

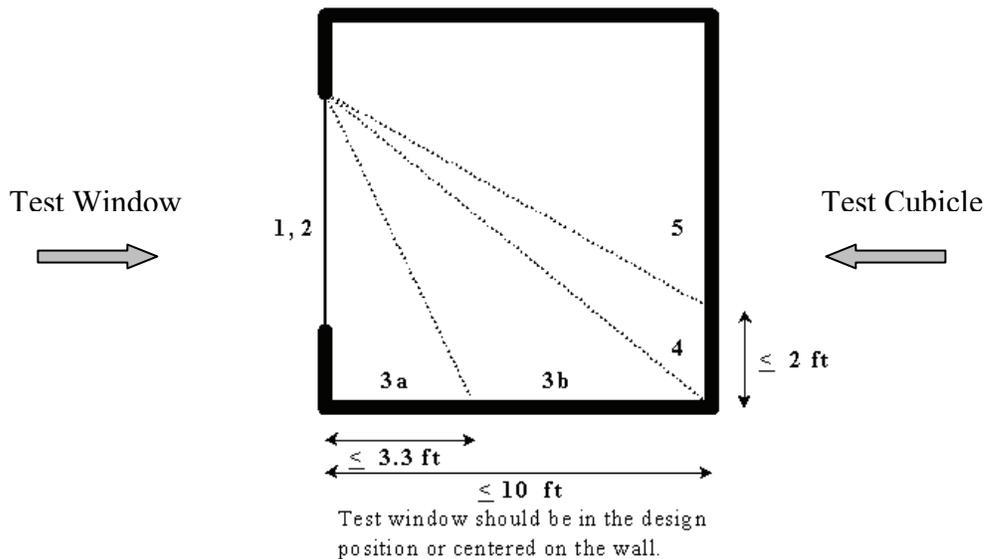
Blast Resistant Protection

Glazing and glazing systems subject to dynamic overpressure or air blast loading

The General Services Administration (GSA) and Interagency Security Committee (ISC) Security Criteria

Following the 1995 bombing of the A.P. Murrah Federal Building in Oklahoma City, the General Services Administration (GSA) established Security Criteria for glazing in all federal buildings. The establishment of these criteria has resulted in the increased use of blast resistant fenestration products in federal courthouses and similar government buildings. In order to expand the use of these criteria beyond the GSA, the Interagency Security Committee (ISC) developed the ISC Security Criteria. The ISC Security Criteria was recently adopted and approved for use in all GSA new buildings and major modernization projects. It requires that windows be designed to mitigate the hazard from flying glass fragments in the case of an explosive event. The intent of these criteria is to reduce (not necessarily eliminate) the potential hazards, recognizing that not all windows will survive a bomb attack. These criteria require that glazed window products meet performance levels that correspond to specific levels of protection.

The GSA and ISC glazing performance criteria are presented graphically in the figure below and are described in the table provided. The approach compares potential hazards based on the type and location of glass fragments interior and exterior to a test cubicle. These criteria reflect the velocity and distance glass fragments will project into an occupied space based on their distance from the window.



Cross-Section through test structure illustrating performance conditions

GSA/ISC (continued)

Performance Condition	Protection Level	Hazard Level	Description of Window Glazing Response
1	Safe	None	Glazing does not break. No visible damage to glazing or frame
2	Very High	None	Glazing cracks but is retained by the frame. Dusting or very small fragments near sill or on floor acceptable.
3a	High	Very Low	Glazing cracks. Fragments enter space and land on floor no further than 3.3 ft. from the window.
3b	High	Low	Glazing cracks. Fragments enter space and land on floor no further than 10 ft. from the window.
4	Medium	Medium	Glazing cracks. Fragments enter space and land on floor and impact a vertical witness panel at a distance of no more than 10 ft. from the window at a height no greater than 2 ft. above the floor.
5	Low	High	Glazing cracks and window system fails catastrophically. Fragments enter space impacting a vertical witness panel at a distance of no more than 10 ft. from the window at a height greater than 2 ft. above the floor.

GSA/ISC Glazing Protection Levels Based on Fragment Impact Locations

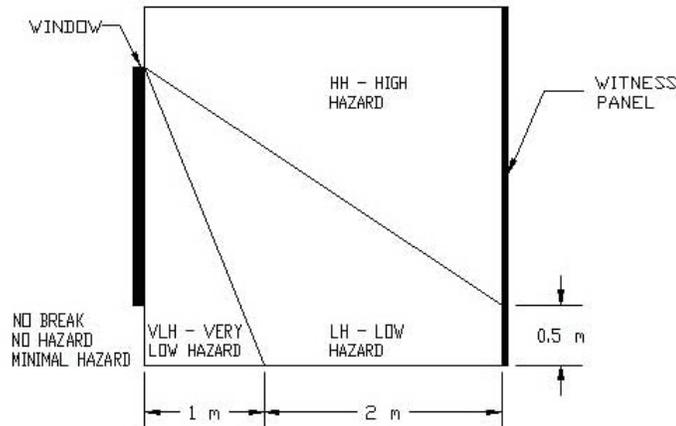
Additional military standards

In addition to the GSA and ISC criteria, blast resistance requirements are also called out in various military standards including:

- Navy Standard MIL-HDBK-1013, "Evaluation and Selection Analysis of Security Glazing for Protection Against Ballistic, Bomb and Forced Entry"
- Army Standard TM 5-853-3, "Security Engineering Final Design"
- Department of Defense (DoD), "Department of Defense Antiterrorism Construction Standards"
- Department of Defense (DoD), "Unified Facilities Criteria (UFC) – DoD Minimum Antiterrorism Standards for Buildings"

ASTM International Standards

ASTM International has developed ASTM F 1642-04 “Standard Test Method for Glazing and Glazing Systems Subject to Airblast Loading”. Similar to the GSA/ISC performance criteria it too establishes a testing method that evaluates levels of protection. These criteria require that glazed window products meet performance levels that correspond to specific levels of protection.



Cross-Section through witness area per ASTM 1642-04: Glazing and Glazing Systems Subject to Airblast Loading

Hazard Rating	Description	Fragments	
		1m to 3m	Witness Panel
No Break	Glazing is allowed to break and there is no visible damage to the framing system.	None	None
No Hazard	Glazing fractures but is fully retained in the facility test frame or glazing system frame and the rear surface is unbroken.	None	None.
Minimal Hazard	Glazing fractures and the total length of tears in the glazing plus the total length of pullout from the edge of the frame is less than 20 per cent of the glazing sight perimeter.	< 10 in. unified dimension	Three or less perforations from glazing slivers and no fragment indents
Very Low Hazard	Glazing fractures and is located within one (1) meter of the original location.	< 10 in. unified dimension	Three or less perforations from glazing slivers and no fragment indents
Low Hazard	Glazing fractures.	Glazing fragments generally fall between one (1) meter and three (3) meters	< 10 perforations 50 cm below the bottom of the specimen and none of the perforations penetrate through the full thickness of the witness panel
High Hazard	Glazing fractures.	One (1) meter and three (3) meters	> 10 perforations in the area of the witness panel and one or more fragments penetrate fully through the witness panel

ASTM 1642-04: Glazing and Glazing Systems Subject to Airblast Loadings Hazard Ratings

Recap of Standards

Products that meet these standards include glazed systems designed to protect the occupants of a building from flying glass fragments as a result of a bomb blast event. Blast resistant products consist of laminated glass infill within standard aluminum frames anchored to the surrounding building. In general, air blast pressures, impulses, and/or durations vary project-to-project. These pressures are not static but do occur at very short durations. Because of the short load duration, a simple conversion to uniform static pressure cannot be made.

Kawneer is committed to work with building owners, architects, structural engineers, consultants, and/or general contractors to evaluate blast resistant projects. Even though initial product requirements can be made with limited information; project specific details and specifications need to be developed with the assistance of an experienced blast consultant. Kawneer application engineers are available to assist in proper product evaluation and selection.

The engineering and customer service teams in our Harrisonburg, VA office have been involved with blast projects for over five years. With years of engineering experience and data collected from Open Air Arena Blast Testing, Kawneer can offer engineered solutions to protect against a range of blast events.
