BRITISH STANDARD

BS EN
1063:2000

# Glass in building — Security glazing — Testing and classification of resistance against bullet attack

The European Standard EN 1063:1999 has the status of a British Standard

ICS 13.310; 81.040.20

# National foreword

This British Standard is the official English language version of EN 1063:1999.

The UK participation in its preparation was entrusted by Technical Committee B/520, Glass and glazing in building, to Subcommittee B/520/3, Security glazing, 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.

This British Standard supersedes BS 5051-1:1988 immediately for the testing and classification of glass and glass/plastics composites. BS 5051-1 will however remain available for the testing and classification of plastics glazing sheet materials until a corresponding British Standard is published for these products.

**Cross-references**

The British Standards which implement international or European publications referred to in this document may be found in the BSI Standards Catalogue under the section entitled "International Standards Correspondence Index", or by using the "Find" facility of the BSI Standards Electronic Catalogue.

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**Summary of pages**

This document comprises a front cover, an inside front cover, the EN title page, pages 2 to 9 and a back cover.

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EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

# EN 1063

November 1999

ICS 13.310; 81.040.20

English version

# Glass in building - Security glazing - Testing and classification of resistance against bullet attack

Verre dans la construction - Vitrage de sécurité - Mise à essai et classification de la résistance à l'attaque par balle

Glas im Bauwesen - Sicherheitssonderverglasung - Prüfverfahren und Klasseneinteilung für den Widerstand gegen Beschuß

This European Standard was approved by CEN on 16 April 1999.

CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration. Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Central Secretariat or to any CEN member.

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.

CEN members are the national standards bodies of Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and United Kingdom.

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

**Central Secretariat: rue de Stassart, 36 B-1050 Brussels**

**Content**

**Foreword**

This European Standard has been prepared by Technical Committee CEN/TC 129 "Glass in building", the secretariat of which is held by IBN.

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 May 2000, and conflicting national standards shall be withdrawn at the latest by May 2000.

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.

The main requirement for bullet-resistant glazing is to prevent the passage of projectiles from various types of weapon. The classification of bullet-resistance of glazing in this standard is a technical classification, based on common weapons and ammunition, in order of attacking power. As the variety of weapons and ammunition does not allow them all to be taken into account, a selection had to be made that covers most weapons and ammunition. The choice of bullet-resistant glazing is established by the user for each individual case.

## 1 Scope

This standard specifies performance requirements and test methods for the classification of the bullet-resistance of glass (consisting of one or more layers of glass) and glass/plastic composites.

> NOTE 1: The term "bullet-resistant glazing" applies to products that have the obvious characteristics of glass, but it is understood to include also laminated products of glass and plastics.

This standard applies to:

-attack by handguns, rifles and shotguns;
-glazing in buildings, for interior and exterior use;

> NOTE 2: For interior use at a temperature of (18 ± 5) °C. For exterior use the influence of outside temperature and weathering should be considered. Any additional requirements should be agreed between the purchaser and the vendor.

-the glazing product itself, assuming proper fixing.

> NOTE 3: The protection provided by bullet-resistant glazing depends not only on the product itself, but also upon the design and fixing of the glass.

## 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 amendment or revision. For undated references, the latest edition of the publication referred to applies.

ISO 48 Vulcanized rubbers. Determination of hardness (Hardness between 30 and 85 IRHD)

## 3 Definitions

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

**3.1 bullet-resistant glazing:** A security glazing that affords a defined resistance against the firing of specified weapons and ammunition.

NOTE: The glass or plastics component of an unitary bullet-resistant panel may be separated by airspace.

**3.2 sample:** A number of nominally identical glazing units offered for type-testing for a certain class.

**3.3 test piece:** One member of the sample prepared for testing.

**3.4 witness foil:** Sheet of aluminium foil as specified in 7.1.3 behind the test piece in order to detect splinters ejected from the rear face of the test piece by the impact of the bullet and to determine the risks of injury due to the ejection of these splinters.

**3.5 attack face:** The face of a bullet-resistant glazing, marked by the manufacturer and/or supplier that is designed to face the attack.

**3.6 perforation:** Piercing of a test piece by a bullet or by bullet fragments, and/or creation of an opening from the attack face to the rear face.

**3.7 striking distance:** The distance between the centres of two strikes on a test piece.

**3.8 bullet velocity:** The velocity of the bullet measured within 2,5 m in front of the attack face of the test piece.

**3.9 test range:** The distance between the muzzle of the firearm and the attack face of the test piece.

## 4 Classification of the levels of bullet-resistance and test conditions

The bullet-resistance glazing intended to withstand certain levels of attack shall be classified as BR1, BR2, BR3, BR4, BR5, BR6, BR7 according to table 1 and SG1 and SG2 according to table 2.

**Table 1: Classification and test requirements for testing the bullet resistance of glazing: hand guns and rifles**

| Class | Type of weapon | Calibre | Type | Mass g | Test conditions | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | test range m | bullet velocity m/s | nr. of strikes | striking distance mm |
| BR1 | rifle | 0,22 LR | L/RN | 2,6 ±0,1 | 10,00 ±0,5 | 360 ±10 | 3 | 120 ±10 |
| BR2 | hand gun | 9 mm Luger | FJ[1)]/RN/SC | 8,0 ±0,1 | 5,00 ±0,5 | 400 ±10 | 3 | 120 ±10 |
| BR3 | hand gun | 0,357 Magnum | FJ[1)]/CB/SC | 10,2 ±0,1 | 5,00 ±0,5 | 430 ±10 | 3 | 120 ±10 |
| BR4 | hand gun | 0,44 Rem. Magnum | FJ[2)]/FN/SC | 15,6 ±0,1 | 5,00 ±0,5 | 440 ±10 | 3 | 120 ±10 |
| BR5 | rifle | 5,56 × 45 * | FJ[2)]/PB/SCP 1 | 4,0 ±0,1 | 10,00 ±0,5 | 950 ±10 | 3 | 120 ±10 |
| BR6 | rifle | 7,62 × 51 | FJ[1)]/PB/SC | 9,5 ±0,1 | 10,00 ±0,5 | 830 ±10 | 3 | 120 ±10 |
| BR7 | rifle | 7,62 × 51 ** | FJ[2)]/PB/HC1 | 9,8 ±0,1 | 10,00 ±0,5 | 820 ±10 | 3 | 120 ±10 |

1) full steel jacket (plated)
2) full copper alloy jacket

* twist length (178 ± 10) mm
** twist length (254 ± 10) mm

L - lead
CB - coned bullet
FJ - full metal jacket bullet
FN - flat nose
HC1 - steel hard core, mass (3,7 ± 0,1) g, hardness more than 63 HRC
PB - pointed bullet
RN - round nose
SC - soft core (lead)
SCP1 - soft core (lead) and steel penetrator (type SS109)

**Table 2: Classification and test requirements for testing the bullet resistance of glazing: shot guns (SG)**

| Class | Type of weapon | Calibre | Type | Mass g | Test conditions | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | test range m | striking velocity m/s | nr. of strikes | striking distance mm |
| SG1 | shot gun | cal. 12/70 | solid lead slug[1)] | 31,0 ±0,5 | 10,00 ±0,5 | 420 ±20 | 1 | - |
| SG2 | shot gun | cal. 12/70 | solid lead slug[1)] | 31,0 ±0,5 | 10,00 ±0,5 | 420 ±20 | 3 | 125 ±10 |
| 1) Brenneke | | | | | | | | |

NOTE 1: The classes BR1....BR7 are classified in order of the level of protection offered, e.g. a panel complying with the requirements specified for a certain class complies with those specified for the preceding classes.

NOTE 2: Classes SG do not necessarily comply with the requirements specified in the classes BR, as the ammunition is different.

## 5 Test pieces for type testing

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

The sample submitted for testing shall be representative of the normal production quality.

The attack face shall be marked by the supplier.

Every test piece shall be clearly marked to identify the product.

The sample submitted for type testing shall consist of 3 test pieces for each class for which testing is required. At least one extra test piece shall be taken as a reserve.

The size of the test pieces shall be (500 ± 5) mm × (500 ± 5) mm square.
The edges of the test pieces shall be smooth for ease of handling.

## 6 Performance requirements

Each of the three pieces of a sample shall comply with at least one of the following requirements, when subjected to the test in 7.2.

**6.1** No perforation of the glazing by the bullet or parts of the bullet and no perforation of the witness foil by glass splinters from the rear face.

This type of bullet-resistant glazing shall be classified in the appropriate class with the additional mark: “NS” (no splinters).

**6.2** No perforation of the glazing by the bullet or parts of the bullet, but with perforation of the witness foil by glass splinters from the protected face.

This type of bullet-resistant glazing shall be classified in the appropriate class with the additional mark: “S” (“splinters”).

# 7 Test method

## 7.1 Apparatus

The testing device shall consist of:

### 7.1.1 Rigid frame

The frame shall not move under the impact of the projectiles.

The conditioned test piece shall be mounted in a rigid frame, in a vertical position and at the distance from the muzzle of the fire arm specified in table 1.

The mounting of the test piece in the frame shall meet the following requirements:

- the test piece shall be mounted perpendicular to the firing line;

- between the glass edges and the frame, neoprene rubber strips shall be applied, of hardness 40 IHRD to 60 IHRD according to ISO 48, thickness 4 mm, and width (30 ± 5) mm;

- at the bottom of the rebate, neoprene rubber strips shall be applied, of hardness 40 IHRD to 60 IHRD according to ISO 48, thickness 4 mm, and width equal to the full thickness of the test piece;

- all four glass edges shall be uniformly clamped over an area of (30 ± 5) mm width, leaving a clear target area of about 440 mm × 440 mm;

- the clamping pressure shall be such that the glass edges remain in place during the test but such that no stresses are induced that might affect the result.

    NOTE: Clamping pressure is not always precisely defined, as the effect of clamping on the final result is relatively small.

### 7.1.2 Splinter collecting box

The glass splinters released from the rear face of the test piece and bullet fragments passing through the test piece are gathered by a splinter collecting box that is positioned behind the test piece and is fixed to the rigid frame. The splinter collecting box shall have an opening at the front of at least 440 mm × 440 mm that matches the target area in the frame, and shall fully enclose the space between the test piece and the witness foil.

A requirement for the splinter collecting box is that the witness foil shall be positioned according to 7.1.3 and be easily accessible for examination and replacement.

### 7.1.3 Witness foil

The wounding potential of the glass splinters released from the rear face shall be determined with a witness foil.

The witness foil consists of an aluminium foil, thickness 0,02 mm and density 54 g/m$^2$.

The aluminium foil shall be mounted in the splinter collecting box in a vertical position at a distance of (500 ± 10) mm behind the test piece and shall have a clear surface of at least 440 mm × 440 mm that matches the target area. The aluminium foil shall be mounted rigidly by its edges. It shall be sufficiently rigidly mounted to ensure that it remains in position during the test; there shall be no tendency for the witness foil to tear at the edges.

#### 7.1.4 Velocity measuring system

The velocity of the bullet shall be measured with an electronic measuring system not more than 2,5 m in front of the test piece.

The mechanism for measuring the bullet velocity shall be accurate to 1,0 m/s.

#### 7.1.5 Ballistic testing equipment

Tables 1 and 2 list the weapons and ammunition required.

The tests may be carried out with ballistic testing equipment that produces the same striking velocity as specified in tables 1 and 2.

Attainment of the specified striking distances can require the use of special barrels and special alignment aids.

Attainment of the specified striking velocity can require the use of specially selected or laborated ammunition.

### 7.2 Test performance

#### 7.2.1 Condition of test piece

The test pieces shall be stored for a period of at least 12 h at a constant temperature of (18 ± 5) °C before the test.

#### 7.2.2 Procedure

The weapon of ammunition is chosen from table 1 or table 2 corresponding to the level of bullet resistance for which the product is to be tested.

Mount the first test piece in the frame at the correct distance from the muzzle of the fire arm, according to table 1 or table 2, with the attack face facing the weapon.

The test temperature shall be (18 ± 5) °C.

Draw an equilateral triangle in the centre of the test piece, with the side length equal to the striking distance, according to table 1 or table 2, or mark the centre point for SG1 (table 2). Mark the vertices so that they are clearly visible to the marksman.

Subject the test piece to one or three shots in accordance with the test conditions in tables 1 and 2, and measure the bullet velocity of each shot.

Measure the centre to centre distances of the three strikes with an instrument with an accuracy to 1 mm.

Examine the test piece to determine whether there is an opening between back and front.

> NOTE: If necessary one could use a blunt pin with a diameter of approximately 4 mm and try gently to determine whether it can pass through.

Examine the gathered fragments in the splinter collecting box for bullet fragments and/or glass splinters released from the rear of the test piece.

Remove the exposed witness foil and examine for perforation against strong light, after lightly brushing to detach any adherent particles.

Determine the validity of the shots according to 7.2.3.

Renew the aluminium foil if necessary and repeat the test for the other test pieces of the series of 3.

### 7.2.3 Validity of shots

A test is considered to be valid if for a specific bullet resistance class the velocity and the striking distance are in accordance with the requirements.

## 8 Report

The report shall indicate at least the following, with reference to this standard:

a) the manufacturers name or trade mark;
b) the product name and model and/or serial number;
c) description of the marking of the product by the manufacturer;
d) the name of the testing institute;
e) the test date;
f) the class of bullet resistance in an abbreviated form as EN 1063 (class and additional designation "NS" or "S", respectively).

## 9 Marking

The product shall be marked with a permanent label or removable label, which may not be removed intact and re-used, indicating class and attack face of the product.

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