BRITISH STANDARD

BS EN
13124-1:2001

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

Part 1: Shock tube

The European Standard EN 13124-1:2001 has the status of a British Standard

ICS 13.230; 91.060.50

National foreword

This British Standard is the official English language version of EN 13124-1:2001.

The UK participation in its preparation was entrusted to Technical Committee B/538, Doors, windows, shutters, hardware, 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 committee can be obtained on request to its secretary.

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This British Standard, having been prepared under the direction of the Sector Committee for Building and Civil Engineering, was published under the authority of the Standards Committee and comes into effect on 15 June 2001

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EUROPEAN STANDARD

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English version

Windows, doors and shutters - Explosion resistance - Test method - Part 1: Shock tube

Fenêtres, portes et fermetures - Résistance à l'explosion - Méthode d'essai - Partie 1: Tube à effet de souffle (shock tube)

Fenster, Türen und Abschlüsse - Sprengwirkungshemmung - Prüfverfahren - Teil 1: Stossrohr

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

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Contents

Foreword

This European Standard has been prepared by Technical Committee CEN/TC 33, ”Windows, doors, 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of an identical text or by endorsement, at the latest by October 2001, and conflicting national standards shall be withdrawn at the latest by October 2001.

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

1 Scope

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

This European Standard concerns a method of test against blast waves generated by using a shock tube facility to simulate a high explosive detonation in the order of 100 kg to 2 500 kg TNT at distances from about 35 m to 50 m .

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 may be required.

It gives no information on the behaviour of the units subjected to other types of loading.

NOTE Care should be taken to ensure that all joints between the wall and the window or door have protection which is at least equal to that of the window or door.

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 13123-1:2001 Windows, doors and shutters – Explosion resistance – Requirements and classification – Part 1 : Shock tube

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
the face of the test specimen designed to face the explosion

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

3.4
breach
an 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
explosive pressure resistance [EXR]
resistance offered against a defined pressure wave

3.6
pressure wave
blast pressure pulse impinging on the test specimen defined in the terms below. The pressure recorded and referred to shall be the reflected pressure experienced by the test specimen when it is positioned at the end of the shock tube

3.6.1
peak pressure (P_{max})
the initial peak pressure above the ambient atmospheric pressure following an instantaneous rise at the time of arrival of the pulse at the test specimen

3.6.2
reflected pressure
a reflected pressure occurs when a blast wave strikes the surface of a target which obstructs the flow. The shock wave moving through the air impacts against the test specimen and is reflected producing a pressure on the surface of the test specimen having a higher value than would have occurred within an unobstructed flow

3.6.3
duration
duration of the positive phase of the mean pressure trace (t_+)

3.6.4
pressure-time wave trace
the pressure expressed as a function of time (see Figure 1)

3.6.5
positive specific impulse (i_+)
the area under the pressure-time trace during the first positive phase duration (see hatched area in Figure 1)

3.6.6
equivalent triangular duration ($t_▲$)
the duration of the equivalent pressure-time trace following a straight line from the peak pressure at the time of arrival to zero pressure, forming a triangle having the same impulse area as the defined pressure wave

i.e. t = two times specific impulse divided by pressure expressed as

$$t = \frac{2i}{P_{\max}}$$

4 Requirements

Classification requirements relating to the explosion resistance of windows, doors and shutters are given in EN 13123-1.

5 Apparatus

5.1 Pressure generating device

Shock tube or similar device capable of reproducing the effects of a plane shock wave from a high explosive.

5.2 Test specimen support

The test specimen support shall be a rigid frame or construction through which the test specimen may be securely attached to the shock tube. 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 other than through deformation or by design intention of the test specimen.

(d) accept mounting of pressure gauges next to the attack face.

Dimensioned drawings of standard supports shall be prepared by the testing authority and made available to potential applicants. These shall show clearly the locations and dimensions of openings and all suitable fixing points, brackets, holes and bolts.

All and any additional or purpose made frames, fixing points, methods or supports and their designs shall be agreed between the applicant and the testing authority prior to a test as being suitable for the purpose.

5.3 Equipment for measuring

Equipment shall comprise :

(a) Thermometers suitable for measuring the ambient air temperature and the temperature of the rear face of the test specimen taking into account variations due to shade, sunlight or other weather conditions to an accuracy of ± 1° C. Measurements to be taken within 30 min of the test.

(b) A barometer suitable for measuring the ambient air pressure outside the shock tube to an accuracy of ± 2 mbar.

(c) Gauges instrumentation systems for measuring and recording the pressure-time history of the blast pulse. These can be : gauges incorporating piezoelectric/piezoresistive or equivalent pressure transducers capable of responding to variations in pressures within 0,1 ms and recording pressures to an accuracy of ± 5 % of the peak pressure throughout the range of pressures and durations to be experienced.

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 dimensions and all other 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 testing authority and the applicant. The attack face shall be clearly marked.

After the test, at the request of the applicant, the testing authority 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, 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 and 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) Pressure gauges are installed in suitably shaped, robust mountings designed to minimise vibration effects. A minimum of two gauges shall be used to record the blast pressures experienced by the attack face of the test specimen. In the normal location for the test specimen, across the end of the shock tube, these gauges shall be positioned to record the reflected pressure-time history and shall be mounted in the reflected pressure zone. Records shall be taken to permit the evaluation of the test in accordance with clause 9.

(g) All measurement devices are checked so as to verify their correct calibration.

7.2 Test – Explosion pressure resistance (EPR)

The test shall reproduce the effects of a blast wave front striking at the attack face of the specimen with pressure generated within a shock tube facility or similar process.

Measurement of the positive maximum over pressure created by the shock wave, shape and the duration of the positive pressure phase shall be calculated in accordance with the procedure given in annex A « Blast parameters and derivation » found in EN 13123-1.

7.3 Pressure or duration outside range

If during the test any of the pressure or the duration or the impulse are recorded as below the specified levels in accordance with EN 13123-1, Windows, doors and shutters – Explosion resistance – Requirements and classification – Part 1 : Shock tube, the test is considered invalid and the product will not receive an EN classification.

8 Sequence of test

(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 camera(s).

(e) Record the ambient temperature and pressure and the surface temperature on the rear face of the test specimen before the test.

(f) Determine the required pressure and the duration of the event according to the resistance class.

(g) Generate the pressure wave.

(h) Record the pressure-time trace of the pressure wave. The measuring devices shall permit the determination of the magnitude and time development of the pressure of the shock wave experienced by the attack face of the specimen to within an accuracy of ± 5 %.

(i) Examine the test specimen and create a photographic record of the level of physical damage visible on the test specimen. Detailed views of particular features or distortions will be recorded and included at the discretion of the testing authority if the latter decides these will be necessary to adequately illustrate the condition. A written record shall be created which describes the condition of and damage to the test specimen with measurements of distortion and deflection. This information forms an integral part of the test report.

(j) Calculate the parameters (pressure, duration, impulse) in accordance with annex A « Blast parameters and derivation » found in EN 13123-1.

9 Evaluation of results

9.1 Evaluate the test in accordance with the procedure and parameters outlined in 8(j).

9.2 From the information recorded determine whether 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 pass.

(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 pass.

(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 and inaccessible. If access can be gained this shall be noted in the test report.

(f) Record the presence or absence of splinters ejected from the rear face (protected side) of the glass or infill material. This shall be recorded in the test report and noted in the test certificate with suffix “S” or “NS” in accordance with clause 5 of EN 13123-1:2001.

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 the above criteria are satisfied then the window, door or shutter can be classified with a resistance value in accordance with EN 13123-1.

9.4 Test results

The results of the test which has been carried out on a 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 size, 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 testing authority shall include as a minimum :

a) The identity and address 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 details including indication of the attack face. (The attack side has to be marked on the drawings which form part of the test report).

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

f) Description of the how pressure was generated.

g) The maximum peak pressure, duration and impulse of the positive pressure phase calculated in accordance with annex A of EN 13123-1.

h) Results of the test according to EN 13123-1.

i) The level of damage caused to the test specimen during the test, in accordance with clause 8 (i).

j) The date(s) on which the test was performed.

k) Reference number of the test report.

NOTE At the convenience of the applicant, for some specific explosion resistant materials, the 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 confidentially.

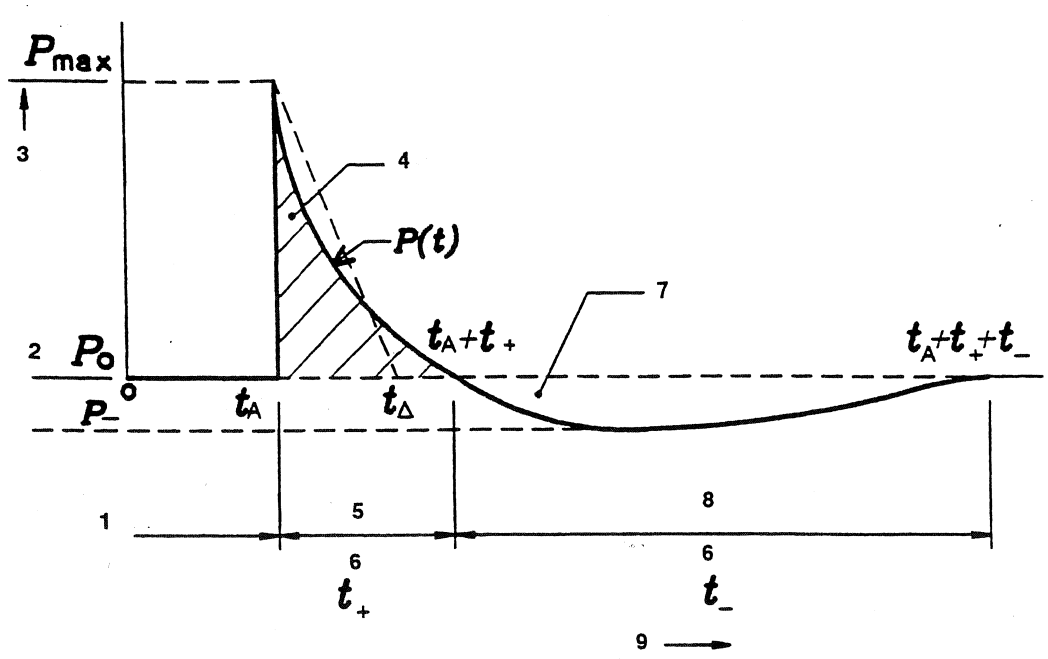
11 Test report summary

The testing laboratory where authorised shall be allowed to 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 tested, with particular emphasis on the type and orientation of the opening elements (inward opening, tilt-and turn, vertical or horizontal sliding etc).

The test report summary shall include :

- The test report reference and date of issue,
- The identify of the testing authority,
- The identify of the applicant,
- result of classification achieved in accordance with EN 13123-1, Windows, doors and shutters – Explosion – Requirements and classification – Part 1 : Shock tube,
- The reference and the manufacturer’s stated trade mark type of the product together with the dimensions of the test specimen,
- Orientation of the test specimen in relation to support structure. Method size and quantity of fixings.
- 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.



Key

1 Time of arrival
2 Ambient pressure
3 Pressure
4 Positive specific impulse, i_+
5 Positive phase
6 Duration
7 Negative specific impulse, i_-
8 Negative phase
9 Time after explosion

NOTE With a blast wave generated by a shock tube the negative phase may not be present

For definition refer to clause 3.

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

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