INTERNATIONAL STANDARD

ISO 16936-2

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Glass in building — Forced-entry security glazing —

Part 2: Test and classification by repetitive impact of a hammer and axe at room temperature

Verre dans la construction — Vitrages de sécurité contre infractions —

Partie 2: Essai et classification par impact répété d'un marteau et d'une hache à température ambiante

Reference number
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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.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

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.

ISO 16936-2 was prepared by Technical Committee ISO/TC 160, *Glass in building*, Subcommittee SC 2, *Use considerations*.

ISO 16936 consists of the following parts, under the general title *Glass in building — Forced-entry security glazing*:

- *Part 1: Test and classification by repetitive ball drop*
- *Part 2: Test and classification by repetitive impact of a hammer and axe at room temperature*
- *Part 3: Test and classification by manual attack*
- *Part 4: Test and classification by pendulum impact under thermally and fire stressed conditions*

Introduction

This part of ISO 16936 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 cutouts 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 part of ISO 16936 does not reproduce the conditions of real human attack, but is intended to give a classification of comparative resistance of glazing.

Glass in building — Forced-entry security glazing —

Part 2:
Test and classification by repetitive impact of a hammer and axe at room temperature

1 Scope

This part of ISO 16936 specifies requirements and a mechanical test method for security glazing designed to resist actions of manual attack by delaying access of objects and/or persons to a protected space for a short period of time. This part of ISO 16936 classifies security glazing products into categories of resistance against repetitive impacts of a hammer and an axe.

In this part of ISO 16936, the categories of resistance have not been assigned to special applications. Glazing classification should be specified on an individual basis for every application.

This part of ISO 16936 deals with mechanical resistance to manual attack only. Other properties can also be important.

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 48:1994, *Rubber, vulcanized or thermoplastic — Determination of hardness (hardness between 10 IRHD and 100 IRHD)*

ISO 6508-1, *Metallic materials — Rockwell hardness test — Part 1: Test method (scales A, B, C, D, E, F, G, H, K, N, T)*

3 Terms and definitions

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

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

3.2
attack face
face of a test piece marked by the manufacturer and/or supplier that is designed to face the attack

3.3
category of resistance
classification of the capability of a security glazing product to resist actions of force

3.4
protected space
space protected against access by the completed installation

3.5
sample
specified number of test pieces which together are representative of the security glazing product intended to comply with a particular category of resistance in this part of ISO 16936

3.6
security glazing composition
specific construction of a glazing product

NOTE A product is deemed to be of the same or superior security glazing composition if individual plies are exchanged with others of a different colour, but without significant effect on the resistance to actions of force; and/or additional glazing products are installed on either face of the security glazing product, laminated to it or with an air space; and/or additional equipment such as alarm wires, heating wires, printing, or surface coatings (on part or all of the surface) are incorporated into the security glazing product, provided that this does not significantly affect the resistance to actions of force.

3.7
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 A security-glazing product is usually transparent or translucent, and provides a specific resistance to the actions of force.

3.8
test piece
specified piece of security glazing product submitted to a specified test procedure

4 Symbols (and abbreviated terms)

a_i	angle of impact, measured between the surface of the test piece and the handle; see Figure 4
E_i	impact energy of the hammer or axe
n_1, n_2	number of axe strikes
r_1	radius of the blade of the axe head
v_i	impact velocity of the hammer or axe
x	length of slit in the security glazing product formed by the axe blade

5 Sampling

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

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

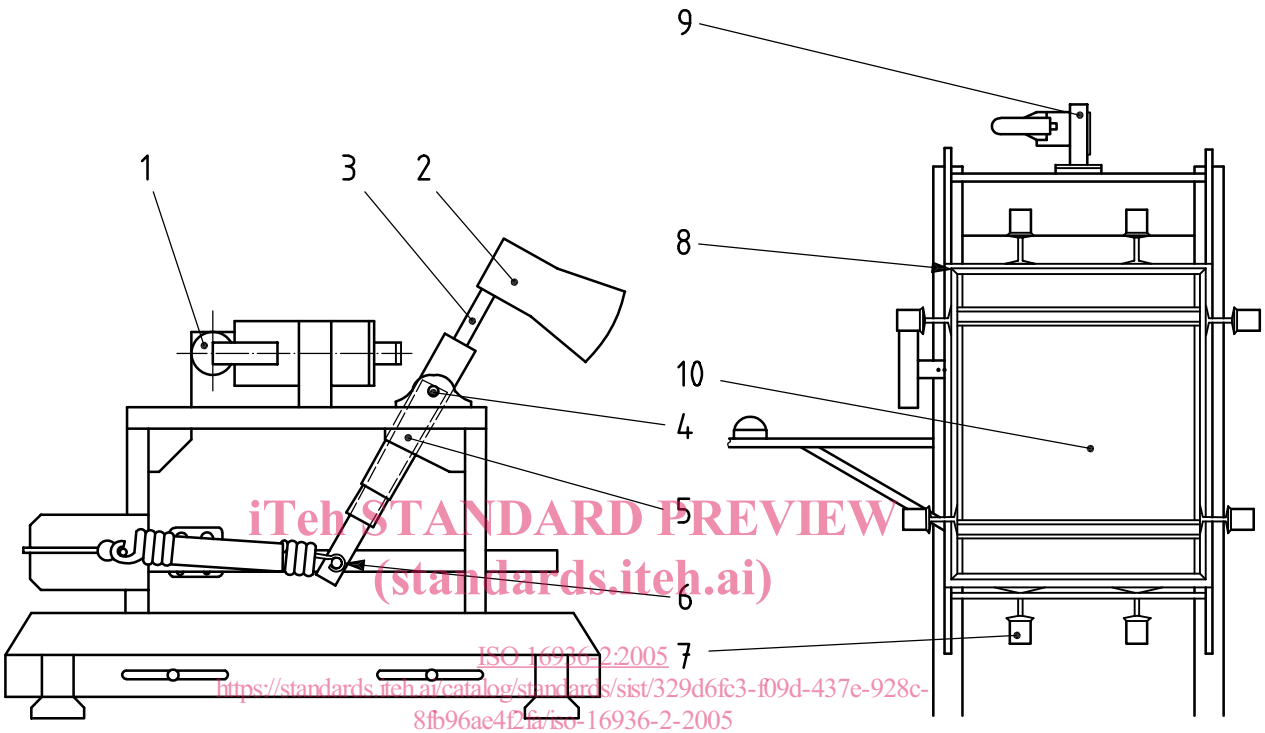
The surface to be impacted shall be marked on each test piece.

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

6 Apparatus

6.1 General

Figure 1 shows the general arrangement of the test piece and the mechanism for swinging the axe. A detailed specification of the component parts is given in 6.2 to 6.4.



Key

1 release mechanism
2 axe head
3 handle
4 axis of rotation
5 sleeve
6 tension spring
7 pneumatic clamp
8 clamping frame
9 height adjustor
10 test piece

Figure 1 — General view of axe test apparatus

6.2 Tool specifications

6.2.1 Axe head

The axe head shall have the form and dimensions in accordance with Figure 2.

Dimensions in millimetres

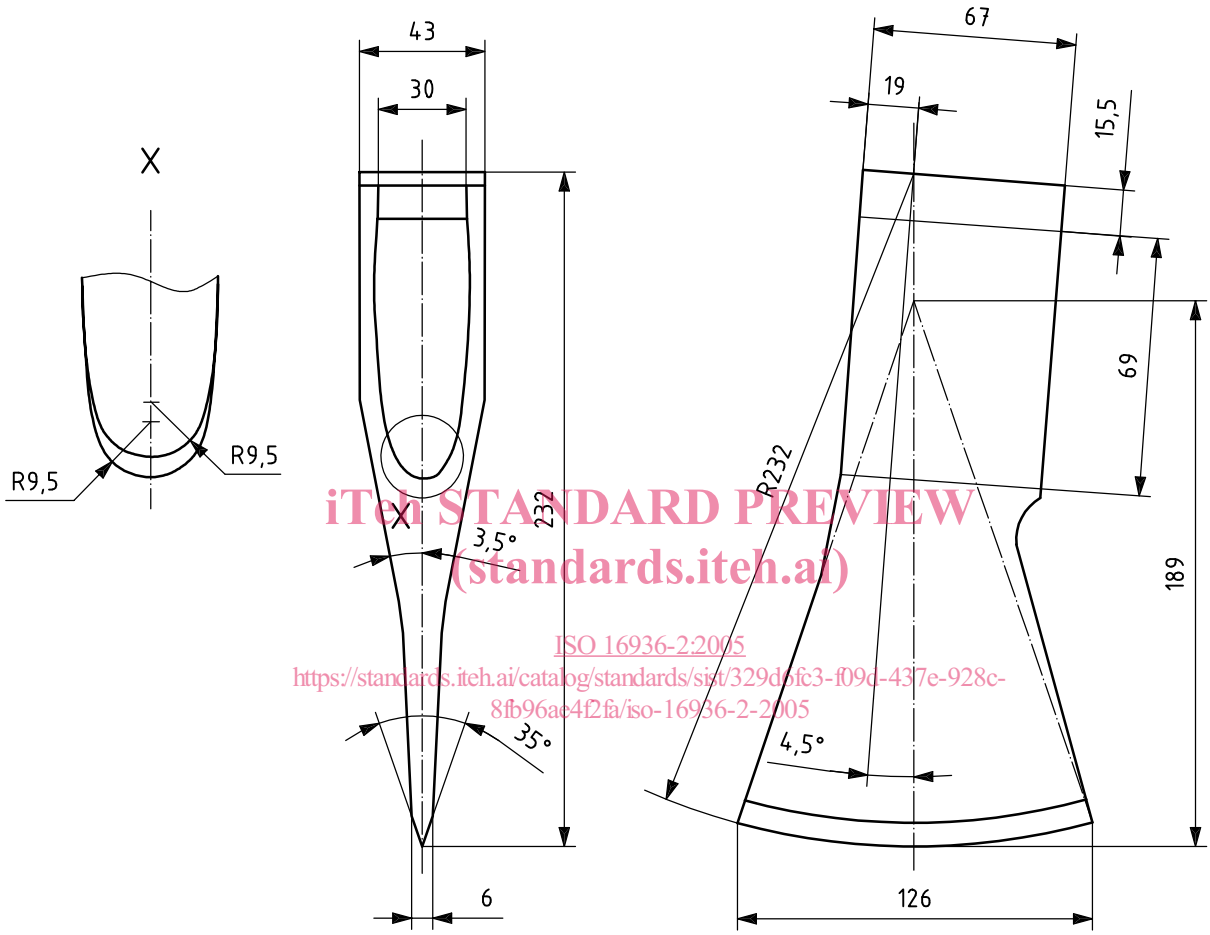


Figure 2 — Axe head

The axe head shall have a mass of (2,0 ± 0,1) kg and shall be made from wrought, unalloyed steel with a chemical composition as shown in Table 1.

Table 1 — Chemical composition of axe head

C min.	Mn min.	Si max.	P max.	S max.	(P + S) max.
0,6	0,6	0,5	0,03	0,03	0,05

The blade of the axe head shall be hardened to a distance of at least 30 mm from the edge.

At the beginning of the test, the blade of the axe head shall have a “qualified sharpness” as follows:

— a blade wedge angle of $(35 \pm 1)^{\circ}$;

— a slightly convex flank;

— a blade radius, r_1, of $232^{\ 0}_{-10}$ mm;

— a hardness of 51 HRC to 56 HRC in accordance with ISO 6508-1.

After every 10 impacts, the blade shall be re-sharpened.

An axe should not be re-used for testing, if

— the axe head was reduced during sharpening to a blade radius less than 222 mm,

— the hardness is no longer within 51 HRC to 56 HRC.

6.2.2 Hammer head

The head of the hammer is designed to simulate the blunt edge of an axe head and is used in place of the axe head. The hammer head shall be made from a steel bar of cross section (40 ± 2) mm square, length (232 ± 10) mm and of mass $(2{,}0 \pm 0{,}1)$ kg. The head shall have a hardness of 46 HRC to 50 HRC in accordance with ISO 6508-1.

The edge of the impact surface shall have a radius less than 1 mm. When this radius is exceeded, it shall be re-sharpened before use.

6.3 Handle specification

The axe head (see 6.2.1) and the hammer head (see 6.2.2) shall be fixed to a handle as shown in Figure 3. The top edge of the tool shall be flush with the end of the handle. The handle shall be made of high-density polyethylene with a density of (940 ± 3) kg/m^3 and a modulus of (400 ± 20) N/mm^2.

Dimensions in millimetres

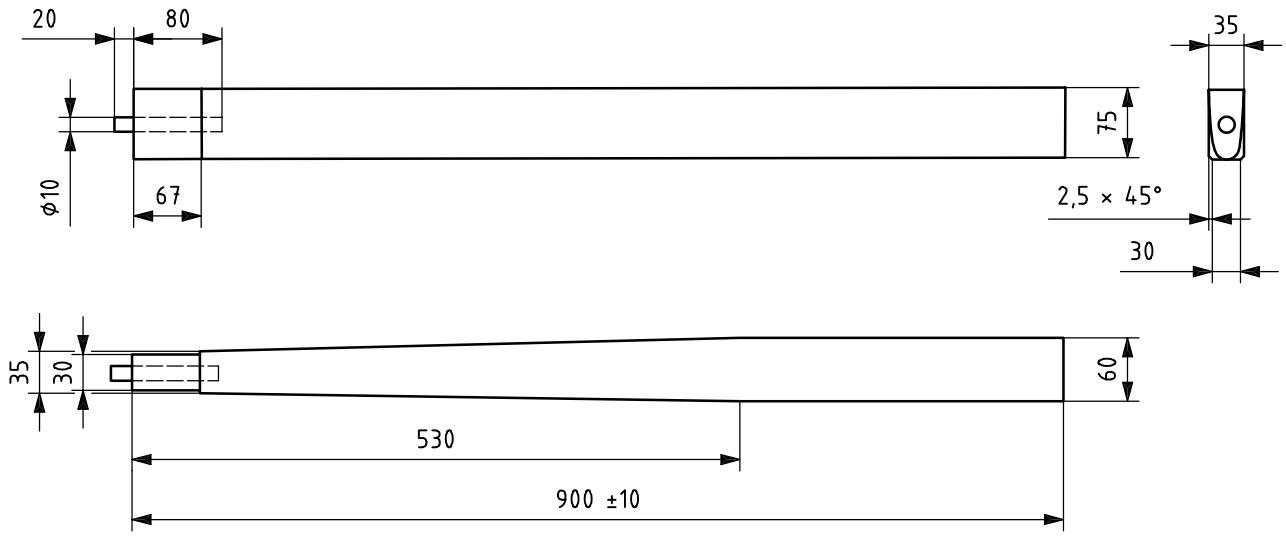


Figure 3 — Handle for the tools