BRITISH STANDARD

BS EN
13124-2:2004

Windows, doors and shutters — Explosion resistance — Test method —

Part 2: Range test

The European Standard EN 13124-2:2004 has the status of a British Standard

ICS 13.230; 91.060.50

BSI
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National foreword

This British Standard is the official English language version of EN 13124-2:2004.

The UK participation in its preparation was entrusted by Technical Committee B/538, Doors, windows, shutters, hardware and curtain walling, to Subcommittee B/538/1, Windows, which has the responsibility to:

— aid enquirers to understand the text;

— present to the responsible European committee any enquiries on the interpretation, or proposals for change, and keep the UK interests informed;

— monitor related international and European developments and promulgate them in the UK.

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

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Summary of pages

This document comprises a front cover, an inside front cover, the EN title page, pages 2 to 17 and a back cover.

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EUROPEAN STANDARD

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EN 13124-2

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English version

Windows, doors and shutters - Explosion resistance - Test method - Part 2: Range test

Portes, fenêtres et fermetures - Résistance à l'explosion - Méthode d'essai - Partie 2: Essai en plein air

Fenster, Türen und Abschlüsse - Sprengwirkungshemmung - Prüfverfahren - Teil 2: Freilandversuch

This European Standard was approved by CEN on 2 January 2004.

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This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CEN member into its own language and notified to the Central Secretariat has the same status as the official versions.

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Foreword

This document (EN 13124-2:2004) has been prepared by Technical Committee CEN/TC 33 "Doors, windows, shutters, building hardware and curtain walling", the secretariat of which is held by AFNOR.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by August 2004, and conflicting national standards shall be withdrawn at the latest by August 2004.

This European Standard is one of a series of standards for windows, doors and shutters.

No existing European Standard is superseded.

Annexes A and B are normative.

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

1 Scope

This European Standard specifies a test procedure to permit classification of the explosion resistance of windows, doors and shutters together with their infills.

This European Standard concerns a test method against blast waves in open air resulting from high explosives that can be carried by hand and placed a few metres from a target. At such close distances blast values vary across an attack face. Controlled measurement of the actual blast on the face of the test specimen being difficult, costly and subject to inaccuracy, consistency of the blast forces is therefore controlled in this European Standard by the characteristics of the explosive charge and its location (see annex A and annex B).

This European Standard covers only the behaviour of the complete unit including infill, frame and fixings as tested. It gives no information on the ability of the surrounding wall or building structure to resist the direct or transmitted forces.

If the windows, doors and shutters are intended for specific conditions of climate, specific test conditions can be required.

This European Standard gives no information on the behaviour of the units subjected to other types of loading.

2 Normative references

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

EN 13123-2: 2004, *Windows, doors and shutters – Explosion resistance – Requirements and classification – Part 2: Range test.*

3 Terms and definitions

For the purposes of this European Standard, the following terms and definitions apply.

3.1
test specimen
sample prepared and submitted for testing

3.2
attack face
face of the test specimen designed to face the explosion

3.3
rear face
opposite side of the test specimen to the attack face

3.4
breach
opening created by distortion in the test specimen during the test and evident after the test exceeding that specified in clause 9. Any opening created by a fragment of the specimen passing through or ejected from the test specimen

3.5
pressure wave
pressure wave generated by the detonation of a high explosive charge, creating an instantaneous rise in pressure which then decays with time (see Figure B.1)

3.6
explosive pressure resistance – Range test (EXR)
resistance offered against a blast created by a defined charge and stand-off distance

3.7
charge
explosive charge as specified in EN 13123-2

NOTE Details of the charge are given in annex A.

3.8
stand-off
perpendicular distance between the centre point of the charge and the attack face of the test specimen

NOTE As indicated in annex B, Figure B.2.

3.9
charge support
apparatus used to support the explosive charge in the required position

NOTE As described in annex B, Figures B.2 to B.5.

3.10
ambient condition
measurement and recording of the ambient climatic test conditions, such as temperature, barometric air pressure and relative humidity, to be undertaken to attain comparable values

4 Requirements

Performance requirements relating to the explosion resistance of windows, doors and shutters, tested under range conditions, are given in EN 13123-2.

5 Apparatus

5.1 Test specimen support

Test specimen support shall comprise a rigid frame or construction to which the test specimen may be securely attached.

It shall

a) be sufficiently strong to resist the blast forces without deformation and without imparting deformations to the test specimen,

b) allow the test specimen to be fixed in a manner representative of its as built condition without imposing abnormal stresses,

c) prevent passage of blast pressure to the rear face of the test specimen other than through deformation or by design intention,

d) accept mounting of pressure gauges where required,

e) provide a minimum of 200 mm perimeter structure at the sides and top of the test specimen, as indicated in annex B, Figures B.3 to B.5,

f) have a rear face, the inside surface of which shall be set back a minimum of 800 mm from the rear face of the test specimen,

g) be a minimum size of 2,40 m wide by 2,40 m high by 0,80 m deep.

5.2 Measuring conditions

The following characteristics shall be measured:

a) ambient air temperature;

b) ambient air pressure;

c) surface temperature of the test specimen;

d) relative humidity;

e) peak pressure and duration if requested.

6 Test specimen

The test specimen shall be representative of the relevant window, door or shutter (see clause 11). The applicant shall supply drawings showing all details of the test specimen to scale together with description and composition of all materials including infills, fixings etc.

The test specimen size and method of fixing to the test specimen support shall be agreed between the test laboratory and the applicant. The attack face shall be clearly marked. The method of fixing used to connect the test specimen to the test specimen support shall be representative of the actual method of fixing employed in the course of installing the window, door or shutter (see 7.1 e)).

After the test, at the request of the applicant, the test laboratory shall return the test specimen, adequately and indelibly marked for retention.

7 Procedure

7.1 Installation

Install the test specimen in the test specimen support at a sill height of not more than 800 mm ensuring that

a) the alignment/relationship between all components is correct,

b) the fixings do not create abnormal stresses in the test specimen,

c) no opening exists between/around the test specimen support,

d) the hardware, mechanisms, movable sashes and door leaves are operable,

e) the method of fixing and type/quantity of fixings used are identical in all respects to the intended application,

f) all measurement devices are checked so as to verify their correct calibration.

7.2 Explosion pressure resistance – Range test (EXR)

The test shall generate a blast wave striking the attack face of the test specimen. The blast wave is generated from the detonation of a specified high explosive charge at a specified stand-off from the test specimen. The explosive charge is described in annex A.

The quantity and stand-off distance shall be in accordance with EN 13123-2.

8 Sequence of test

The following steps shall be taken:

a) take measurements to verify that the test specimen dimensions, including infills, are in accordance with the drawings supplied by the applicant;

b) install the test specimen in accordance with 7.1;

c) check that the fixings are correct and that the infills are correctly installed;

d) create a photographic record of the test specimen as installed in the test specimen support. Where desired set up high speed motion cameras;

e) record the ambient conditions within 30 min of the test;

f) position the required charge at the stand-off distance according to the resistance class;

g) detonate the explosive charge;

h) the test laboratory shall verify that full high order detonation has taken place;

i) examine the test specimen and record the level of physical damage, including presence or absence of splinters, visible on the test specimen by photograph or film. A written record shall be created which specifies the level of distortion, deflection etc. evident on the test specimen. This information will form an integral part of the test report.

9 Evaluation of results

9.1 The following criteria shall be used in evaluating the results of the test.

9.2 Evaluate the test in accordance with the requirements and classification in EN 13123-2 ensuring that the following test criteria are fulfilled:

a) no perforation or opening through the test specimen is evident after the test through which a blunt 10 mm diameter rigid bar can be gently passed;

b) no opening between the test specimen frame and the test specimen support is evident after the test through which a blunt 10 mm diameter rigid bar can be gently passed;

c) no perforation or opening through the test specimen is evident after the test created by detachment or ejection of material from the test specimen;

d) no part of the frame or hardware shall be ejected from the rear face;

e) security closures or locking mechanisms previously secure from the attack face shall remain secure. If access through the test specimen can be gained this shall be noted in the test report;

f) the absence or presence of splinters ejected from the rear face of the test specimen is fully described. The results shall be fully recorded in the test report and noted in the test certificate with suffix S or NS in accordance with EN 13123-2:2004, Table 1.

9.3 The test is considered successful even if after the test the opening mechanisms are no longer operable, or if the other performances (such as air permeability, water tightness, wind resistance etc.) except those concerning security, cannot be maintained.

If the results are ambiguous, the test shall be repeated on a new test specimen.

If these criteria are fulfilled, the window, door or shutter can be classified in accordance with EN 13123-2.

9.4 Test results

The results of the test which has been carried out on a test specimen of a window, door or shutter is only representative of that test specimen. If in the future changes are made in the design of this product the testing laboratory will judge if the same test report can be extended to that modification or if an additional test is required. This can be the case when there is a minor change in hardware, in accessory pieces etc. In this case it will be mentioned in the new test report summary.

10 Test report

The test report issued to the applicant by the test laboratory shall include as a minimum:

a) the identity of the test applicant;

b) the reference and the manufacturer's stated trade mark type of the product;

c) the detailed description of the constituent parts (material, connections, reinforcements, hardware, accessories etc.) and method of fixing which have been previously submitted by the applicant;

d) the drawings of the test specimen showing all dimensions and details including indication of the attack face. The attack side shall be marked on the drawings which form part of the test report;

e) conditions: Ambient temperature, barometric air pressure, relative humidity and surface temperature of test specimen;

f) description of the explosive charge used in the test;

g) results of the test according to EN 13123-2. Record the relevant class;

h) the level of damage caused to the test specimen during the test, in accordance with clause 9;

i) the date(s) on which the test was performed;

j) reference number of the test report;

k) reference to this European Standard.

NOTE At the convenience of the applicant, for some specific explosion resistant materials, the test report will indicate that those materials have been declared with precision by the applicant to the test laboratory for registration but are not described in the test report for reasons of commercial confidentiality.

11 Test report summary

The testing laboratory shall issue a test report summary to enable the applicant to make trade use of the results obtained with the test specimen.

The test report summary shall state that it is valid only for the individual window, door or shutter design tested, with particulars recorded on the test specimen size and also orientation of any opening elements (inward opening, tilt-and turn, vertical or horizontal sliding etc).

It shall include:

a) the relevant classification obtained in accordance with EN 13123-2;

b) the test report reference and date of issue;

c) the identity of the test laboratory;

d) the identification of the applicant;

e) reference to this European Standard;

f) the reference and the manufacturer's stated trade mark type of the product together with the dimensions of the test specimen;

g) orientation of the test specimen in relation to support structure, method, size and quantity of fixings;

h) any observations concerning particular phenomena directly related to the behaviour of the test specimen including a description of the level of damage suffered by the test specimen during the test including perforation and splintering.

Annex A
(normative)

TNT explosive charge

A.1 Objectives

This annex details the acceptable TNT explosive charges for carrying out tests according to this European Standard (see clause 1).

Acceptable explosive charges are spheres of trinitrotoluene (TNT) formed, placed and detonated in accordance with the procedures described in this European Standard. Alternative explosive sources may only be used if supported by test data demonstrating equivalent blast effects to the satisfaction of an accredited body and the CENCER certification committee.

Each charge shall have a mass as stated in the relevant category (see Table B.1). The classification charges are 3 kg, 12 kg and 20 kg, each ± 2 % by mass.

A.2 Composition

Use charges made from trinitrotoluene (TNT) which has a setting point limit of between 80,4 °C and 80,9 °C maximum.

A.3 Constitution

Form spherical charges by a method which ensures uniform consistency and density throughout. The final density shall be not less than 1 580 kg/m^3. The method used shall be stated in the test report and shall be as follows or by an equivalent process agreed prior to the test with the applicant and an independent attestation authority:

a) procure the TNT in the form of flakes of approximately 1 mm thickness;

b) form hemispherical moulds of radii such as to cast the TNT spheres within the required mass tolerance and with sufficient dimensional stability to produce smooth, even surfaces within ± 4 % of true position relative to the centre;

c) fill the moulds in equal layers of not more than 50 mm thickness by pouring in molten TNT at a temperature of 90 °C ± 2 °C and immediately adding, while stirring in, solid flake TNT until the formation of a thickening slurry. Stop addition of solid flake, while continuing to stir until the mass has set. Repeat the process until each hemisphere is filled to depth as follows: For each sphere fill one hemisphere flush to the rim, i.e. to full radius depth, and fill the other hemisphere to a depth 3 mm below the rim;

d) drill an 8 mm diameter hole through the centre axis of the flush filled hemisphere;

e) to form the sphere take the mould filled to 3 mm below the rim and add molten TNT flush to the rim. Immediately place the hemisphere with the drilled hole on top to meld the two halves together into a continuous unit with no joint or crack plane. Within a few minutes the plastic moulds can be removed and any surface imperfections at the circumferential join made good;

f) insert an 8 mm drill down the centre of the sphere and deepen the hole by 5 mm to ensure that the detonator can be placed at the dead centre of the sphere;

g) check the mass to be within tolerance;

h) form and store the charges in such a manner that there are no cracks or discontinuities at the time of detonation. Acceptable surface, drying or shrinkage crazing shall be limited to less than 0,5 mm width and 10 mm depth and shall be of a superficial nature that will not result in uneven detonation.

NOTE 1 The approximate density of TNT formed by such a process is 1 590 kg/m^3 and the approximate mean diameter of the spheres will be :

¾ for 3 kg : 153,4 mm ± 0,66 % = ± 1,0 mm to remain within ± 2 % mass;

¾ for 12 kg : 243,4 mm ± 0,66 % = ± 1,6 mm to remain within ± 2 % mass;

¾ for 20 kg : 288,6 mm ± 0,66 % = ± 1,9 mm to remain within ± 2 % mass.

NOTE 2 The ± 4 % dimension tolerance (see b)) is for local deviations, not mean radius. On a radius of 144,3 mm (20 kg) this equates to 5,8 mm, i.e. a potential difference of 11 mm between a local hollow and a bump.

A.4 Positioning of charge

Place the centre of the charge within ± 25 mm of the classification stand-off distance in plan from the face of the main panel element of the test specimen.

Position the centre of the charge within ± 50 mm of the following height above the hard standing upon which the test specimen support stands:

¾ 3 kg charge: height of centre = 500 mm;

¾ 12 kg charge: height of centre = 800 mm;

¾ 20 kg charge: height of centre = 800 mm.

This hard standing shall comprise a firm, hard and level surface of concrete or equivalent extending below and between the charge and the test specimen support. A steel protective plate may be placed on the surface under the charge of thickness not greater than 100 mm.

Suspend the charge or support it on a material such as polystyrene foam or styrofoam, in a manner such that no fragments from the support system are produced upon detonation.

A.5 Detonation system

Initiate detonation from the centre of the spherical charge by a method that ensures immediate, uniform, and complete detonation of the whole charge. The detonation system shall be as described in A.6 or by an equivalent that will produce full order detonation.

Place 10 g to 20 g of high performance plastic explosive or equivalent as a booster at the bottom of the hole at the centre of the charge. Insert a low voltage detonator such as type L2A1 or 8 star, ensuring that it is positioned at the centre of the sphere and in intimate contact with the booster charge.

A.6 Confirmation of full order detonation

Confirm that full order detonation takes place. The method used shall be stated in the test report. A common method is to measure the pressure and impulse levels as follows.

Measure the incident (side-on) blast parameters at the relevant classification stand-off distance at the same height as the charge using a calibrated piezo-electric or piezo-resistive blast gauge that is suitable for the purpose. The blast parameters shall be measured using electronic equipment capable of recording and reproducing on screen and in the form of a hard printed visual trace the pressure time history of the blast pulse in steps of not less than 0,1 ms.

The pressure time history shall be recorded and reproduced over a period at least five times that of the positive pressure phase. The blast gauge shall be positioned at not less than the classification stand-off distance from any obstruction including the test specimen and support.

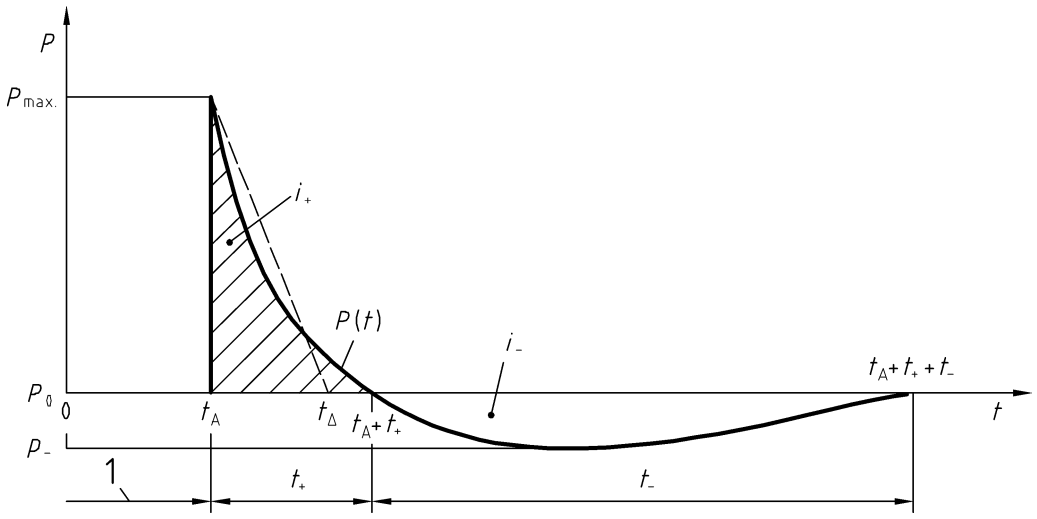
Full order detonation shall be deemed to have occurred if the incident peak pressure (P_{so}) and the positive specific incident impulse (i_{so}) exceed the values given in Table A.1.

Table A.1 — Peak pressure P_{so} and incident impulse (i_{so})

Class	kg at m	Pressure P_{so} bar	Impulse i_{so} bar/ms
EXR1	3 at 5	0,75	1,05
EXR2	3 at 3	2,30	1,65
EXR3	12 at 5,5	1,70	2,25
EXR4	12 at 4	3,60	3,00
EXR5	20 at 4	6,30	4,20

Annex B
(normative)

Idealised pressure-time variation for a blast wave and orientation of test specimen and explosive charge



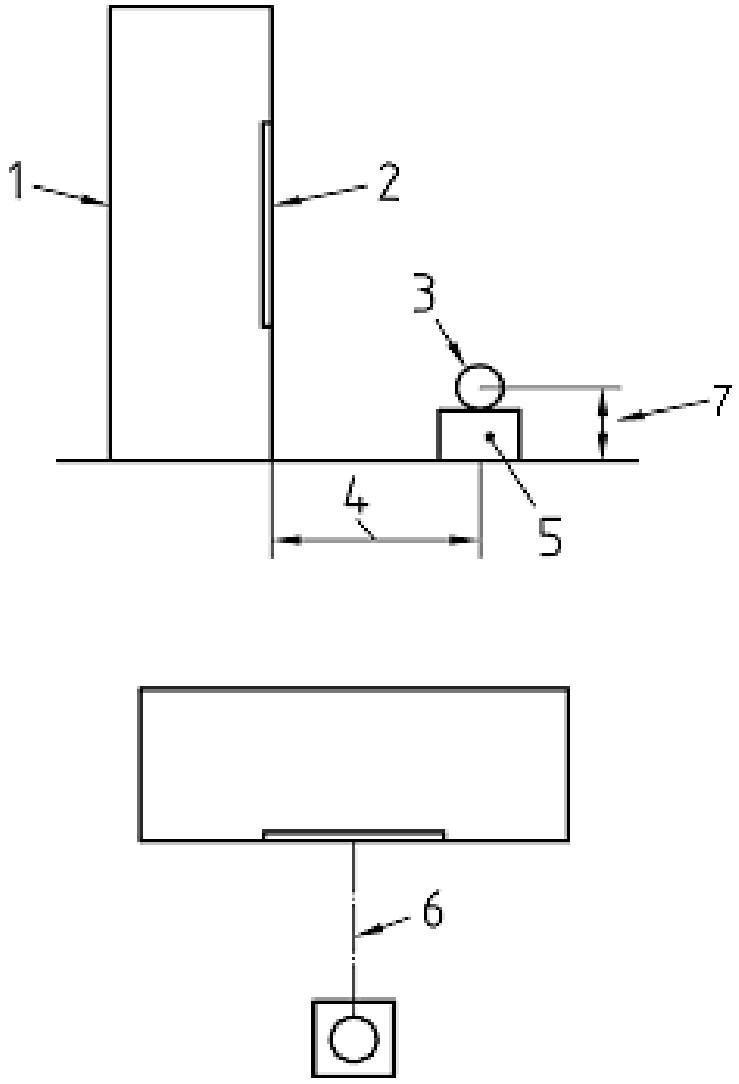
Key

P Pressure
Po Ambient pressure
i_+ Positive specific impulse
i_- Negative specific impulse
1 Time of arrival period
t_+ Positive phase duration
t_- Negative phase duration
t Time
t_A Time of arrival

Figure B.1 - Idealised pressure-time variation for a blast wave

Table B.1 — Classification, charge mass, range and height of charge

Class	Charge mass (kg)	Range stand-off	Height of charge (mm)
EXR1	3	5	500 ± 50
EXR2	3	3	500 ± 50
EXR3	12	5,5	800 ± 50
EXR4	12	4	800 ± 50
EXR5	20	4	800 ± 50



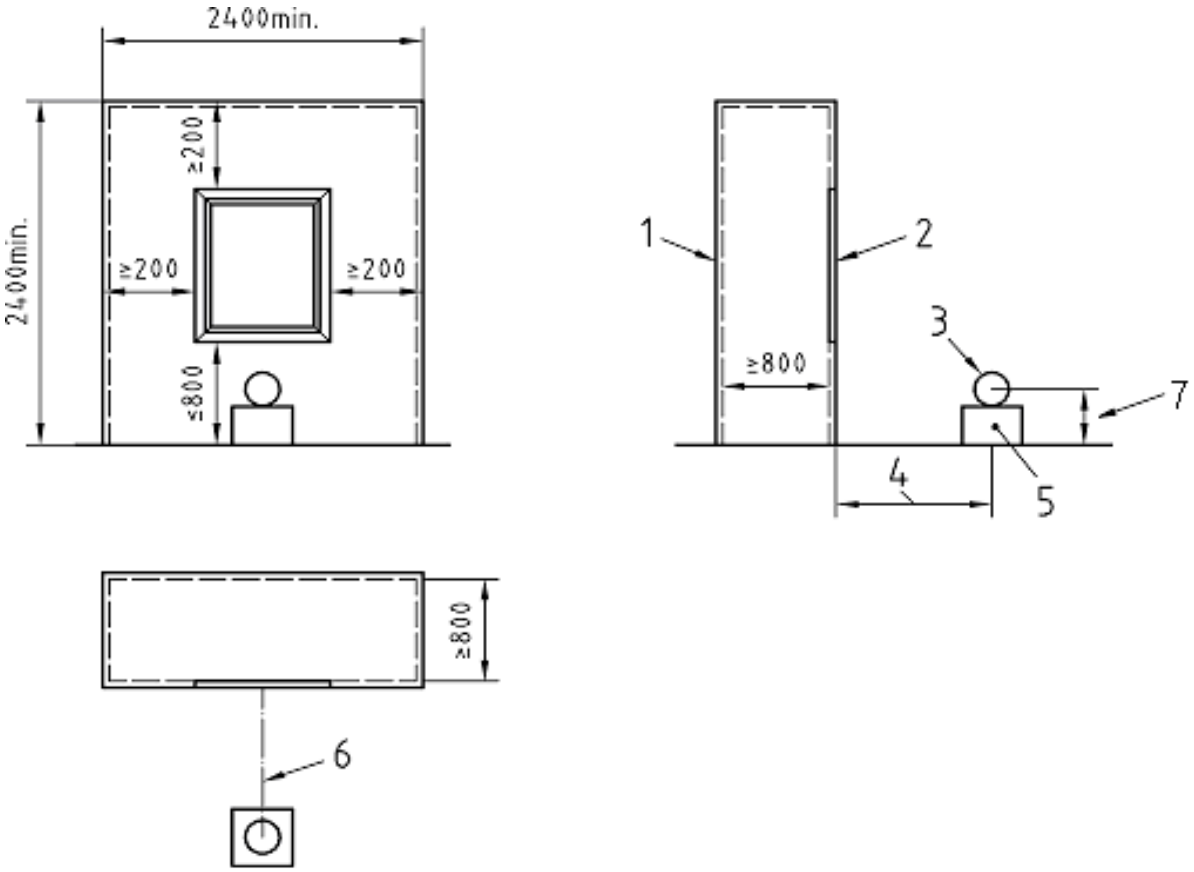
Key

1 Test specimen support with closed rear face
2 Test specimen
3 Specified charge
4 Stand-off
5 Charge support
6 Centre line of test specimen
7 Height to centre of charge

Figure B.2 - Test installation

The charge support shall be such that it does not produce splinters which could adversely impact against the test specimen. Charges can be supported on a poly foam block or suspended from an overhead support.

Dimensions in millimetres



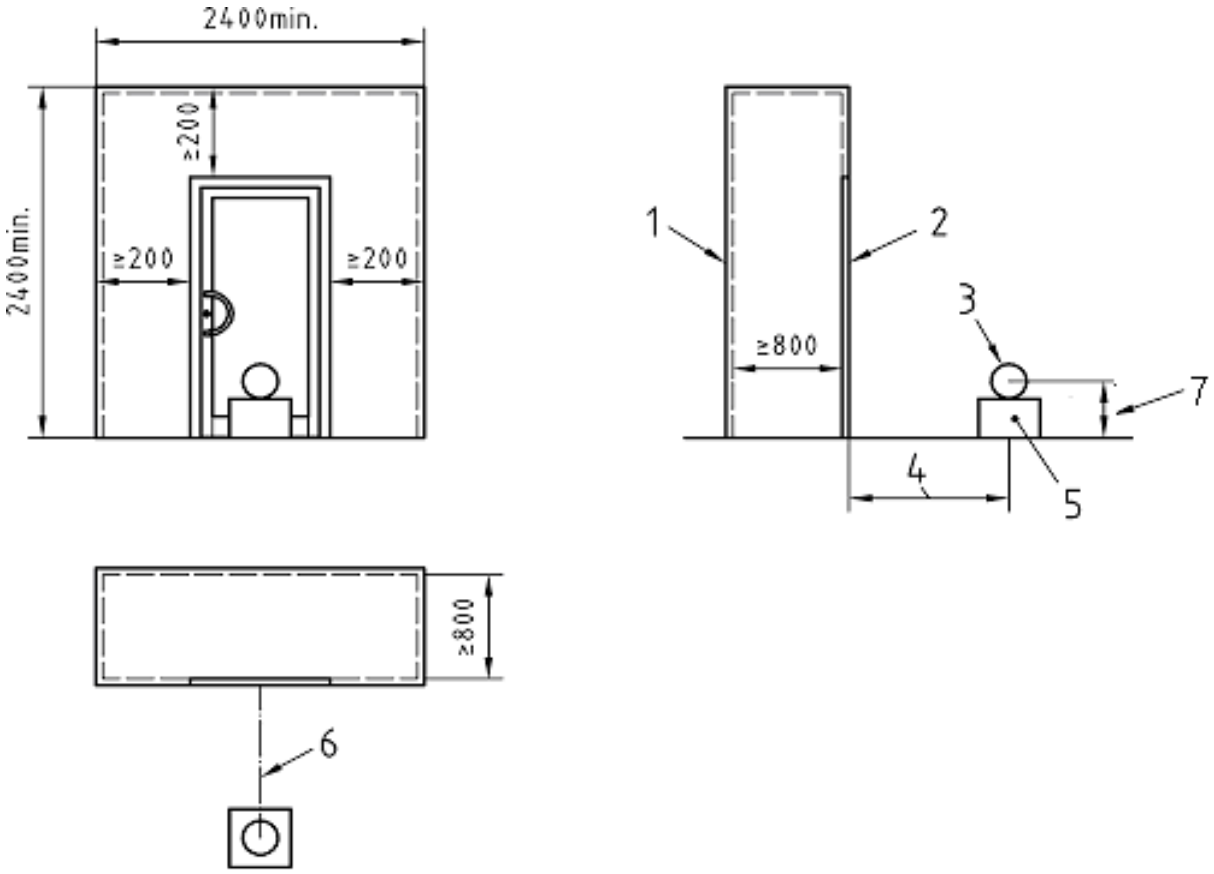
Key

1 Test specimen support with closed rear face
2 Test specimen window
3 Specified charge
4 Stand-off
5 Charge support
6 Centre line of test specimen
7 Height to centre of charge

Figure B.3 - Window element - Test installation

The charge support shall be such that it does not produce splinters which could adversely impact against the test specimen. Charges can be supported on a poly foam block or suspended from an overhead support.

Dimensions in millimetres



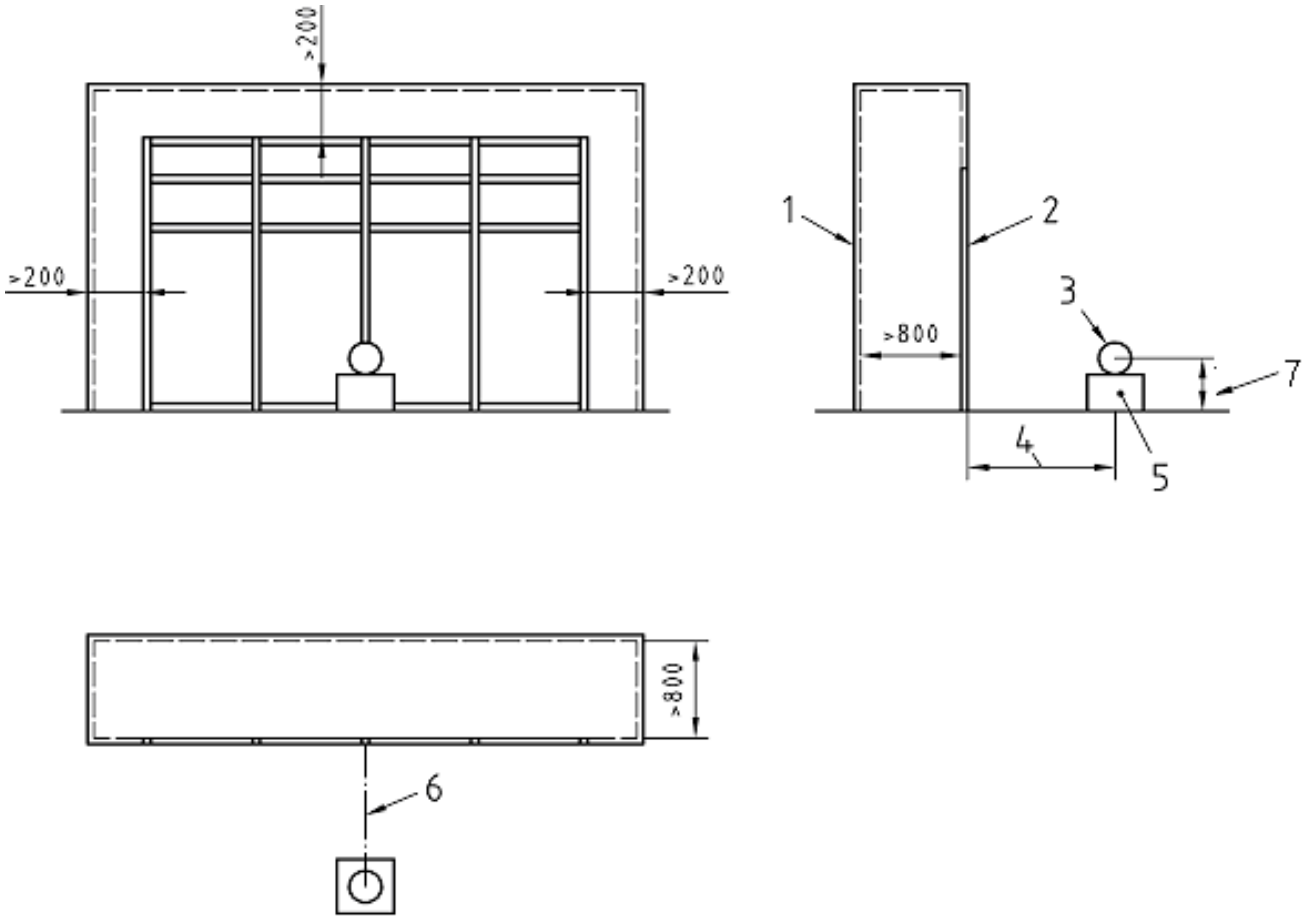
Key

1 Test specimen support with closed rear face
2 Test specimen door
3 Specified charge
4 Distance
5 Charge support
6 Centre line of test specimen
7 Height to centre of charge

Figure B.4 - Door element - Test installation

The charge support shall be such that it does not produce splinters which could adversely impact against the test specimen. Charges can be supported on a poly foam block or suspended from an overhead support.

Dimensions in millimetres



Key

1 Test specimen support with closed rear face
2 Test specimen
3 Specified charge
4 Stand-off
5 Charge support
6 Centre line of test specimen
7 Height to centre of charge

Figure B.5 - Large test specimen - Test installation

The charge support shall be such that it does not produce splinters which could adversely impact against the test specimen. Charges can be supported on a poly foam block or suspended from an overhead support.

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