Description of Test Specimens

For blast testing, Avery Dennison Hanita provided the windows fully assembled and installed in a 4.5 inch aluminum frame. The layup was a ¼" annealed glass with clear span dimensions of 48" wide by 66" high. Eight mil safety zone film was applied to the interior side with a daylight (unanchored) application. Window system assemblies were captured directly in the test fixture with steel angles at the head and sill; the jambs were not supported.

Test Results and Certifications

Window performance conditions were assigned in accordance with the performance criteria in ASTM F 1642-12[1], GSA TS01-2003[2], and ISO 16934[3] test protocol. Figure 1 and Table 1 summarize the performances of the test. Table 2 provides the overall window classification.

Pre-Shot Photograph

Post-Shot Photograph

Figure 1. Before and After Photographs of Typical Window System

Table 1: Test Results Summary

Test Specimen	Window 04
Damage Description	Glazing fractured and was fully released from frame. No measurable indents or perforations were noted in the witness panels.
Average Pressure (psi)	5.1
Average Impulse (psi-ms)	31
GSA Performance	3B
ASTM Performance	Low Hazard
ISO Performance	E

Table 2: Window System Classification for 8-Mil Safety Zone with Daylight Application

GSA	**3B**
ASTM F-1642	**N/A***
ISO 16934	**N/A***

* Test standard requires 3 tests for classification.

Approved:

Jeffrey Goodman
Engineer II
ABS Consulting

ABSG Consulting Inc. • 140 Heimer Rd, Suite 300 • San Antonio, TX 78232 USA • Tel: 210-495-5195 • www.abs-group.com

Test Approach and Procedure

ABSG Consulting, Inc. conducted testing of select blast resistant window retrofits for Avery Dennison Hanita. The objective of the testing was to determine the performance of window systems subjected to blast loads. A total of ten tests were conducted on four different window retrofits systems as part of project number 3615475. This report covers test 04. Testing was conducted at ABS Consulting's shock tube facility at 9092 Green Rd, Converse, Texas, 78109 USA on January 18 of 2016.

Tests were conducted in accordance with the protocol defined in ASTM F1642-12[1], US General Services Administration (GSA)[2], and International Organization for Standardization (ISO)[3]. A test enclosure, nominally 10 feet deep, 10 feet wide and 10 feet tall, was placed flush with the end of the tube. A witness panel was provided on the back wall to detect the impact of glass shards. Composition of the witness panel was in accordance with ASTM-1642. All of the windows were tested at a height of 24 inches above the floor (fragment collecting surface). Following each test, glass fragments were collected and the unified dimensions of fragments projected into the test cubicle were determined. Fragments striking and embedding in the witness panel were collected and documented. Frame deflections and performance were also recorded.

Applied Blast Load

Blast loads were applied using a "shock tube" as shown in Figure 2. This device uses a sudden burst of compressed air to create a blast pulse, which travels down the tube and is applied to a secured test specimen at the end of the tube. The target load was 4.0 psi and 28 psi-ms.

Four blast pressure gauges were mounted on the shock tube bulkhead immediately adjacent to the test specimens. Blast pressures gauges were piezoelectric type calibrated for a range of 0-10 psi. Pressure waveforms were recorded at a minimum frequency of 500 kHz. Figure 3 show the time dependent average load for the test.

Figure 2. ABS Consulting Shock Tube System

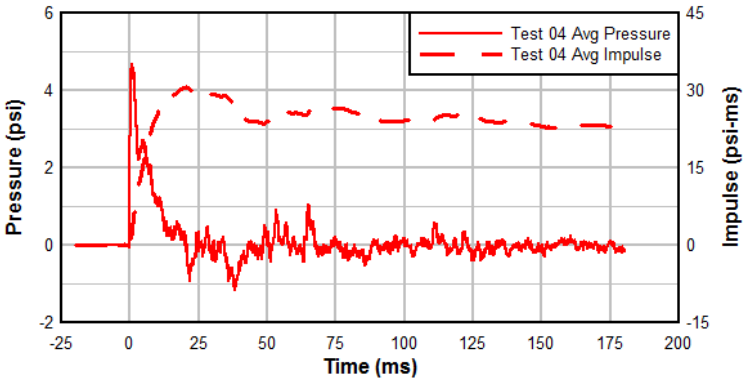

Figure 3. Time Dependent Average Load for Test 04

[1] ASTM Standard, F 1642-12 "Standard Test Method for Glazing and Glazing Systems Subject to Airblast Loadings," ASTM Book of ASTM Standards, Vol. 04.07, 2012.

[2] US General Services Administration (GSA), GSA-TS01-2003, "Standard Test Method for Glazing and Glazing Systems Subject to Dynamic Overpressure Loadings," GSA, January, 2003.

[3] International Organization for Standardization, ISO 16934, "Glass in building - Explosion-resistant security glazing - Test and classification by shock-tube loading," 2012.