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Standard Specification for Glazing and Glazing Systems Subject to Airblast Loadings[1]

This standard is issued under the fixed designation F2912; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

1. Scope

1.1 This specification covers glazing, glazed windows, glazed curtain walls, glazing panels in doors, other glazed protective systems, and non-attached window retrofit systems used in buildings that may be subjected to intentional or accidental explosions.

1.2 This specification addresses only glazing, glazing systems, and glazing retrofit systems. This specification does not address the structural integrity and functionality of door assemblies. It assumes that the designer has verified that other structural elements have been adequately designed or tested to resist the anticipated airblast loads.

1.3 This specification is designed for all glazing, glazing systems, and glazing retrofit systems including, but not limited to, those fabricated from glass, plastic, glass-clad plastics, laminated glass, glass/plastic glazing materials, organic coated glass (filmed), and non-attached glazing retrofit systems such as blast curtains, cables, shades, and architectural mesh.

1.4 This specification does not determine the assessment of a facility nor acceptable hazard ratings. Threat and risk assessment shall have already been performed and the acceptable hazard rating defined. The hazard rating should be selected taking into account the installed position of the glazing. Glazing at higher elevations relative to the floor may require more stringent hazard considerations.

1.5 This specification determines the hazard rating associated with blast tested glazing, glazing systems, and non-attached glazing retrofit systems. In addition to glazing fragments and system components creating hazards, glazing slivers are also included as part of the hazard rating. The inclusion of slivers may cause a worse hazard rating than is predicted when using analytical approaches such as presented in Practice F2248 or in other methods.

1.6 The values stated in SI units are to be regarded as the standard. Values given in parentheses are for information only. For conversion of quantities in various systems of measurements to SI units, see IEEE/ASTM SI 10.

1.7 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

2. Referenced Documents

2.1 *ASTM Standards:*[2]

E631 Terminology of Building Constructions

F1642 Test Method for Glazing and Glazing Systems Subject to Airblast Loadings

F2248 Practice for Specifying an Equivalent 3-Second Duration Design Loading for Blast Resistant Glazing Fabricated with Laminated Glass

IEEE/ASTM SI 10 American National Standard for Metric Practice

3. Terminology

3.1 *Definitions of Terms Specific to This Standard:* Not included in Terminology E631.

3.1.1 *fragment*—particle of glazing, window component, or retrofit component with a mass equal to or greater than 1.5 g (0.0033 lbm).

3.1.2 *glazing*—transparent materials used for windows, doors, or other panels.

3.1.3 *glazing dust and slivers*—particles of glazing with a mass less than 1.5 g (0.0033 lbm).

3.1.4 *glazing system*—the assembly comprised of the glazing, its framing system, anchorage devices, attached trim, operators, and any other components that would be used to install a complete system or non-attached retrofit system.

3.1.5 *glazing pullout*—disengagement of the glazing from the frame member supporting the glazing.

3.1.6 *hazard level*—rating assigned to the performance of the glazing, glazing system and its components, and non-attached glazing system retrofit system and its components

[1] This specification is under the jurisdiction of ASTM Committee F12 on Security Systems and Equipment and is the direct responsibility of Subcommittee F12.10 on Systems Products and Services.

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[2] For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

based on the amount and location of integral materials expelled from the system under specific blast conditions of the test.

3.1.7 *peak positive pressure (P)*—the maximum measured positive phase airblast pressure, kPa (psi).

3.1.8 *positive phase impulse (i)*—the integral, over time, of the measured positive phase reflected airblast pressure history, kPa-ms (psi-ms).

3.1.8.1 *Discussion*—The airblast pressure history, whether reflected or otherwise, as measured at a point on the surface, consists of two separate phases. The positive phase for high explosive detonations is characterized by a nearly instantaneous rise to a maximum pressure followed by an exponential decay to ambient pressure. In the negative phase, which immediately follows the positive phase, the pressure decreases below ambient for a period of time before returning to ambient.

4. Classification

4.1 The classification of airblast resistant glazing is determined by the defined blast load and the performance of the glass or glazing system or glazing retrofit system when subjected to blast testing in accordance with Test Method F1642.

4.1.1 *Hazard Levels*—The hazard levels are identified and described in Table 1. Also, the hazard rating descriptions are shown graphically in Fig. 1 of Test Method F1642.

TABLE 1 Hazard Levels and Descriptions

Hazard Rating Description	Description of Fenestration Glazing Response	Hazard Level
No Break	The glazing is observed not to fracture and there is no visible damage to the glazing system or glazing retrofit system.	H1
No Hazard	The glazing is observed to fracture but is fully retained in the facility test frame or glazing system frame and the rear surface (the side opposite the airblast loaded side of the specimen) is unbroken.	H1
Minimal Hazard	The glazing is observed to fracture and the total length of tears in the glazing plus the total length of glazing pullout from the frame is less than 50 % of the glazing sight perimeter. Also, there are three or less perforations or indents anywhere in a vertical witness panel located 3 m (120 in.) from the interior face of the specimen and there are fragments with a total mass of 15 g (0.033 lbm) or less on the floor of the witness area between 0 to 1 m (0 to 40 in.) from the interior face of the specimen and no fragments in the witness area greater than 1 m (40 in.) from the interior face of the specimen.	H2
Very Low Hazard	The glazing is observed to fracture and fragments are located 1 m (40 in.) or less from the original interior surface of the specimen. Also, there are six or less perforations anywhere in a vertical witness panel located 3 m (120 in.) from the interior face of the specimen and there are fragments with a total mass of 15 g (0.033 lbm) or less on the floor of the witness area between 1 and 3 m (40 and 120 in.) from the interior face of the specimen.	H3
Low Hazard	The glazing is observed to fracture, and fragments generally fall between 1 and 3 m (40 and 120 in.) of the interior face of the specimen. Also there are 25 or less perforations 50 cm (20 in.) or less above the floor of a vertical witness panel located 3 m (120 in.) from the interior face of the specimen and 10 or less perforation high than 50 cm (20 in.) in a vertical witness panel located 3 m (120 in.) from the interior face of the specimen. For perforations in the vertical witness panel, up to 5 of the perforations may penetrate through the full thickness of the foil backed insulation board layer of the witness panel as defined in Test Method F1642.	H4
Moderate Hazard	The glazing is observed to fracture, and fragments generally fall between 1 and 3 m (40 and 120 in.) of the interior face of the specimen with numerous perforations and penetrations lower than 50 cm (20 in.) in a vertical witness panel located 3 m (120 in.) from the interior face of the specimen. Also there are 25 or less perforations 50 cm (20 in.) or higher above the floor of a vertical witness panel located 3 m (120 in.) from the interior face of the specimen. For perforations, in the vertical witness panel, up to 5 of the perforations may penetrate through the full thickness of the foil backed insulation board layer of the witness panel as defined in Test Method F1642.	H5
High Hazard	Glazing is observed to fracture and there are more than 25 perforations in the area of a vertical witness panel located 3 m (120 in.) from the interior face of the specimen and higher than 50 cm (20 in.) above the floor or there are more than 5 perforations in the same witness panel area with fragment penetration through the full thickness of the foil backed insulation board layer of the witness panel as defined in Test Method F1642.	N/A