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**Glass in building — Explosion-resistant  
security glazing — Test and classification  
for arena air-blast loading**

*Verre dans la construction — Vitrages de sécurité résistant à  
une explosion — Essai et classification par charge circulaire d'air*



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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 16933 was prepared by Technical Committee ISO/TC 160, *Glass in building*, Subcommittee SC 2, *Use considerations*.

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## Introduction

This International Standard provides a method for carrying out arena blast tests in order to assess and classify the response of glazing to the overpressure and impulse characteristics of high-explosive blasts. This International Standard provides criteria for rating the level of damage to the glazing and the hazard consequences to the area located behind the glazing. The increasing use of glazing designed to protect persons and property from accidental explosions, and from the effects of terrorist attacks with high explosives, has prompted the preparation of this International Standard.

Structural response to blast loading is dependent upon specimen size and edge constraint as well as material composition and thickness. The classifications and test results derived by using this International Standard can be used in conjunction with calculation procedures and further validation tests on framed glass during the process of designing complete glazing systems against explosive threats.

The following annexes are included in this International Standard:

- Annex A (normative)      Blast parameters and derivation
- Annex B (informative)    Characteristics of blast shock waves and explosives
- Annex C (informative)    Nominal charge size and standoff distances
- Annex D (informative)    Fragment dimensions and criteria comparisons

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# Glass in building — Explosion-resistant security glazing — Test and classification for arena air-blast loading

## 1 Scope

This International Standard provides a structured procedure to determine the air-blast resistance of glazing and sets forth the required apparatus, procedures, specimens, other requirements and guidelines for conducting arena air-blast tests of security glazing. Seven standard blasts simulating vehicle bombs and seven standard blasts simulating smaller satchel bombs that can be used to classify glazing performance are incorporated in this International Standard and cover a broad range of blast parameters.

Security glazing, including that fabricated from glass, plastic glazing sheet material, glass-clad plastics, laminated glass, insulated glass, glass/plastic glazing materials and film-backed glass, can be tested and classified in a standard frame or tested but not classified in frames provided with the glazing.

Classification and ratings are assigned based on the performance of glazing loaded by air-blast pressures and impulses, and are specific to the blast characteristics under which the test takes place. Glazing that has received an air-blast classification and rating is suitable for use in blast-resistant applications only for blasts of comparable characteristics and only if installed in a properly designed frame. Design based on knowledge of the air-blast resistance reduces the risk of personal injury.

## 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)*

## 3 Terms and definitions

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

### 3.1

#### **air-blast pressure history**

description of the pressure of a reflected or free-field air blast, as measured at a point on the surface and consisting of two separate phases:

- positive phase, which is characterized by a nearly instantaneous rise to a maximum pressure followed by an exponential decay to ambient pressure;
- negative phase, immediately following the positive phase, during which the pressure decreases below ambient for a period of time before returning to ambient

### 3.2

#### **ambient temperature**

temperature at which the test is conducted