SLOVENSKI STANDARD
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Steklo v gradbeništvu - Varnostna zasteklitev - Preskušanje in razvrščanje odpornosti proti zvočnemu tlaku pri eksploziji

Glass in building - Security glazing - Testing and classification of resistance against explosion pressure

Glas im Bauwesen - Sicherheitsonderverglasung - Prüfverfahren und Klasseneinteilung des Widerstandes gegen Sprengwirkung

Verre dans la construction - Vitrage de sécurité - Mise à essai et classification de la résistance à la pression d'explosion

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Glass in building - Security glazing - Testing and classification of resistance against explosion pressure

Verre dans la construction - Vitrage de sécurité - Mise à essai et classification de la résistance à la pression d'explosion

Glas im Bauwesen - Sicherheitssonderverglasung - Prüfverfahren und Klasseneinteilung des Widerstandes gegen Sprengwirkung

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Foreword

This document (FprEN 13541:2011) has been prepared by Technical Committee CEN/TC 129 “Glass in building”, the secretariat of which is held by NBN.

This document is currently submitted to the Unique Acceptance Procedure.

This document will supersede EN 13541:2000.

Introduction

The choice of an explosion pressure resistant glazing material (e.g. security and/or anti terrorism glazing product) in an individual case should be established by the user. Experts in the field of explosions are able to determine in most situations the expected level and duration of the shock wave, based on the type of explosion and the distance from the heart of the explosion.

The classification of explosion pressure resistance is based on the maximum positive pressure of the reflected shock wave and the duration of the positive pressure phase.

1 Scope

This European Standard specifies a test method, performance requirements and classification for explosion pressure resistant glazing for use in buildings.

The explosion pressure resistant glazing is intended to offer resistance against explosives with respect to human safety.

This European Standard concerns a method of test against blast waves generated using a shock tube or similar facility to simulate a high explosive detonation.

The classification is only valid for tested glass sizes of about 1 m^2. Based on theoretical considerations and/or experimental work, the results can be used for estimating the explosion-pressure-resistance of other glass sizes.

NOTE 1 The resistance classes are not assigned to specific situations. For each individual case the individual who specifies,, if necessary with the help of experts in the field of explosion, should be consulted.

NOTE 2 The protection provided by explosion-resistant-glazing not only depends on the product itself, but also on the design and fixing of the glass.

2 Normative references

The following referenced documents are indispensable for the application 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.

ISO 48:2010, *Rubber, vulcanised or thermoplastic — Determination of hardness (hardness between 10 IRHD and 100 IRHD)*

3 Terms and definitions

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

3.1
explosion pressure resistant glazing
security glazing that affords a defined resistance against a specified explosive blast

NOTE The glass and/or plastics component of an explosion pressure resistant glazing unit may be separated by air spaces.

3.2
sample
number of nominally identical glazing units on which type testing is performed for a certain explosion pressure class

3.3
shock tube
tube with sufficient dimensions and rigidity in order to generate a plane shock wave as from a spherical detonation

3.4
test piece
one member of the sample prepared for testing

3.5
attack face
face of the explosion pressure resistant glazing, marked by the manufacturer and/or supplier, that is designed to face the explosive blast

4 Classification and designation

Table 1 specifies the classification of and the appropriate test conditions for explosion pressure resistant glazing.

If all three test pieces of the sample fulfil the performance requirements of a certain class according to Clause 6, and the test conditions lie within the tolerance given in Table 1, then the glazing product may be classified in the relevant class. When a security glass pane achieves a particular class, it also automatically achieves all lower classes.

Table 1 — Classification of explosion-pressure-resistant glazing

Classification Code	Characteristics of the plane shock wave		
	Positive maximum overpressure of the reflected blast wave Pr (kPa)	Positive specific impulse i_+ (kPa . ms)	Duration of the positive pressure phase t_+ (ms)
ER1	$50 \leq Pr < 100$	$370 \leq i_+ < 900$	≥ 20
ER2	$100 \leq Pr < 150$	$900 \leq i_+ < 1500$	≥ 20
ER3	$150 \leq Pr < 200$	$1500 \leq i_+ < 2200$	≥ 20
ER4	$200 \leq Pr < 250$	$2200 \leq i_+ < 3200$	≥ 20

NOTE 1 The specific impulse (i_+) results from the pressure-time history versus time, in accordance with EN 13123-1 and EN 13124-1.

$$i_+ = \int_0^{t+} p(t) \cdot dt = Pr \cdot t_+ \left\{ 1/A - 1/A^2 \left[1 - \exp(-A) \right] \right\} \quad (1)$$

where:

Pr is the positive maximum overpressure;

t_+ is the duration of the positive pressure phase;

A is the wave form parameter (values lie between 0 and 4).

NOTE 2 No extrapolation can be made for bigger samples.

5 Test pieces for type testing

5.1 Type, dimensions and marking

The construction and materials of the test pieces shall comply with the specification of the manufacturer.

The test pieces (or the sample) submitted for type testing shall be representative of the normal production.

The dimensions of the test pieces shall be:

— length (1100 ± 5) mm;

— width (900 ± 5) mm.

The edges of the test pieces should be raised for ease of handling.

The sample shall be identified with a permanent label or removable label, which may not be removed, indicating, as minimum, the attack face of the product.

5.2 Number of test pieces

The sample submitted for testing shall consist of three test pieces for each attack face and each class for which testing shall be required.

NOTE One extra test piece should be supplied in case of transport breakage or other logistic handling.

6 Requirements

Each of the three test pieces of a sample, according to Clause 5, submitted for testing, shall comply with the following requirements when tested according to Clause 7:

— the test piece shall not have any "through" holes, from the front to the back;

— there shall not be any opening between the clamping frame and the edges of the test piece.

NOTE An opening between the clamping frame and the edges of the test piece can be caused by insufficient clamping pressure. If so, the test can be repeated with a higher clamping pressure. In this case the test report shall state the applied clamping pressure.

7 Test Method

7.1 Apparatus

7.1.1 Specimen holder

The specimen holder shall be intrinsically rigid, and rigidly fixed onto a solid foundation and/or into solid masonry.

The specimen holder shall have facilities to ensure:

— plane parallel clamping of the test piece in a vertical position;

— support of the test piece only by the frame;

— clamping of the edges on all sides over an edge width of (50 ± 10) mm;

— clamping between rubber strips of (50 ± 2) mm wide and (4 ± 1) mm thick, and hardness (50 ± 10) IRHD in accordance with ISO 48:2010;

— a clamping pressure of (14 ± 3) N/cm^2;

— around the edges a shield not less than 1000 mm wide and/or meeting the wall of the blast tube;

— that the surface of the attack face of the shield is plane with the surface of the specimen holder;

— that the surface of the attack face of the test piece recesses not more than 20 mm behind the surface of the specimen holder.

7.1.2 Device for generating the explosive blast

A shock tube or a similar device for generating the desired explosive blast shall ensure the consistent reproduction of a plane shock wave normal to the attack face of the specimen. The shock wave shall simulate that from a spherical non-fragmenting high explosive charge. The positive pressure phase should be of a form which can be related to that from a spherical charge of a known weight of trinitrotoluene (TNT) detonating at a known distance.

7.1.3 Measuring device

The measuring device shall permit the determination of the magnitude and time of development of the overpressure of the shock wave reflected from the attack face of the specimen with an accuracy of ± 5 %.

7.2 Preparation of test procedure

7.2.1 Test specimen temperature condition

The surface and mass temperature of the test specimen shall be at a temperature of (18 ± 5) °C. The test piece shall be stored for at least 12 hours prior to the test in that range. The ambient testing conditions may be (18 ± 10) °C.

7.3 Test procedure

For each test the following procedure shall be followed:

— clamp the test piece into the specimen holder according to 7.1.1;

— ensure that the edges of the test piece fully contact the supporting surface;

— determine the pressure level and load duration according to the requested class and the corresponding blast load;

— initiate the blast;

— measure the pressure-time parameters of the reflected blast wave;

— determine the positive maximum overpressure and duration of the positive pressure phase;

— inspect the test piece for "through" holes, openings between frame and edges and fragmentation on the rear side.

NOTE Each test piece may be exposed to only one blast, as each blast causes weakening.