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Glass in building — Destructive-windstorm-resistant security glazing — Test and classification

Verre dans la construction — Vitrages de protection résistant aux tempêtes destructrices — Essai et classification

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Contents

Page

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 third edition cancels and replaces the second edition (ISO 16932:2016), which has been technically revised. The main changes compared to the previous edition are as follows:

— updated hazard classifications;

— modification of missile impact weight requirements.

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.

Glass in building — Destructive-windstorm-resistant security glazing — Test and classification

1 Scope

1.1 This document determines resistance of security glazing products to natural threats characterized by simulated destructive-windstorm events.

1.2 The test method determines the performance of security-glazing for use in fenestration assemblies under conditions representative of events that occur in severe, destructive-windstorm environments using simulated missile impact(s) followed by the application of cyclic static-pressure differentials.

1.3 A missile-propulsion device, an air pressure system and a test chamber are used to model some conditions that can be representative of windborne debris and pressures in a windstorm environment.

1.4 The performance determined by this test method relates to the ability of glazing in the building envelope to remain without openings during a windstorm.

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

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
windstorm-resistant security glazing
glass-based fenestration glazing product, usually transparent or translucent, intended to protect property or people from natural threats

3.2
destructive windstorm
severe weather event with high winds and turbulent gusts, such as a tropical cyclone having a *basic wind speed* (3.3) equal to or greater than 50 m/s, capable of generating *windborne debris* (3.11)

3.3
basic wind speed
V
velocity of the wind used in calculation as determined by the authority having jurisdiction

Note 1 to entry: The basic wind speed is intended to represent the gust wind speed design basis for a tropical cyclone such as used to describe a 50-year recurrence period or annual 0,02 probability of being exceeded.

3.4
fenestration assembly
glazing system intended to be installed in a building

EXAMPLE Exterior windows and glazed doors.

3.5
air-pressure differential
P
specified maximum differential in static air pressure across the specimen, creating an inward or outward load

Note 1 to entry: The air-pressure differential is expressed in pascal or its multiples.

3.6
missile
object that is propelled towards a *test specimen* (3.8)

3.7
cyclic test load
specified differential in static air pressure, creating an inward or outward load, to which the specimen is subjected in a series of cycles

Note 1 to entry: The cyclic test load can be positive or negative.

3.8
test specimen
glazing materials and glazing unit assembled in a standard frame

Note 1 to entry: See Annex B.

3.9
test-loading programme
entire sequence of air-pressure cycles applied to the *test specimen* (3.8)

3.10
lumber missile
dressed piece of surface-dried, soft-wood, structural timber that impacts the glazing surface of the specimen

3.11
windborne debris
objects carried by the wind in windstorms

3.12
design pressure
uniform, static air-pressure difference, inward or outward, for which the *test specimen* (3.8) is designed under service load conditions, using local conventional structural engineering specifications and concepts

Note 1 to entry: This pressure is determined by either analytical or wind-tunnel procedures.

4 Principle and significance

4.1 General

This test method consists of mounting the test specimen and testing to an appropriate class, by impacting the test specimen with (a) missile(s) and then applying cyclic static-pressure differentials across the test specimen in accordance with a specified test-loading programme. The condition of the test specimen is observed and measured, and the results reported.

4.2 Purpose

The purpose of this document is to determine the resistance of various glazing materials and glazing systems to threats characteristic of destructive windstorms. Qualification under this document provides a basis for judgment of the ability of elements of the building envelope to remain without openings during a tropical cyclone. This minimizes the damaging effects of a destructive windstorm on the building interior and reduces the magnitude of internal pressurization.

Classification is intended as a basis for judging the ability of glazing to remain essentially without openings during a tropical cyclone with wind speed of 50 m/s or greater. Impact by missile(s) and subsequent cyclic static-pressure differentials simulate conditions representative of windborne debris and pressures in a destructive windstorm. Glazing is tested in a standard frame. Classification is based on the potential hazard to human life using the appropriate wind speed, pressure and level of protection.

4.3 Options

The user of this document either

a) tests the glazing material to a specified and required “level of protection” for classification according to 9.3, or

b) tests the glazing material to other conditions without classification as requested by the authority having jurisdiction, in which case the required information, as described in Annex A, shall be provided for the test procedure.

5 Apparatus

5.1 General

Any equipment capable of performing the test procedure within the allowable tolerances may be used.

5.2 Equipment

5.2.1 Mounting frame supporting the outer specimen test frame(s) described in Annex B in a vertical position during testing. The maximum mounting-frame deflection of the longest member (either during impact or at the maximum specified static air-pressure differential) shall not exceed $L/360$, where L denotes the greatest unsupported length of a member of the mounting frame. Frame-deflection measurements shall be made normal to the plane of the specimen at the point of maximum deflection. The mounting frame shall be either integral with the test chamber or capable of being installed into the test chamber prior to or following missile impact(s). The mounting frame shall be anchored so it does not move when the specimen is impacted. The specifications for the inner and the outer specimen-support frame shall be as specified in Annex B.

5.2.2 Air-pressure cycling test chamber, consisting of an enclosure or box with an opening against which the test specimen is installed. It shall be capable of withstanding the specified cyclic static-pressure differential. The chamber shall be deep enough to avoid contact with the test specimen during

pressure cycling. Pressure taps shall be provided to facilitate measurement of the cyclic static-pressure differential. They shall be located such that the measurements are unaffected by the air supplied to or evacuated from the test chamber or by any other air movements.

5.2.3 Air-pressure system, consisting of a controllable blower, a compressed-air supply/vacuum system or other suitable system capable of providing the required maximum air-pressure differential (inward and outward acting) across the test specimen. Specified pressure differentials across the test specimen shall be imposed and controlled through any system that subjects the test specimen to the prescribed test-loading programme. Examples of suitable control systems include manually operated valves, electrically operated valves or computer-controlled servo-operated valves.

5.2.4 Air-pressure-measuring apparatus.

Pressure differentials across the test specimen shall be measured by an air-pressure-measuring apparatus with an accuracy of ±2 % of its maximum rated capacity, or ±100 Pa, whichever is the lowest, and with a response time of less than 50 ms.

EXAMPLE Mechanical pressure gages and electronic pressure transducers are acceptable.

5.2.5 Missile-propulsion device(s), capable of propelling a missile at a specified speed and orientation towards a specified impact location; see Annex C. The missile shall not be accelerating upon impact due to the force of gravity along a line normal to the specimen.

5.2.6 Speed-measuring system, capable of measuring missile speeds within the tolerances defined in 7.3.2.

5.2.7 Missiles.

5.2.7.1 General

Missiles shall be one or more of the following as appropriate to classification; see 9.2. Any other representative missiles shall have mass, size, shape and impact speed determined by engineering analysis considering the design basic wind speed.

5.2.7.2 Small-ball missile

A solid steel ball weighing 2 g ± 5 %, with an 8 mm nominal diameter, and an impact speed between 0,40 and 0,80 of the basic wind speed; see Table 4.

5.2.7.3 Lumber missile

The lumber missiles typically have a relative density of 0,48; a hardness of 2 600 N, as measured by a modified Janka hardness test[8]; and cross-section dimensions of 38 mm × 89 mm, with a linear density of between 1,61 kg/m and 1,79 kg/m. The timber, generally called "2 · 4s" in reference to its nominal dimensions of 2 in by 4 in, shall have a mass and an impact speed as shown in Table 1. The missile shall have no defects, such as knots, splits, checks, shakes or wane, within 30 cm of the impact end. The impact end shall be trimmed square. If required for propulsion, a circular sabot having a mass of no more than 0,2 kg may be applied to the trailing edge of a large missile. The mass of the large missile includes the mass of the sabot.

5.3 Calibration

5.3.1 Speed-measuring system

The speed-measuring system shall be calibrated to an accuracy of ±2 % of the elapsed time required to measure the speed of the specified missile. Calibration shall be performed at the manufacturer's

