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Glass in building — Forced-entry security glazing —

Part 1: Test and classification by repetitive ball drop

Verre dans la construction — Vitrages de sécurité contre infractions —

Partie 1: Essai et classification par balle lancée répétée

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 160, *Glass in building*, Subcommittee SC 2, *Use considerations*.

This second edition cancels and replaces the first edition (ISO 16936-1:2005), which has been technically revised. The main changes compared to the previous edition are as follows:

— addition of Figure 2;

— Annex A status has been changed to normative due to reference in 7.1.

A list of all parts in the ISO 16936 series can be found on the ISO website.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

This document assesses security-glazing products that are more familiarly known as “anti-vandal”, “anti-bandit” and “detention” glazing products. Because there is no single test that will cover the wide range of resistances to attack, four separate test methods are provided to assess the forced entry resistant properties of security glazing. It is not intended that any particular test method be associated with the terms “anti-vandal” or “anti-bandit”, since these terms can be only loosely defined and there is considerable overlap in their definition.

It is important that security-glazing products be installed in a frame which can give appropriate resistance to impact and which also provides a suitable support for the security-glazing product. It is important that cut-outs and holes in security-glazing products be avoided where possible, as these can affect the resistance of the product.

The test method specified in this document does not reproduce the conditions of a real human attack but is intended to give a classification of comparative resistance.

Glass in building — Forced-entry security glazing —

Part 1:
Test and classification by repetitive ball drop

1 Scope

This document specifies requirements and a test method for security glazing designed to resist impacts of a hard body by delaying access of objects and/or persons to a protected space for a short period of time. It also classifies security-glazing products into categories of resistance to repetitive impacts of a steel sphere.

In this document, the categories of resistance have not been assigned to special applications. It is intended that the glazing classification be specified on an individual basis for every application and anticipated action of force upon the glazing.

This document deals with mechanical resistance to impact only.

NOTE Other properties can also be important.

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.

ISO 48-2:2018, *Rubber, vulcanized or thermoplastic — Determination of hardness — Part 2: Hardness between 10 IRHD and 100 IRHD*

ISO 6508-1, *Metallic materials — Rockwell hardness test — Part 1: Test method*

3 Terms and definitions

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

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

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at http://www.electropedia.org/

3.1
action of force
deliberate attempt on the part of a person made with the intention of creating a hole in the *security-glazing product* (3.6), by the use of manually held implements or thrown objects

3.2
asymmetric construction
product in which, from both outer surfaces, the sequence of glass panes, plastic glazing sheet material and interlayer(s) by type, thickness, finish and/or general characteristics is different

3.3
category of resistance
classification of the capability of a security-glazing product to resist *actions of force* (3.1)

3.4
protected space
area the access to which is prevented by the completed installation

3.5
sample
specified number of test pieces which together are representative of the *security-glazing product* (3.6) intended to comply with a particular *category of resistance* (3.3)

3.6
security-glazing product
product based on glass with or without plastics with a single or multiple ply construction, where the individual plies are of uniform thickness over the whole area of the product

Note 1 to entry: A security-glazing product is usually transparent or translucent and provides a specific resistance to the actions of force.

4 Sampling

The sample submitted for testing shall consist of three test pieces for each category for which testing is required.

To ensure against invalid test results because of errors during the test, it is advisable to submit at least one extra test piece.

If the test pieces are of an asymmetric material, their number shall be doubled.

Each test piece shall be (1 100 ± 5) mm long × (900 ± 5) mm wide. The edges shall be free from visible chips, cracks and flaws. Glass samples should be lightly arrissed for ease of handling.

Each test piece shall be stored vertically and self-supporting at (18 ± 3) °C for at least 12 h immediately prior to the test.

For exterior uses under extreme conditions, the influence of the outside temperature should be considered.

5 Apparatus

5.1 Impactor, consisting of a steel sphere with a diameter of (100 ± 0,2) mm and a mass of (4,11 ± 0,06) kg. The sphere shall be manufactured from polished steel with a hardness of 60 HRC to 65 HRC on the Rockwell C scale, in accordance with ISO 6508-1.

5.2 Impactor-holding equipment, with a drop height adjustable to the required tolerance (see Table 1).

The equipment for holding the impactor and the mechanism for releasing the impactor shall not induce any momentum or rotation in the impactor, so that the impactor is accelerated only by gravitational forces and falls vertically.

Table 1 — Drop heights

Category of resistance	Drop height mm
P1A	1 500 ± 50
P2A	3 000 ± 50
P3A	6 000 ± 50
P4A	9 000 ± 50
P5A	9 000 ± 50

5.3 Test piece support apparatus, consisting of a steel frame to clamp the edge of the test piece and a receiving box to collect fragments and the impactor (see Figure 1).

The support apparatus shall:

— be inherently rigid;

— have an unyielding connection to a solid base;

— ensure plane and parallel clamping of the test piece in a horizontal position;

— be designed in such a way that the test piece touches only the clamping frame during the test;

— ensure clamping of the test piece on all four edges with an edge cover of (30 ± 5) mm;

— have the clamping frame covered on the contact area of the test piece with rubber strips 30 mm wide and 4 mm thick of hardness 40 IHRD to 60 IHRD, according to method N of ISO 48-2:2018;

— ensure that the edges of the test piece are clamped with a uniform pressure of (140 ± 20) kN/m^2;

— ensure that the impactor is not damaged and does not rebound when hitting the bottom of the receiving box;

— ensure that air cannot be trapped in the support apparatus in such a way that it can cushion the effects of the impact.

6 Required characteristics

The security-glazing product shall be submitted to testing for a particular category of resistance.

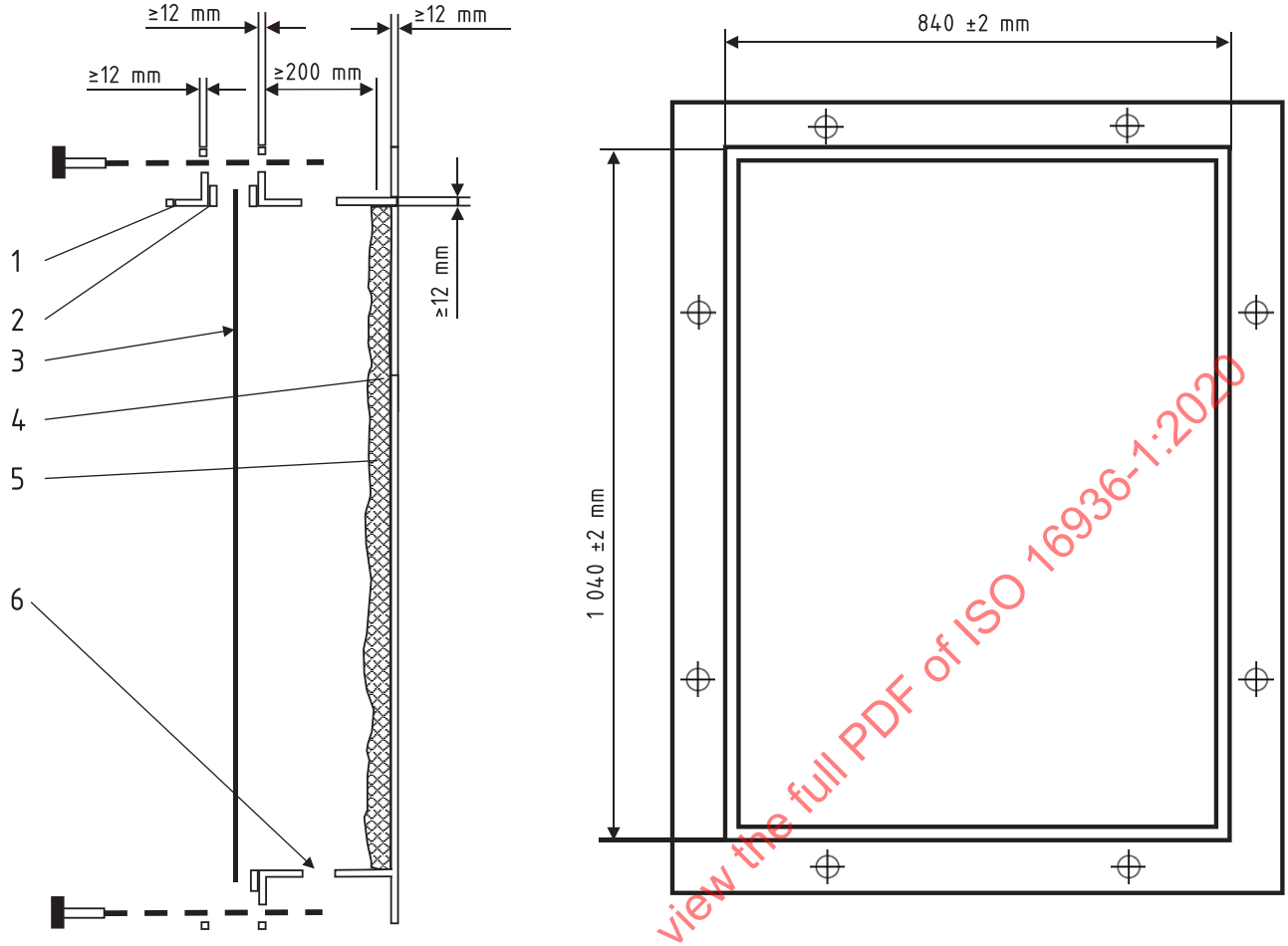
The security-glazing product shall be classified in that particular category of resistance if all three test pieces (or all six test pieces in the case of an asymmetric material) prevent penetration by the impacting body when tested by the method described in Clause 7.

7 Test method

7.1 Room temperature test

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

If the glass is tested at extreme temperatures, i.e. at −20 °C or at +40 °C, it shall be tested according to the specifications given in Annex A.



Key

1 steel clamping frame
2 rubber strip
3 test piece
4 steel receiving box
5 energy absorber
6 vent holes

Figure 1 — Example of a test piece support apparatus

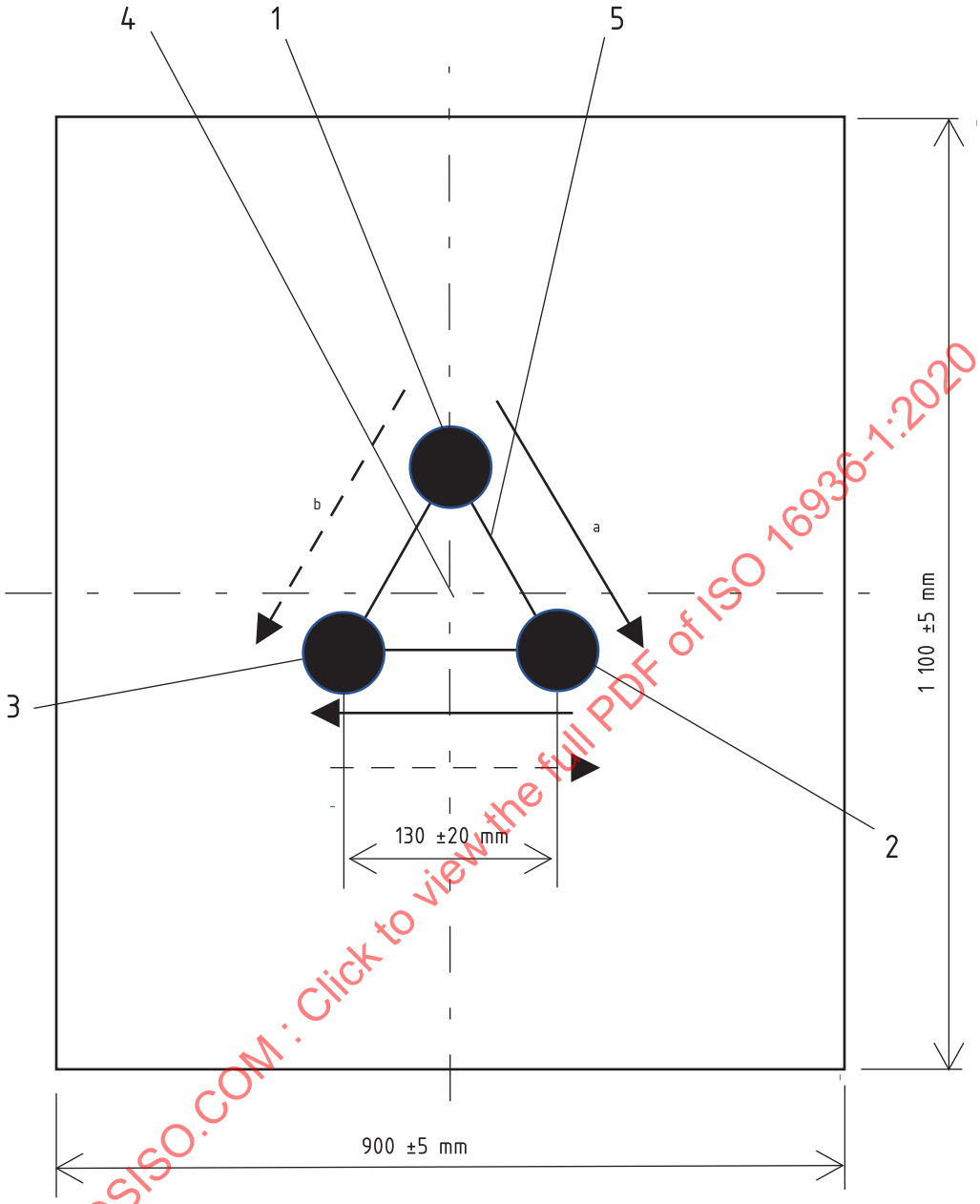
7.2 Installation of the test piece

The test piece shall be placed horizontally into the clamping frame of the test piece support apparatus and fixed in accordance with the requirements of 5.3.

The surface of the test piece shall be marked to indicate the location of the clamping frame relative to the test piece. This is to check for slippage of the test piece during the test.

7.3 Test procedure

The drop height (measured from the bottom of the impactor to the surface of the test piece) shall be adjusted in accordance with Table 1 for the category of resistance to be tested.



Key

1 first impact position
2 second or third impact position
3 third or second impact position
4 geometric centre
5 equilateral triangle
a Progress of impact positions.
b Alternate progress of impact position.

Figure 2 — Impact positions on a test piece

For categories P1A, P2A, P3A and P4A, the impactor shall be dropped on each test piece three times from the same height, in such a way that the impact positions form the pattern of an equilateral triangle with a side length of (130 ± 20) mm around the geometric centre of the test piece, with one side of the triangle parallel to a short side of the specimen. The impact position opposite to this side of the triangle shall be hit first.

For the category P5A, the above procedure shall be repeated a total of three times on each test piece, giving nine impacts, three on each point of the triangle.

Loose fragments shall be removed from the test piece after each impact for all levels.

For asymmetric constructions, carry out the test on both sides, i.e. the test shall be carried out first on one side and, if successful, it shall be repeated by impacting the other surface of the test piece.

7.4 Evaluation of the test results

After each impact, the test piece shall be checked for penetration by the impactor. A test piece shall be regarded as being penetrated if the impactor has completely passed through the test piece before 5 s have elapsed since the time of impact.

After each impact, the test piece shall be also examined for signs of slippage from the clamping frame. The test is invalid if any edge of the test piece has moved more than 5 mm in the clamping frame. If this is the case, then the test shall be repeated with a new test piece. If it is found necessary to increase the clamping pressure to prevent slippage, this shall be stated in the test report.

The clamping pressure should not exceed 200 kN/m^2. High clamping pressures can make a product unsuitable for use in insulating glass units.

8 Classification and designation

The security-glazing product shall be classified in that category of resistance corresponding to the applied drop height and number of impacts, provided all test pieces have resisted penetration by the impactor.

Table 2 gives the code designations for the categories of resistance.

Table 2 — Classification table for the resistance of security-glazing products

Category of resistance	Drop height mm	Total number of strikes	Code designation for category of resistance
P1A	1 500	3 in a triangle	ISO ... P1A
P2A	3 000	3 in a triangle	ISO ... P2A
P3A	6 000	3 in a triangle	ISO ... P3A
P4A	9 000	3 in a triangle	ISO ... P4A
P5A	9 000	3 × 3 in a triangle	ISO ... P5A

9 Test report

The following items shall be included in the test report:

— name of the testing laboratory;

— test number;

— date of test;

— reference to this document, i.e. ISO 16936-1:2020;

— name of the company or authority submitting the sample for test;

— name (trade name or descriptive name) of the security-glazing product;

— description of the composition of the security-glazing product;

