



**Glass Informational Bulletin**

**GANA PGC 02-0509**

## **Blast Mitigating Glazing**

### **Introduction**

Blast mitigating glazing can substantially reduce injury from flying glass resulting from direct blast shock waves (over-pressures). When properly designed, framed, and anchored, blast resistant laminates are capable of maintaining the integrity of the building envelope following an explosion and reducing interior damage. Although there are other mechanisms of reducing the number of glass shards that enter a facility this document deals with factory fabricated glazing with at least two pieces of glass or plastic glazing bonded together with a high performance polymer interlayer.

### **Test Standards**

Blast resistant testing can be conducted on the entire glazed fenestration system. There are two North American test methods that are used for blast testing:

**ASTM F 1642** – *Standard Test Method for Glazing and Glazing Systems Subject to Airblast Loadings*

**GSA-TS01** - US General Services Administration *Standard Test Method for Glazing and Window Systems Subject to Dynamic Overpressure Loadings.*

The other standards related to blast resistant laminate design are:

**AAMA 510** – *Guide Specification for Blast Hazard Mitigation for Fenestration Systems*

**ASTM F 2248** - *Standard Practice for Specifying an Equivalent 3-Second Duration Design Loading for Blast Resistant Glazing Fabricated with Laminated Glass*

**UFC 4-010** - Unified Facilities Criteria / Department of Defense (DoD) *Anti-terrorism Standards for Buildings*

Blast tests typically describe the type of test, shock-tube or arena, the test site, apparatus and instrumentation, the specimen requirements and performance criteria. Both test methods and types of blast testing use a chamber and witness panel that is set behind the sample in which the glass shards may fly or fall during the test. The floor of this chamber and the witness panel are used to determine the hazard rating of the tested assembly. Both of these documents test glazing to a specified overpressure and impulse and rate the glass particles from the glazing at various

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hazard levels depending upon the amount, size and impact location of the glass particles. Ratings range from “no” or “low” hazard to “high” hazard. The test methods do not include or specify the blast requirements; overpressure, duration or impulse. These requirements must come from the test sponsor or specifying authority.

ASTM F 1642 sets forth procedures for the evaluation of hazards of glazing or glazing systems against air-blast loadings. This test method allows for glazing to be tested and rated with or without framing systems and is designed to test and rate 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, and film-backed glass.

GSA-TS01 is intended to ensure an adequate measure of standardization and quality assurance in the testing of window systems including but not limited to glazing, sealants, seats and seals, frames, anchorages and all attachments and/or secondary catcher or restraint mechanisms designed to mitigate the hazards from flying glass and debris. This standard is the sole test protocol by which blast resistant windows and related hazard mitigation technology and products shall be evaluated for facilities under the control and responsibility of the US General Services Administration (GSA). This test method has been adopted by the Interagency Security Committee (ISC). There are five GSA building classifications A through E and six performance levels 1, 2, 3A, 3B, 4 & 5 as depicted in Figure 1.

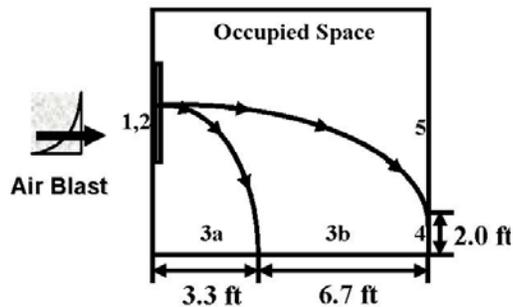


Figure 1. GSA/ISC performance conditions for window system response.

ASTM F 2248 is a practice for design and not a test method. It sets forth a method to specify an equivalent 3-second design loading suitable to use with ASTM E 1300 - *Standard Practice for Determining the Load Resistance of Glass in Buildings* to select the thickness and type of blast resistant glazing fabricated with laminated glass to glaze a fenestration. It applies to laminated glass only, including single laminated glass and insulating glass fabricated with laminated glass. It also assumes that the laminated glass will adhere to its supporting frame that restricts deflection of the edges of the glazing to  $L/160$  under the equivalent 3-second duration design loading and that structural silicone sealant or adhesive glazing tape are used. Therefore this practice cannot be used for dry-glazed, or gasket glazing.

#### UFC 4-010

*The Unified Facilities Criteria (UFC) Department of Defense (DoD) Minimum Antiterrorism Standards for buildings* provides prescriptive guidelines for ALL DoD buildings. It should be



noted carefully that this is the minimum standard and higher standards may apply depending on local conditions.

Section B 3.1 *Windows, Skylights and Glazed Doors* give minimum standards of construction. A minimum of 1/4" laminated glass containing a minimum of 0.030" PVB interlayer shall be used. This glass should be glazed with a 3/8" minimum bite if installed with a structural adhesive or glazed with a minimum of 1" bite if dry glazed. If insulating glass is required the laminated glass must be the inboard lite. This document also gives minimum standards for window framing and anchoring.

### **Test Reports**

Blast testing is performed using controlled practices and very rigid safety guidelines. There are several laboratories throughout North America that are capable of administering these tests. Test reports can be requested from the interlayer suppliers, laminators and systems manufacturers.

### **Certification Programs**

The American Architectural Manufacturers Association<sup>i</sup> (AAMA) offers an AAMA Licensed Security Fenestration Rating and Certification Program based on the AAMA 510-06 *Voluntary Guide Specification for Blast Hazard Mitigation for Fenestration Systems* and administered by Architectural Testing, Inc.<sup>ii</sup>

### **Conclusion**

Large scale arena testing and shock tube testing indicates that laminated glass when installed properly in a standard frame can withstand the published GSA/ISC performance values. Laminated glass in single and laminated insulating units can also perform at higher loads as described by GSA, ISC, DoD and DoS. The performance will vary based on the frame design, anchorage, glazing details, glass and interlayer type and thickness. Consult the manufacturer for specific information and achieved performance levels.

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