COMMERCIAL
WINDOW SHIELD

Headquarters:
9292 Pence Highway
Blissfield, MI 49228

Southern Office:
Bonita Springs, FL

EXPLOSIVE BLAST TESTS PER GSA SECURITY CRITERIA

Test Site: Chestnut Test Site, Kirtland Air Force Base, New Mexico, Owned and Operated by Defense Threat Reduction Agency

Conducted By: Applied Research Associates, Inc., Security Engineering Group

Date: February 2000

Summary: A number of high explosive tests were conducted in an open air environment to determine the hazard mitigation value of safety and security films applied to commercially available windows with annealed glass.

These films were tested with and without "anchoring (attachment)" systems. The results demonstrated that glass filmed by Commercial Window Shield provided significant hazard reduction with regard to flying glass due to explosive blast loads. The films tested met the GSA Security Criteria for Level C buildings for the tested configuration. Certain tested films met the overpressure requirements of the Level D buildings but, due to range restrictions, were only tested to 60% of the impulse requirements.

The executive summary follows. For a copy of the full report, contact Commercial Window Shield.

PH: 517-443-5967
FAX: 517-443-5968
www.commercialwindowshield.com
EM: info@commercialwindowshield.com

EXECUTIVE SUMMARY

In response to the heightened concern about terrorism, the US Government and private industry are developing and testing new technologies to mitigate hazards to people in the vicinity of a terrorist bombing. In cooperation with the Defense Threat Reduction Agency, Applied Research Associates conducted tests to assess the capability of security window film to reduce the hazards of flying glass shards during an explosion. Propelled by the forces of a terrorist bomb, glass fragments cause large numbers of serious injuries.

The US General Services Administration (GSA) developed criteria for evaluation of acceptable levels of protection from the glass fragment hazards in a terrorist bombing. These criteria are part of the comprehensive security criteria (GSA Security Criteria, Final Working Version, January 1997) developed by the GSA, which includes physical security, electronic security, and many other criteria for blast considerations. The GSA has indicated that manufacturers must test their window products against the criteria to evaluate the performance of these products in blast if they want to be considered for use in GSA buildings. The current GSA Test Procedure is included in Appendix A.

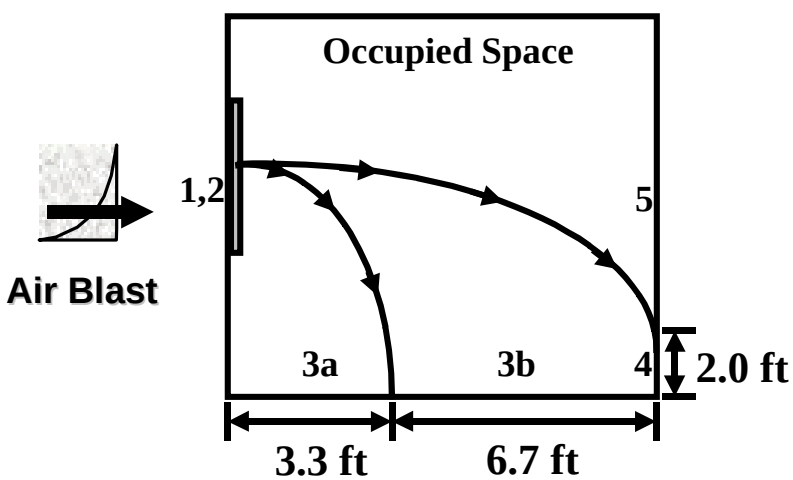
MSC Specialty Films Inc. commissioned ARA to perform a series of five open-air high explosive tests in order to evaluate the performance of security window film products. The tests were conducted from February 15 to March 3, 2000. Four windows were evaluated in each test for a total of 20 windows. The test data collected in this effort will provide useful information for many other government and civilian entities, both domestic and foreign, that are responsible for security planning of building facilities.

The test used the GSA protocol in Appendix A. The windows were mounted in enclosed concrete reaction structures. The response of each window was captured with high-speed film and still photography. An exterior high-speed camera and an exterior normal-speed video camera were used to capture the views of the structures and the explosive detonation for each test. The reaction structures were instrumented with pressure gages to measure the exterior reflected pressure on the specimens and the internal pressure in the structures.

The test charge was 600 lb of Ammonium Nitrate and Fuel Oil (ANFO), which is equivalent to 500 lb of TNT. The standoff distance to the structures was varied to affect specific peak pressures on the test specimens.

A thorough test matrix was developed to explore the effect of film thickness and attachment method on window response. The nominal window size for the tests was 4 ft by 5-1/2 ft. One-fourth inch thick annealed glass was used during testing. The windows were tested in commercially available aluminum storefront window frames. The glass type and film attachment method for each window is given in the summary and test description for each test.

The GSA glass fragment hazard rating scheme is presented graphically and is described in the table which follows. The approach compares potential hazards based on the type and location of glass fragments interior and exterior to the test cubicle. These criteria indirectly reflect the velocity (hence hazard level) of fragments based on their distance from the original window position.



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.

The results of the tests are documented in the following tables. MSC Specialty Films Inc. safety/security films provided significant reductions in glass fragment hazards versus unprotected windows. The films performed well at mitigating hazard in monolithic, ¼ inch annealed glass window systems. Different film attachment methods performed to specified criteria for GSA Level C buildings up to a 4 psi (28 psi-msec) peak blast pressure. Thicker film with attachment system performed to a GSA performance condition 3 at 10 psi and 48 psi-msec.