NOTE The term "insulating" when used as an insulating glass unit according to EN 1279-1, should not be confused with the term "insulation" used in EN 13501-2 classification standard for fire resistant glazed element.

3.4
glass product range
group of fire resistant glass (see 3.3) products, including products from one or more glass product families, e.g. monolithic glass, laminated glass, insulating glass units, defined and produced by one manufacturer for which the characteristic resistance to fire from any one product within the range is valid for all other products within this range

NOTE The glass product families are defined in the relevant product standards.

3.5
glazing system material
all materials used to glaze the fire resistant glass into its frame, e.g. glazing strips, beads and bead fixings, setting blocks, gaskets and sealant

NOTE See example in Figure 1.

3.6
pre-existing test data
test data generated by fire resistance tests that have been undertaken in accordance with former versions of European test standards

3.7
reference test
fire resistance test in accordance with EN 1364-1:2015 and EN 1363-1, and where applicable EN 1363-2 which the extended application is based and the results, which are used as the main source of data for the extended application

3.8
framing system
frame profile and fixing to the supporting construction

NOTE See example in Figure 1.

3.9
direct field of application of test results
outcome of a process (involving the application of defined rules) whereby a test result is deemed to be equally valid for variations in one or more of the product properties and/or intended end-use applications

3.10
extended field of application of test results
outcome of a process (involving the application of defined rules that may incorporate calculation procedures) that predicts, for a variation of a product property and/or its intended end-use application(s), a test result on the basis of one or more test results to the same test standard

4 Principles

4.1 General principles

Extended application is a prediction of the expected fire resistance of fire resistant glazed elements. It may be based on interpolation between or extrapolation from test data. The fundamental consideration shall be that the fire resistant glazed element after extension would achieve the required fire performance if it were to be tested according to EN 1364-1:2015.

The test results are applicable to similar constructions where one or more of the changes in the direct field of application in EN 1364-1:2015 and this standard are made, and it is the manufacturer's responsibility that the construction continues to comply with the appropriate design code for its stiffness and stability.

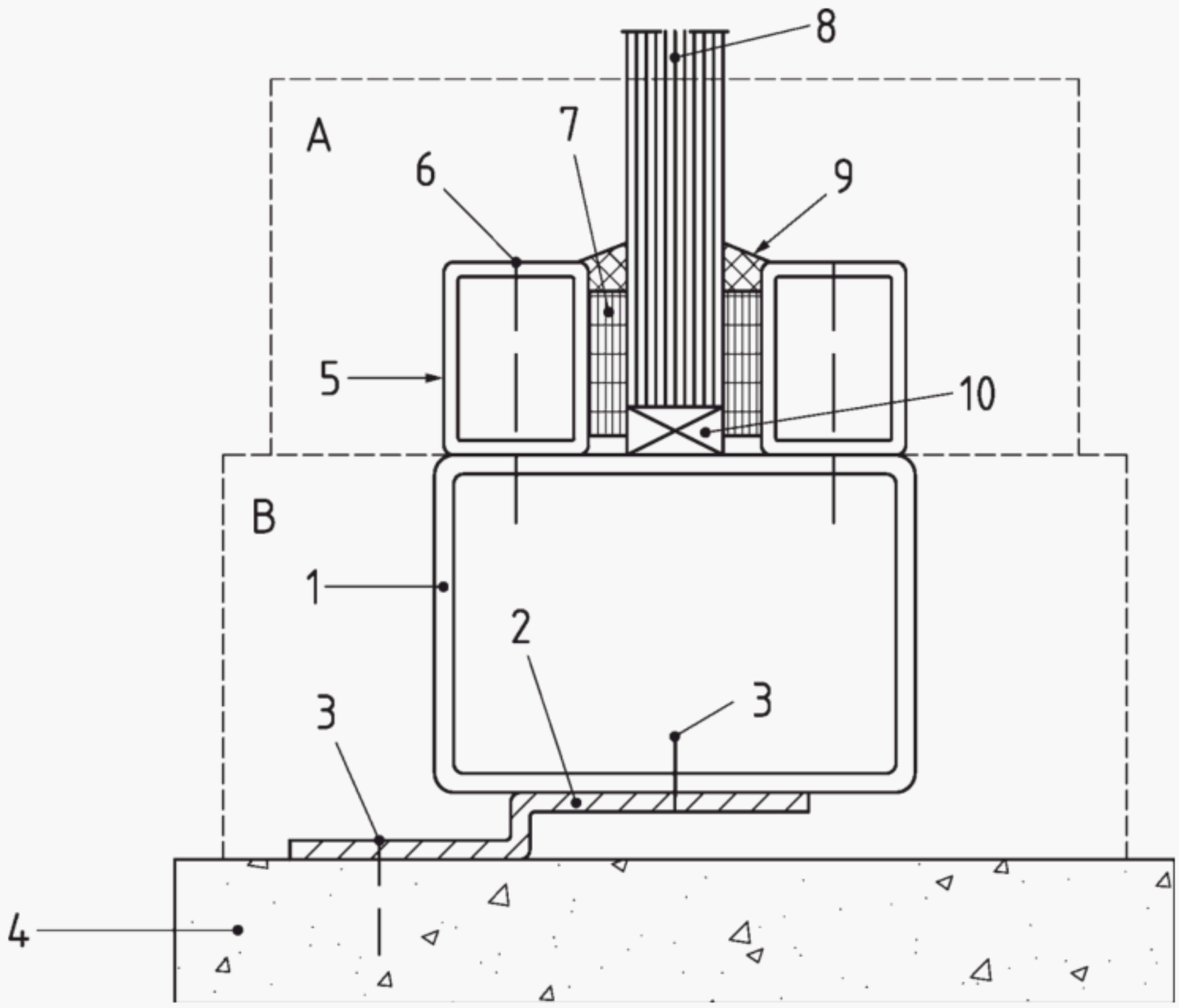
For test reports based on an edition of EN 1364-1 earlier than 2015, the direct field of application according to EN 1364-1:2015 may be applied.

An increase in the classification time (e.g. from EI 30 min to EI 45 min) and/or changes to the fire performance classification (e.g. from E to EW) achieved in the reference test shall not be permitted by the application of the extended application rules. The only exception is detailed in 7.2.

The overview regarding the relevant changeable parameters for extended application for fire resistant glazed elements is given in Table 1.

Extended application reports shall be prepared according to EN 15725.

Fire resistant glazed elements function as an integral system in which the individual components (glass, glazing system materials and framing system) are combined in such a way that they are effective in meeting the defined fire resistance criteria. However, in this document fire resistant glazed elements are separately characterized as the glazing system and the framing system (see example in Figure 1).



Key

A	glazing system
B	framing system
1	frame
2	metal anchor, screwed or bolted to the supporting construction (4) by a fixing anchor (3)
3	screw and fixing anchor
4	supporting construction
5	bead, screwed or clipped or clamped
6	bead fixing
7	glazing strip
8	glass
9	sealing or gasket
10	setting block

Figure 1 — Example of a framing system and glazing system

4.2 Use of test evidence

4.2.1 General

The applicant for the extended application shall either be the “owner” (i.e. sponsor) of all reference tests and pre-existing test data being submitted for the extension, or have written permission from the owner to use the submitted test evidence.

4.2.2 Reference tests

Reference tests are the basis for any changes. For some of the changes an overrun time is required in accordance with EN 1364-1:2015. A reference test may be submitted for either rectangular or non-rectangular panes.

Reference tests provide the main source of data to determine the following:

— resistance to fire classification (integrity E, integrity with radiation EW or integrity with insulation EI);

— maximum pane area and dimensions for the fire resistant glass;

— maximum dimensions of the fire resistant glazed element for each type of frame;

— side exposed to fire.

Reference tests may also provide other data to assist in determining the following:

— permitted dimensional changes to the framing system;

— changes to the glazing system.

4.2.3 Use of pre-existing test data

Pre-existing test data may be used to support extended application, for instance to evaluate the influence of a particular component (e.g. glazing material) or aspect of the design (e.g. direction of fire exposure) or to establish which design variations affect the performance in the most or least onerous way. If this can be identified, then a reference test of the most onerous design may be undertaken. If the product achieves the required classification then the other less onerous variations will be covered. The relevant clauses state when pre-existing test data may be used.

The following parameters and factors are considered in this standard:

Table 1 — Parameters, Factors and Rules for glazing and framing systems and glazed elements

Parameter	Factor	Rule see clauses:
Glazing system		
Change of glass type and thickness	Replacement of glass within the same glass product range	5.1
Glass shapes	Rules to glass shapes	5.2
Glass dimensions	Increase in glass dimensions	5.3
Timber beads	Exchange of timber species / bead fixing / bead shape and dimensions	5.4
Metal beads	Exchange of bead fixing / bead shape and dimensions	5.5
Exchange of glazing materials	Gaskets/glazing strips / setting blocks	5.6
Bead surface coverings	Changes or adding surface coverings	5.7
Framing system		
Exchange of frames (general)	Type of material / junction types / edge cover	6.1.1
Timber frames	Thickness / profile / timber type (charring rate / density)	6.1.2
Metal frames	Frame materials / sections / thickness of chamber walls	6.1.3
Frame surface covering	Changes or adding frame surface coverings	6.2
Fire resistant glazed element		

Parameter	Factor	Rule see clauses:
Glazed element classified EW	Increase in dimensions and replication for fire resistant glazed elements	7.1
Glazed element classified EW	Decrease in dimensions for fire resistant glazed elements	7.2

4.3 Combination of extended application

Within the extended application, a combination of changes is allowed (see Clauses 5, 6 and 7), provided that each change needed for these combinations can be substantiated by the supporting test evidence and/or pre-existing test data.

An extended application that has already been granted can be used for a new extended application, provided it can be shown that the new changes do not contradict any of the principles used to establish the first extended application.

For reasons of traceability, all supporting documents used for any extension should be referenced in the extended application report.

5 Specific changes to the glazing system

5.1 Exchange of the fire resistant glass

5.1.1 General

The exchange of the tested fire resistant glass, for another is allowed without additional test, provided that

— both glass types are within the same glass product range, and

— the replacing fire resistant glass has at least the same resistance to fire classification according to EN 13501-2 as the tested glass, and

— the dimensions (width x height) of the replacing glass are within the maximum dimensions given by the field of direct application of the tested glass.

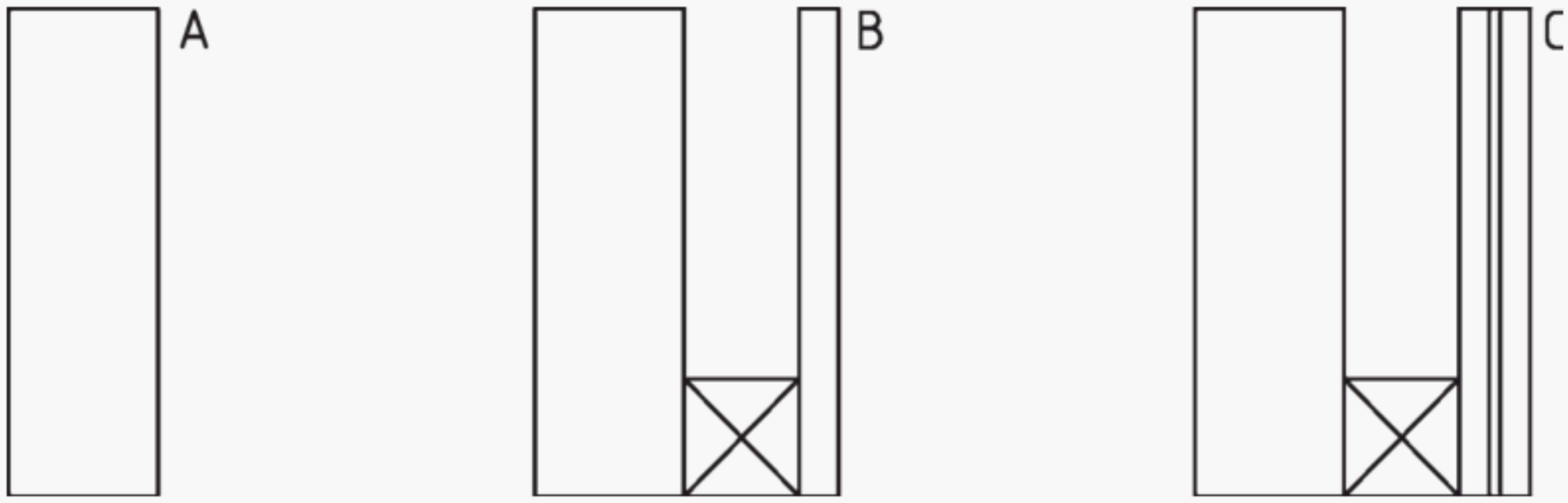
There are three major types of fire resistant glass:

— fire resistant glass consisting only of the glass component that provides the fire resistance (i.e. a monolithic or a laminated glass) indicated in Figure 2, type A;

— an insulating glass unit (IGU) consisting of the component that provides the fire resistance, a monolithic counter pane with or without additional coatings on either side of the counter pane and an optional middle pane with or without coatings indicated in Figure 2, type B;

— an IGU consisting of the component that provides the fire resistance, a laminated counter pane with or without additional coatings on either side of the counter pane and an optional middle pane with or without coatings, indicated in Figure 2, type C.

NOTE An IGU can consist of a glass component that provides the fire resistance and one or more cavities and counter panes.



Key

A fire resistant glass

B IGU with monolithic counter pane

C IGU with laminated counter pane

Figure 2 — Types of fire resistant glass

For classification E, EW and EI the following rules apply:

The overall glass thickness may be increased provided that no fire protection interlayer and no individual glass component will be decreased. Specific rules are given in 5.1.2, 5.1.3 and 5.1.4.

The thickness of individual non-fire protection components (e.g. polyvinyl butyral PVB, ethyl vinyl acetate EVA, polyurethane PU, polycarbonate PC) shall not be increased. It may be decreased which results in a decrease of the overall glass thickness. Specific rules are given in 5.1.2, 5.1.3 and 5.1.4. For IGUs, the width of each cavity may be reduced. The width of each cavity may be increased by not more than a factor of 2. Specific rules are given in 5.1.2, 5.1.3 and 5.1.4.

5.1.2 Classification EI with the component that provides the fire resistance tested on the exposed face

The following exchanges are allowed without additional test evidence:

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

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

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

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

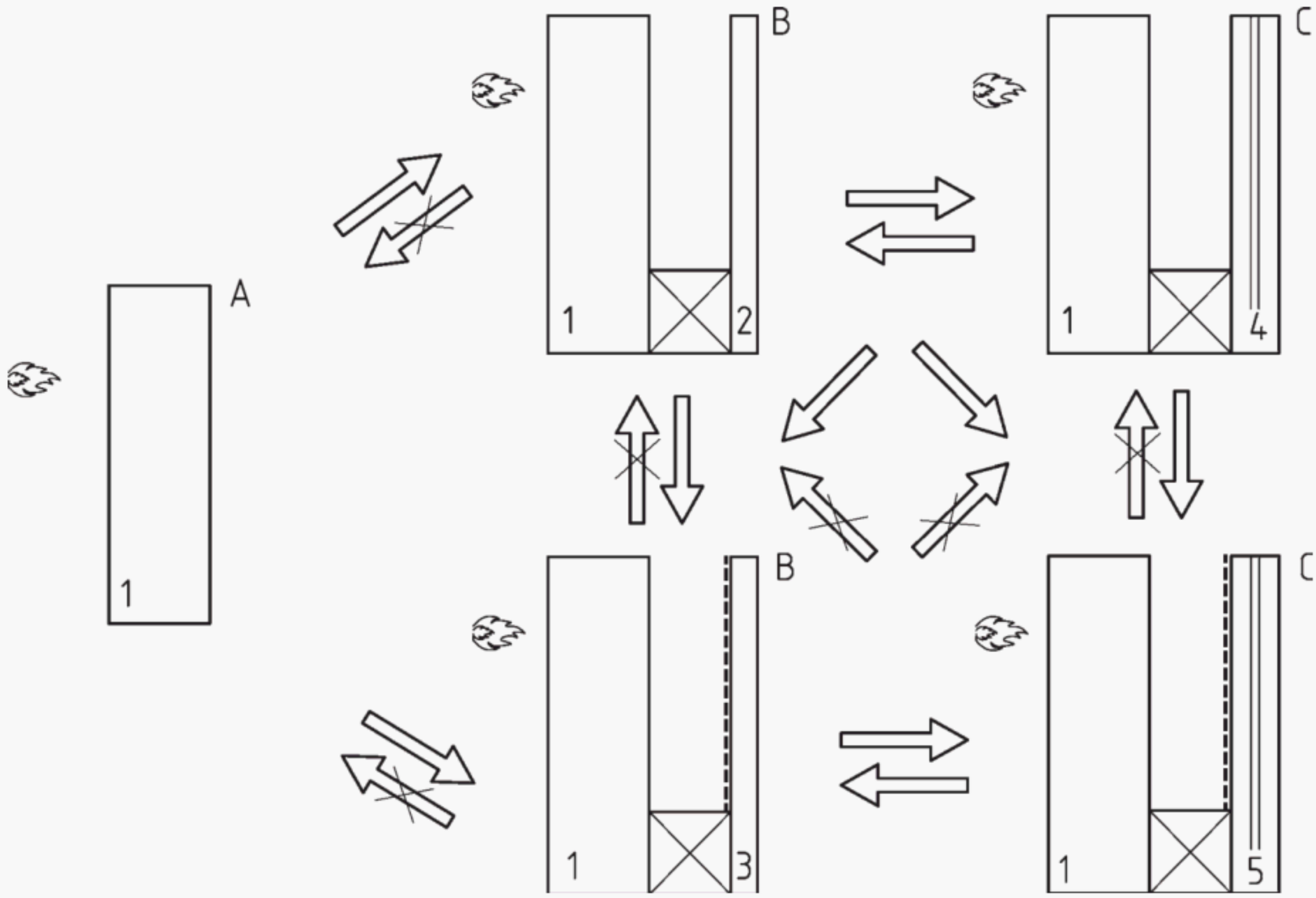
e) Test results of type C without additional coatings are equally applicable to type B with additional coatings but not vice versa.

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

g) Test results of IGUs obtained with one cavity are equally applicable for IGUs with 2 cavities. The total width of both cavities may not be increased by more than a factor of 2 based on the tested cavity width.

h) Additional non-fire resistant glass panes may be added to the tested glass using non-fire protection interlayers with a thickness < 1mm.

NOTE For details, see Figure 3.



Key

A fire resistant glass
B IGU with monolithic counter pane
C IGU with laminated counter pane
1 Glass component that provides fire resistance
2 monolithic counter pane
3 monolithic, coated counter pane
4 laminated counter pane
5 laminated, coated counter pane

Figure 3 — Exchange rules for classification EI with the component that provides the fire resistance tested on the exposed face

5.1.3 Classification EI with the component that provides the fire resistance tested on the unexposed face

The following exchanges are allowed without additional test evidence:

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

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

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

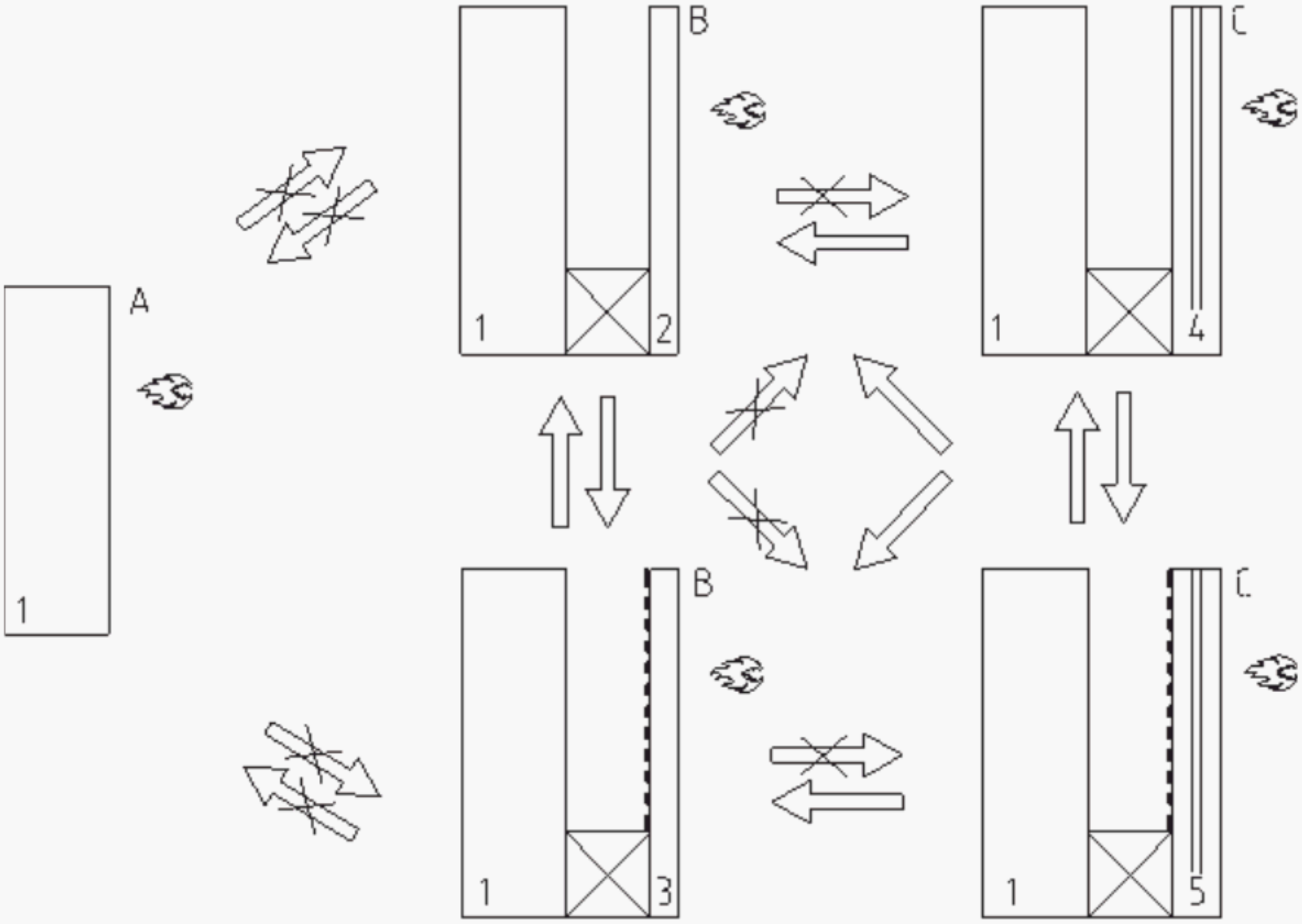
d) Test results of type C with additional coatings are equally applicable to type B without additional coatings but not vice versa.

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

f) Test results of IGUs obtained with two cavities are equally applicable for IGUs with 1 cavity - provided the cavity width is not increased from the total width of both cavities tested.

g) Additional non-fire resistant glass panes may be added to the tested glass using non-fire protection interlayers with a thickness < 1 mm.

NOTE For details, see Figure 4.



Key

A fire resistant glass
B IGU with monolithic counter pane
C IGU with laminated counter pane
1 glass component that provides fire resistance
2 monolithic counter pane
3 monolithic, coated counter pane
4 laminated counter pane
5 laminated, coated counter pane

Figure 4 — Exchange rules for classification EI with the component that provides the fire resistance tested on the unexposed face

5.1.4 Classification E, EW

No rules beyond those detailed in 5.1.1 are applicable.

5.2 Glass shapes

Circular, triangular or 4 sided non-rectangular shapes may be cut from within the extended rectangular pane size defined by the field of direct application. All other non-rectangular shapes may only be cut from the tested rectangular pane size and shall not be extended further.

5.3 Increase of glass dimensions

For individual panes where the E or EI classification is relevant, no extension to those defined by the field of direct application is allowed.

For an individual pane where the EW classification is relevant, the individual pane size of a fire resistant glass may be increased according to the field of direct application rules given in EN 1364-1:2015, A.4.3.3, 1st and 2nd paragraph, under the precondition that the dimensions (width and height) of the total glazed test element are not increased and the radiation does not exceed 15 kW/m^2. The value W_{ext} of an individual rectangular or circular glass shall be calculated according to Formulae B.1 and B.4 given in Annex B.

The increased glass dimension can also be used in combination with the rules given in 7.1

NOTE This requirement deviates from EN 1364-1:2015, A.4.3.3, where the extension of the individual glass pane is based on an unjustifiable request of a specific radiation limit.

5.4 Exchange of timber glazing beads

The basis for the exchange of timber types is a reference test together with data on the basis of density tests (when available), or calculations according to EN 1995-1-2 or reference values for the replacement timber type and its density.

Glued laminated timber shall only be used if it has been tested according to EN 1364-1. Test results of any solid or laminated timber type apply to other timber types except beech under the following conditions:

— Glued laminated timber may be replaced by solid timber but not vice versa.

— Timber to be exchanged shall have the same or higher density as tested.

— Hard wood with a density ≥ 450 kg/m^3 shall not be exchanged with soft wood.

Beech may only be used instead of soft wood or hard wood with a density ≤ 450 kg/m^3.

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.

A bead fixed by screws shall not be exchanged by a clipped or nailed bead unless this possibility has been shown to work by pre-existing test data.

The bead depth (see Figure 5, item 6) may be increased provided the mechanical edge cover remains within the limits determined by the reference test or as determined by pre-existing test data. A reduction of the depth of the bead or the rebate is not allowed.

For E and EW classified fire resistant glazed elements, exchange of the bead profile from a sloped or chamfered bead to a flat profile bead is allowed if demonstrated by a reference test or pre-existing test data.

Exchange of a flat bead or flat rebate profile to a sloped or chamfered profile of the same depth facing the glass is allowed for all fire resistant glazed elements. But in this case the subsequent reduction in a bead or rebate cross section is only allowed where it is demonstrated by pre-existing test data that it does not have a detrimental effect on the fire performance.

Reduction in bead width (see Figure 5, item 7) is only allowed if it is demonstrated by pre-existing test data that it does not have a detrimental effect on the fire performance. The bead width may be increased without restriction (see Figure 5, item 7).

NOTE The timber bead can have a major influence on the integrity performance of a timber-glazed system incorporating fire resistant glass with an E or EW classification. This is because it is possible for the timber bead to flame under the influence of radiation immediately adjacent to the glass surface on the unexposed face. Charring of the timber also occurs at radiation intensities much less than those required to cause flaming. Fire resistant glazed elements with an EI classification significantly reduce the possibility of this occurrence by reducing the transmitted radiation directly at the glazing surface to low levels.

5.5 Exchange of metal glazing beads

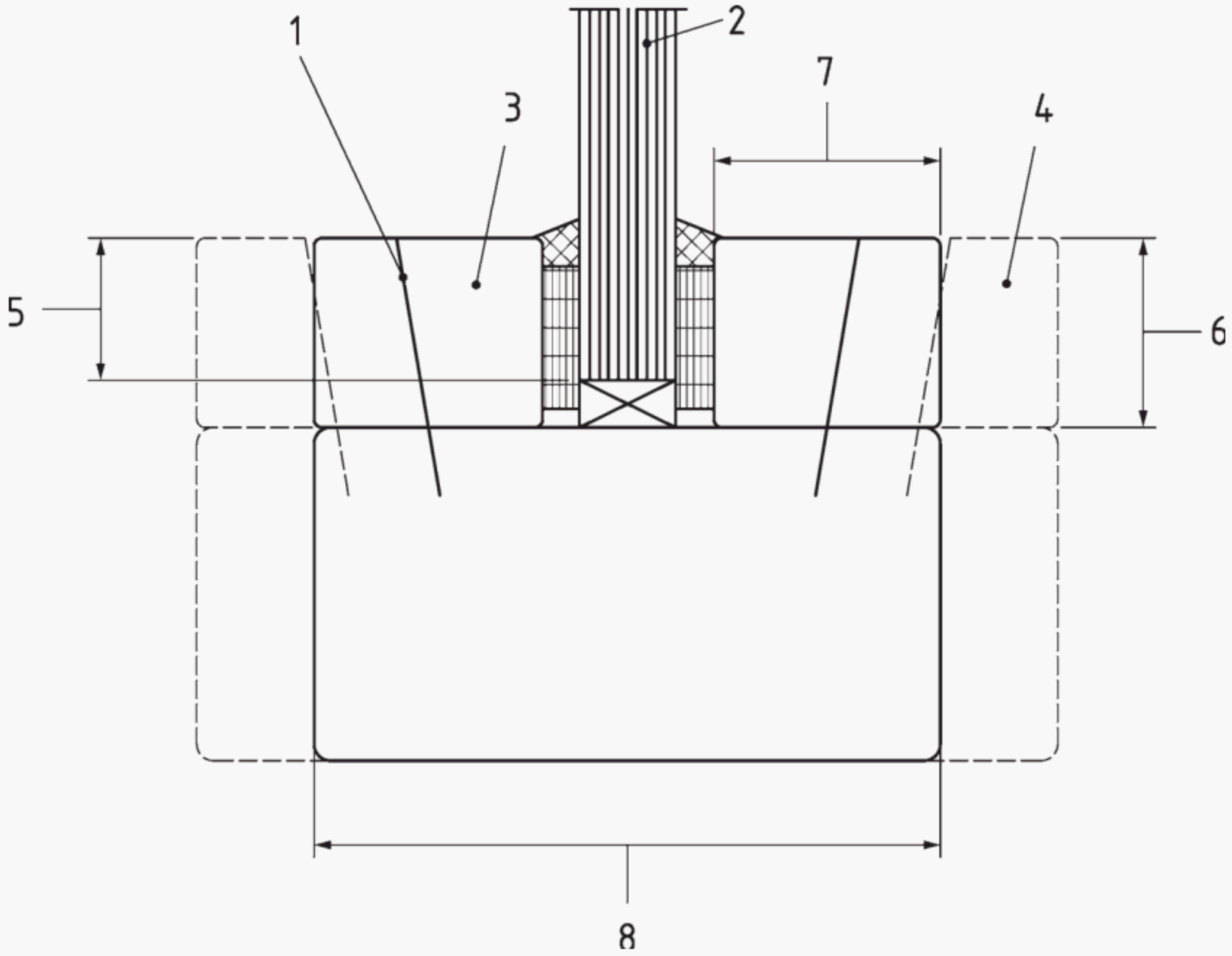
It is not allowed to exchange the type of material used for the glazing beads (e.g. mild steel to aluminium or mild steel to stainless steel).

However, the exchange of stainless steel to mild steel is allowed.

Changes in bead shape are only allowed if it is demonstrated by pre-existing test data that it does not have a detrimental effect on the fire performance. Pre-existing test data are allowed.

Bead width maybe increased (see Figure 5, item 7).

Reductions in bead width (see Figure 5, item 7) are only allowed based on existing test data. The bead depth (see Figure 5, item 6) may be increased provided that the mechanical edge cover (see Figure 5, item 5) does not change, or it is shown by the reference test and/or by pre-existing test data that the increase in the mechanical edge cover does not have a detrimental effect on the fire performance.



Key

1	bead fixing, e.g. screws, nails, etc.	5	mechanical edge cover (see EN 12488)
2	glass	6	bead/rebate depth (see EN 12488)
3	bead	7	bead width
4	bead extended in width	8	frame section width

NOTE This applies to wooden and metal frames.

Figure 5 — Change in bead/frame section width

5.6 Exchange of glazing system materials

Except for glazing beads, exchange of a glazing material, e.g. gaskets, is only allowed if it is demonstrated in a reference test and/or pre-existing test data that the exchange does not have a detrimental effect on the fire performance within a comparable glazing system of the same glass product range.

5.7 Bead surface coverings

Decorative surface coverings of the glazing beads may be exchanged, or added where one does not exist, provided it is demonstrated that the covering material achieves at least Class A2 when tested according to EN 13501-1. In addition, it shall be shown that they do not adversely affect the fire resistance performance of the fire resistant glazed element, e.g. in the case of replacement coverings that provide a contribution to insulation.

If the surface covering is not Class A2 then it has to be proven in reference test data and/or pre-existing test data that it does not negatively affect the fire performance.

Any coverings on glazed elements classified EI shall be secured using only fixing method(s) proven in the reference test and/or by pre-existing test data.

6 Specific changes to the framing system

6.1 Exchange of frames

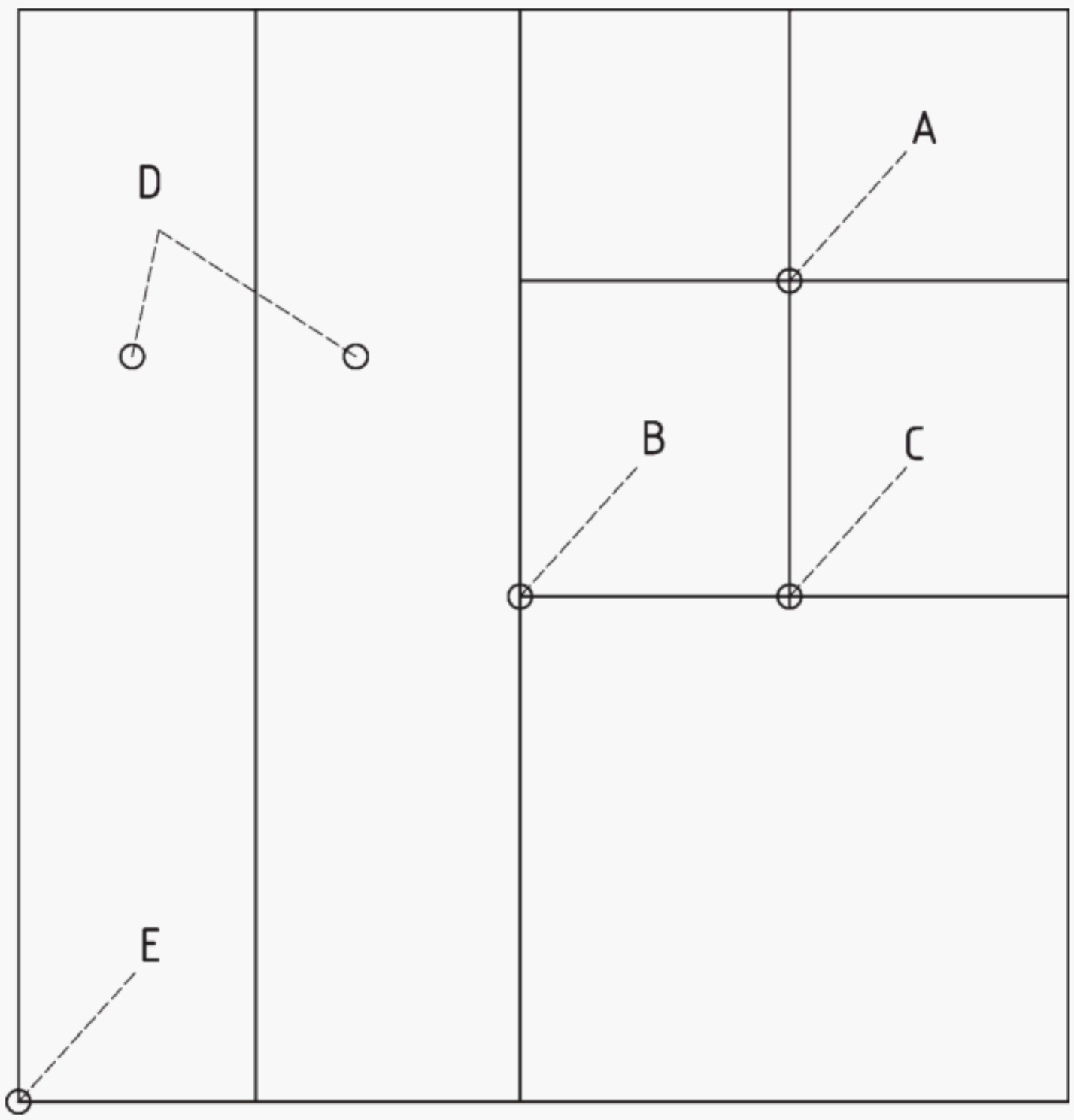
6.1.1 General

It is not allowed to exchange the type of material used to construct the frame (e.g. steel for timber or aluminium for steel).

However, the exchange of stainless steel to mild steel is allowed.

Frames may be manufactured using some or all of the junction types detailed below. But all the junction types considered in the extended application have to be covered in the reference test or pre-existing test data provided the glass is part of the same glass product range.

Some possible junction types are shown in Figure 6 below.



Key

Type A: four panes coming together at one point;
Type B: three panes coming together at one point, including a full height vertical pane;
Type C: three panes coming together at one point, including a full width horizontal pane;
Type D: two panes, side by side, all panes in full size vertical (mullion) or horizontal (transom);
Type E: corner junction

Figure 6 — Examples of possible junction types

The mechanical edge cover shall remain within the limits determined by fire test evidence unless supported by pre-existing test data.

6.1.2 Timber frames

No rules beyond those detailed in 5.4 and 6.1.1 are applicable.

Split timber frames (bolted, glued or nailed) shall be tested unless scaled drawings and representative frame sections show that there is sufficient timber in the section such that the char line in the required period does not reach the bead fixings.

6.1.3 Metal frames

In addition to the general rules given in 6.1.1, the following additional rules apply for steel and aluminium frames.

Exchange of steel for steel frames, or aluminium for aluminium frames is allowed provided that:

a) Substitute frame has the same material specification as in the reference test. This shall be as demonstrated by the appropriate characteristics of the frame (e.g. thermal expansion, thermal conductivity, melting point, strength). The specifications of the two framing systems shall be included in the extended application report for comparison.

b) Substitute frame has the same fire performance as the frame in the reference test. This shall be demonstrated by reference to fire test data at the same classification time. Pre-existing test data may be used.

c) Deflection of the frame that is being considered in the extended application shall be no more than the measured deflection in the reference test. The deflection of this frame shall be known from pre-existing test data. If data is not available or it is not possible to accurately calculate the deflection, then exchange is not allowed.

d) Alternative frame has successful test evidence, which demonstrates that all the necessary design features (e.g. junctions, fixings) of the fire resistant glazed element under consideration can be constructed with the alternative frame without impairing the required fire performance in a test of the fire resistant glazed element. Pre-existing test data may be used.

e) In particular, the test report shall include information on expansion joints of the construction if these are to be covered by the extended application.

f) Frame section may be changed provided that it is be demonstrated that:

   1) the inertia of the profiles is not reduced in the cold state;

   2) frame section width is not reduced (see Figure 5, item 8);

   3) wall thickness and number of chambers in the frame are not reduced.

6.2 Frame surface coverings

Decorative surface coverings of the framing members may be exchanged, or added where one does not exist, provided it is demonstrated that the covering material achieves at least Class A2 when classified according to EN 13501-1. If the surface covering is not Class A2 then the rules laid down in the EN 15269-2, EN 15269-3 and EN 15269-5 apply.

7 Changes to the fire resistant glazed element

7.1 Increase in dimensions and replication for fire resistant glazed elements with classification EW

The extension of the area of rectangular and circular glazed elements with EW classification is given based on the overrun time from Table 2 together with the following.

Table 2 — Overrun time

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

The test result of the glazed element covers dimensions up to a maximum of the tested dimensions multiplied by a factor 1,1 in width and/or height, provided that

— overrun time A is achieved;

— the maximum tested area multiplied by a factor 1,1 is not exceeded;

— $W_{ext} \leq W_{max}$ (definitions are given in Annex B).

The test result of the glazed element covers dimensions up to a maximum of the tested dimensions multiplied by a factor 1,2 in width and/or height, provided that

— overrun time B is achieved;

— the maximum tested area multiplied by a factor 1,21 is not exceeded;

— $W_{ext} \leq W_{max}$ (definitions are given in Annex B).

For rectangular and circular glazed elements, W_{ext} shall be calculated according to Formulae B.1 and B.4 given in Annex B.

In the absence of appropriate formulae, extension in area for EW classified fire resistant glazed elements for all other shapes is allowed by the method described in B.1.4 which is based on the area of a rectangle prescribed around the shape.

There may be cases where the extended application considers an increase in the glazed area within the fire resistant glazed element by replacing opaque sections or panels with glass. In these cases, the increase in radiation from the extended fire resistant glazed element as a whole shall be re-calculated and evaluated against the radiation criteria given in Annex B. In cases where this is not possible then no extension of the glazed area is allowed.

NOTE The increase in radiation is not proportional to the increase in area of the fire resistant glazed element.

The calculated radiation W_{ext} for a replicated glazed element of 9 m width represents all wider glazed elements.

The relevant calculation shall be provided in the extended application report.

7.2 Decrease in dimensions for fire resistant glazed elements with classification EW

Tested rectangular and circular glazed elements with a radiation value > 15 kW/m^2 at the end of the intended EW-classification time may be decreased or changed in height and/or width in order to reach a maximum radiation value of W_{max} of 15 kW/m^2 as given in B.1.1. The classification E for the intended EW-classification time shall be achieved.

For rectangular and circular glazed elements, W_{ext} shall be calculated according to Formulae B.1 and B.4 given in Annex B.

Rules given in the field of direct application in EN 1364-1:2015, Annex A shall be applied provided the calculated radiation based on Formulae B.1 and B.4 given in Annex B of this standard does not exceed

W_{max}. The provisions for glazed elements intended to be classified for EW given in EN 1364-1:2015, A.4 are to be replaced by this calculation.

The calculated radiation W_{ext} for a replicated glazed element of 9 m width represents all wider glazed elements.

The relevant calculation shall be provided in the extended application report.

Annex A
(informative)

Examples for using this standard with regard to requested extended applications based on the reference test and pre-existing test data

A.1 Examples for fire resistant glass with E Classification based on Table A.1

The sponsor provided three test reports to the Notified Test Laboratory, one reference test and two tests of pre-existing test data for integrity only glass (E Glass) summarized in Table A.1 and requested the following extension.

Request 1: The sponsor requested an exchange of the glass from the colours tested to a blue glass contained within the manufacturer's product range but provided no fire test evidence for this glass.

Assessment: The blue glass is contained in the manufacturer's glass product range and has the same thickness as the clear, green and grey glass that was submitted to a fire resistance test. It is also documented that the light transmission/absorption values of the blue glass lie between the transmission/absorption values of the tested glasses. But the blue glass does not have any supporting fire test reports as required by rule 5.1. Hence, it is not allowed to exchange the green glass in the reference test by the blue glass.

NOTE If a fire test report is available for the blue glass and the size/area of the glass tested is below the size/area of the reference test (green glass), then the exchange of green glass for blue glass would be allowed but only at the tested size of the blue glass.

Request 2: The sponsor above on the basis of the same tests requested that as well as exchanging the green glass for a blue glass that the steel beads are replaced with timber beads.

Assessment: The green glass and the steel beads shall not be exchanged. The green glass shall not be exchanged with the blue glass for the reasons above (Q1). The steel beads shall not be exchanged for timber beads because the fire test data only covers steel beads and the rules in 5.5 do not allow an exchange of different types of materials for glazing beads.

Request 3: The sponsor above on the basis of the same tests requested that as well as exchanging the green glass for a blue glass the pane area is also increased to its maximum.

Assessment: The green glass shall not be exchanged with the blue glass for the reasons above (Q1), hence increasing the area is not relevant.

But if the green glass in the reference test was not exchanged, then due to the overrun time of 6 min being achieved, the area of the green glass may be increased by 21 % according to EN 1364-1:2015.

Table A.1 — Input data — Examples for glass with E Classification

Reference Test Data to EN 1364-1 **(not necessarily a Type Test (TT), may be a Market Application Test)**	Report xxx of notified test lab A. Drawing given in the report.	Pre-existing test data according to EN 1364-1. Report yyy of accredited test lab B. Drawing given in the report.	Pre-existing test data according to EN 1364-1. Report zzz of accredited test lab C. Drawing given in the report.
Glass Product Range Product Standard **Test Standard**	EN 12150-2	EN 14179-2	EN 14179-2
Trade Name **Colour** **Thickness**	A (toughened) green 6mm	A (toughened) clear 6mm	A (toughened) grey 4mm
Glass Symmetry	symmetrical	symmetrical	symmetrical
Frame Type **Frame Material Symmetry**	non-insulated steel asymmetrical (identical to TT report, but beads to non-fire side)	steel symmetrical	steel asymmetrical (tested with smallest bead to fire side)
Number of Panes	1 pane	2 panes	2 panes
Max. Glass Size (B x H) **[mm x mm]**	2 000 x 2 000	1 000 x 2 000 each	750 x 2 000 each
Fixed or Free Frame Edge **Frame Section Details**	all edges fixed to high density rigid wall dimensions according to test report	top and bottom edges fixed to concrete, two free edges dimensions according to test report	fixed to concrete, one free edge dimensions according to test report
Bead Type, Bead Shape **Bead Dimension** **Bead Fixing** **Surface Covering** **Edge Cover**	steel, square 25 mm x 25 mm clipped no covering 10 mm - 12 mm	steel, square 20 mm x 20 mm screwed beads only covered class A2 10 mm -12 mm	steel, chamfered 30 mm x 35 mm frame only covered class A2 10 mm - 12 mm
Glazing system Material	intumescent strip	intumescent mastic	glazing strip
Constructional Element (see 6.1.1)	junction E (corner)	junction D + E (corner)	junction D + E (corner)
E	36 min	32 min	33 min
EW	n/a	n/a	n/a
EI	n/a	n/a	n/a

A.2 Examples for fire resistant glass with EW Classification, based on Table A.2

The sponsor provided two test reports to the Notified Test Laboratory, one reference test and one test of pre-existing data for an integrity and radiation glass (EW Classification) summarized in Table A.2 and requested the following extensions.

Q1 The sponsor requested an exchange of the green tinted and coated EW glass tested (of size 1,8 m × 1,8 m in the reference test) with a bronze tinted and coated EW glass (of size 2,0 m × 2,0 m in the pre-existing test data). Both glasses are contained within the manufacturer's product range. The sponsor also requested an extension of the pane area of the bronze glass from its tested size of 2,0 m × 2,0 m up to the maximum allowed under the extension rules.

Answer: The bronze EW glass is contained in the manufacturer's product range and has a greater thickness than the green EW glass. The green EW glass was fire tested using a glass size/area less than that of the bronze EW glass. Hence according to rule 5.1 (even with a bronze EW glass with an increased nominal thickness), it is allowed to exchange the green EW glass in the reference test by the bronze EW glass but only in the size/area as indicated below.

The radiation level for the green EW glass measured in the reference test was 10,0 kW/m^2 with an overrun time of 8 min on a pane size of 1,8 m × 1,8 m (3,24 m^2). The overrun time for the green EW glass was sufficient to allow an increase in area of 21 % (to 3,92 m^2) according to 7.1 or in accordance with EN 1364-1:2015.

It has already been shown above that the bronze EW glass may replace the green EW glass. The maximum area of the bronze EW glass may be up to the increased area of the green EW glass (3,92 m^2) provided that the radiation value for the bronze EW glass remains below 15 kW/m^2.

The original radiation value measured for the bronze EW glass was 12,0 kW/m^2. A recalculation of the radiation according to Annex B, Formula B.1 for the extended bronze EW glass shows that it still remains below 15 kW/m^2. Therefore, the green EW glass may be replaced with the bronze EW glass up to 3,92 m^2.

The original request by the manufacturer for a further extension of the pane area of the bronze EW glass from its tested size of 2,0 m × 2,0 m is not allowed because all extensions in size/area shall only be based on the reference test. The rules given in 5.1 say that in all cases the size/area of the replacement glass shall be no greater than either the size/area documented in the pre-existing test data or the extended size/area based on the reference test.

Table A.2 — Input data — Examples for glass with EW Classification

Reference Test Data to EN 1364-1 **(not necessarily a Type Test (TT), may be a Market Application Test)**	Report xxx of notified test lab A. Drawing given in the report.	Pre-existing test data according to EN 1364-1. Report yyy of accredited test lab C. Drawing given in the report.
Glass Product Range **Product Standard** **Test Standard**	EN 12150-2	EN 14179-2
Trade Name **Colour** **Thickness**	A (toughened) green coated 6 mm	A (toughened) bronze coated 8 mm
Glass Symmetry	asymmetrical	asymmetrical
Frame Type **Frame Material** **Frame Symmetry**	steel asymmetrical (identical to TT report, but beads to non-fire side)	steel asymmetrical (tested smallest bead to fire side)
Number of Panes	1 pane	1 pane
Max. Glass Size (B x H) **[mm x mm]**	1 800 x 1 800	2 000 x 2 000

Fixed or Free Frame Edge **Frame Section Details**	all edges fixed to high density rigid wall dimensions according to test report	fixed to concrete, one free edge dimensions according to test report
Bead Type, Bead Shape	steel, square	steel, chamfered
Bead Dimension	25 mm x 25 mm	30 mm x 35 mm
Bead Fixing	clipped	riveted
Surface Covering	no covering	frame only covered class A2
Edge Cover	10 mm - 12 mm	10 mm -12 mm
Glazing system Material	intumescent strip	glazing profile
Constructional Element (see 6.1.1)	junction E (corner)	junction E (corner)
E	n/a	n/a
EW	38 min (10 kW/m^2)	33 min (12 kW/m^2)
EI	n/a	n/a

A.3 Examples for fire resistant glass with EI Classification based on Table A.3

The sponsor provided two test reports to the Notified Test Laboratory, one reference test and one test report based on pre-existing data for integrity and insulating glass (EI Classification) summarized in Table A.3 and requested the following extensions.

Q1 The sponsor requested an exchange of the clear, laminated 23 mm EI 60 glass tested size 2,0 m × 2,0 m in the reference test report with a patterned and bronze tinted 23 mm EI 60 glass tested size 2,0 m × 2,5 m in the pre-existing test data report. Both glasses are contained within the manufacturer's product range.

Answer: The type of glass used in the laminated construction does not influence the fire resistance according to rule 5.1 so exchange of the glass is allowed.

Q2 The Sponsor above on the basis of the tests as well as exchanging the glass also requested an extension of the pane area of the patterned and bronze tinted glass from its tested size of 2,0 m × 2,5 m up to the maximum allowed under the extension rules.

Answer The clear 23 mm EI 60 glass may be exchanged with a patterned and bronze tinted 23 mm EI 60 glass (see Q1). This patterned and bronze tinted glass was also tested at a greater size than that of the glass in the reference test but any extension may only be based on the reference test (rules given in 4.2.2) and only on the basis that an overrun time B was achieved (see 7.1). As the reference test size was 2,0 m × 2,0 m and had an overrun time of 8 min then according to the rules in 7.1 and in EN 1364-1:2015 the bronze and patterned glass area may be increased by 21 % but only based on a pane size of 2,0 m × 2,0 m (4,84 m^2).

Table A.3 — Input data — Examples for glass with EI Classification

Reference Test Data to EN 1364-1 **(not necessarily a Type Test (TT), may be a Market Application Test)**	Report xxx of notified test lab A. Drawing given in the report.	Pre-existing test data according to EN 1364-1. Report yyy of accredited test lab B. Drawing given in the report.

Glass Product Range **Product Standard** **Test Standard**	EN 14449	EN 1364-1
Trade Name **Colour** **Thickness**	A (laminated) clear 23 mm	A (laminated) bronze patterned 23 mm
Glass Symmetry	symmetrical	symmetrical
Frame Type **Frame Material** **Frame Symmetry**	wood symmetrical	steel symmetrical
Number of Panes	1 pane	1 pane
Max. Glass Size (B x H) **[mm x mm]**	2 000 x 2 000	2 000 x 2 500
Fixed or Free Frame Edge **Frame Section Details**	all edges fixed to high density rigid wall dimensions according to test report	top and bottom edge fixed to concrete, two free edges dimensions according to test report
Bead Type, Bead Shape **Bead Dimension** **Bead Fixing** **Surface Covering** **Edge Cover**	wood, square 25 mm x 25 mm screwed no covering 10 mm - 12 mm	steel, square 20 mm x 20 mm screwed beads only covered class A2 10 mm -12 mm
Glazing system Material	intumescent strip	intumescent mastic
Constructional Element **(see 6.1.1)**	junction E (corner)	junction E (corner)
E	n/a	n/a
EW	n/a	n/a
EI	68 min	65 min

Annex B
(normative)

Radiation calculations

B.1 Radiation calculations

B.1.1 General

The following Formulae B.1 to B.6 shall be applied to a test specimen that consists of either:

— single-glazed fire resistant glazed element with only one individual pane (as indicated in 5.3);

— fully glazed fire resistant glazed element with several panes (as indicated in 7.1 or 7.2);

— replication of several fully glazed fire resistant glazed elements (as indicated in 7.1 or 7.2).

All the parameters and formulae given below (e.g. W_{max}, W_{ext}, W_0, φ_{ext}, φ_0, d, w_0, h_0, w_{ext}, h_{ext}, w_{max}, h_{max}) relate to the characteristics of the tested or test specimen after extension or reduction.

For a test specimen with an EW classification, the radiation W shall be measured (in accordance with EN 1363-2) along the centre line from the centre of the test specimen. According to EN 13501-2, the radiation classification shall be given only by the time for which the measured radiation does not exceed the given 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 extended application.

A change in area of a test specimen will result in a change in radiation intensity. Hence, any possible extension or reduction of the area of the test specimen as detailed in Clause 7 may be affected by the radiation limit $W_{ext} \leq W_{max}$.

B.1.2 Rectangular fire resistant glass panes or glazed elements

A change in radiation is not proportional to a change in area of the test specimen. However, for a rectangular test specimen it can be calculated according to a defined mathematical function (Formulae B.1 to B.3).

$$W_{ext} = W_0 \times [\varphi_{ext} / \varphi_0] \leq W_{max} \tag{B.1}$$

with

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

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

where

W_{ext}	is the radiation of the test specimen after extension or reduction;
W_0	is the measured radiation from the test specimen at the time of classification;
φ_0	is the configuration factor for tested test specimen;
φ_{ext}	is the configuration factor of the test specimen after extension or reduction;
d	is the distance between test specimen and sensor (1 m as required by EN 1363-2);
w_0, h_0	is the width and height of the test specimen;
w_{ext}, h_{ext}	is the extended or reduced width and height of the test specimen;
w_{max}, h_{max}	is the maximum extended or reduced width and height of the test specimen.

NOTE Source: VDI-Wärmeatlas.

In any case, the final calculated radiation value W_{ext} for the extended or reduced area shall remain below the given W_{max}. This may limit the extension of the area of the test specimen or the W-classification will be lost.

The relevant calculation shall be provided in the extended application report.

B.1.3 Circular fire resistant glass panes or glazed elements

For circular shaped test specimen Formula B.4 is applicable:

$$W_{ext} = W_0 \times [\varphi_{ext} / \varphi_0] \leq W_{max} \quad \text{(B.4)}$$

with

$$\varphi_0 = r_0^2 / (r_0^2 + d^2) \quad \text{(B.5)}$$

$$\varphi_{ext} = r_{ext}^2 / (r_{ext}^2 + d^2) \quad \text{(B.6)}$$

where

r_0	is the radius of tested test specimen (m);
r_{ext}	is the radius of test specimen after extension or reduction (m);
d	is the distance between the test specimen and sensor (1 m as required by EN 1363-2).

In any case, the final calculated radiation value W_{ext} for the extended or reduced area shall remain below the given W_{max}. This may limit the extension of the area of the test specimen or the W-classification will be lost.

The relevant calculation shall be provided in the extended application report.

B.1.4 Other shapes of fire resistant glazed elements

For an EW classified test specimen of a shape other than rectangular or circular, an extension in area shall be allowed in accordance with 7.1 by calculating the radiation of the area of a rectangle prescribed around the shape, according to Figure B.1.

The principle is that the calculated radiation of the extended rectangle prescribed shall remain below W_{max}.

The relevant calculation shall be provided in the extended application report.

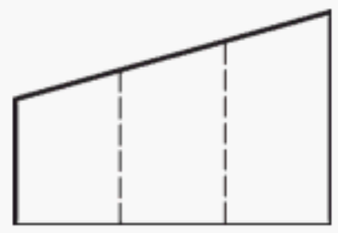
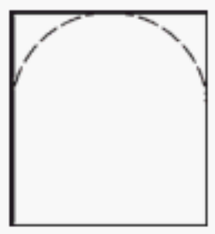
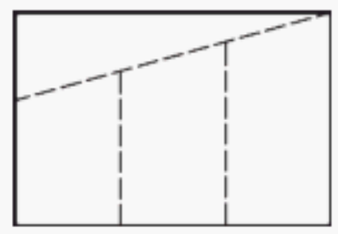
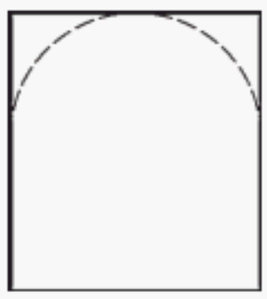
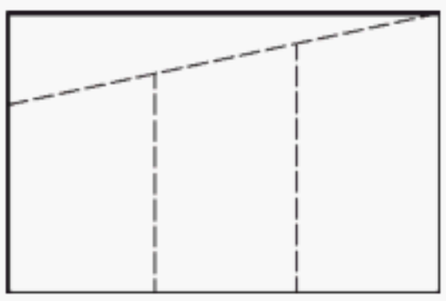
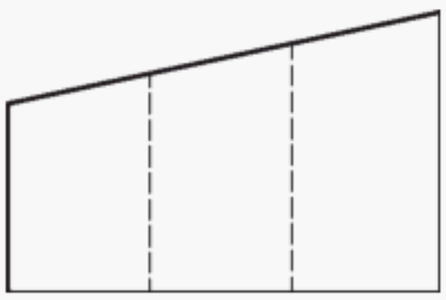
Steps	Example of test element with one glass pane	Example of test element with several glass panes
a) determine the area A_0 of the tested element; b) determine the measured radiation W_0 of A_0;		
c) determine the area $A_{0\text{-rect}}$ of the rectangle prescribed based on A_0 ; d) calculate the radiation $W_{0\text{-rect}}$ of $A_{0\text{-rect}}$ on the basis of formula: $W_{0\text{-rect}} = W_0 \times A_{0\text{-rect}} / A_0$		
e) extend area $A_{0\text{-rect}}$ based on rules given in 7.1 f) calculate radiation W_{ext} on the basis of formula: $W_{ext} = W_{0\text{-rect}} \times [\varphi_{ext}/\varphi_0] \leq W_{max}$ where: φ_{ext} see Formula (B.3) φ_0 see Formula (B.2)		
g) if $W_{ext} \leq W_{max}$ the extension of the shape can be applied		

Figure B.1 — Radiation calculation methodology for irregular shapes

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