

1. INTRODUCTION

Wilfred Baker Engineering, Inc. (WBE) was contracted by Film Technologies International, Inc. (FTI) to test the performance of their batted safety film under blast load conditions. Tests were performed on two variations of batten systems provided by CHB Industries and Window Lock™. All specimens were tested on October 15 and 16, 1998 at WBE's shock tube facility located in Elmdorf, Texas. WBE utilized an 8 ft x 8 ft shock tube to produce blast loads for all tests.

The objective of the test program was to determine the performance of the batted safety film when subjected to the design blast loads for Level C and Level D Waterways Experiment Station (WES) Test Series.

Performance was evaluated by comparing residual glass fragment hazards with criteria developed by the Security Facilities Executive (SFE) in the United Kingdom and incorporated into GSA's glazing performance criteria. The criteria defines three hazard levels corresponding to Break Safe (1 and 2), Low Hazard (3a, 3b, and 4), and High Hazard (5) levels. See Figure 1.1 for classification sketch.

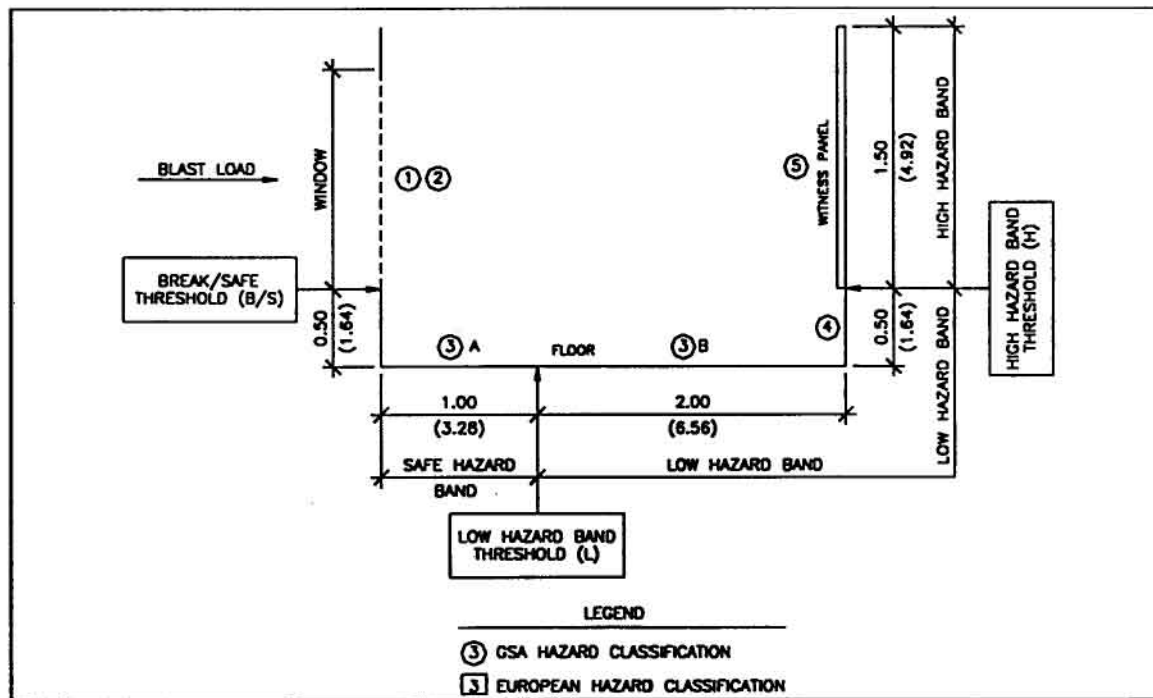


Figure 1.1 Classification Sketch

2. SPECIMEN INFORMATION

FTI provided nine window specimens with several different configurations. The following is a brief description of each test:

Test No. 1 - the first window specimen had a 7 mil, single ply film applied to the window. The film overlapped the frame and was battened on all four sides. The batten system was anchored with 1/4" Tek screws at 2" on center. The window system was supported in the sub-frame at the top and bottom only.

Test No. 2 - the second window specimen had a 7 mil, single ply film applied to the window. The film overlapped the frame and was battened on all four sides. The batten system was anchored with 1/4" Tek screws at 2" on center. The window system was supported in the sub-frame on all four sides.

Test No. 3 - the third window specimen had a 7 mil, single ply film applied to the window. The film overlapped the frame and was battened on all four sides. The batten system was placed 1/2" from the glass and anchored with 1/4" Tek screws at 4" on center. The 1/2" opening was filled with Lock Glaze™ silicone. The window system was supported in the sub-frame on all four sides.

Test No. 4 - the fourth window specimen had a 14 mil, three ply film applied to the window. The film overlapped the frame and was battened on all four sides. The batten system was placed 1/2" from the glass and anchored with 1/4" Tek screws at 2" on center. The 1/2" opening was filled with foam. The window system was supported in the sub-frame on all four sides.

Test No. 5 - the fifth window specimen had a 12 mil, three ply film applied to the window. The film overlapped the frame and was battened along the vertical sides. The batten system was anchored with 1/4" Tek screws at 2" on center. The window system was supported in the sub-frame on all four sides.

Test No. 6 - the sixth window specimen had a 12 mil, three ply film applied to the window. The film overlapped the frame and was battened on all four sides. The batten system was anchored with 1/4" Tek screws at 2" on center. The window system was supported in the sub-frame on all four sides.

Test No. 7 - the seventh window specimen had a 19 mil, three ply film applied to the window. The film overlapped the frame and was battened on all four sides. The batten system was placed 1/2" from the glass and anchored with 1/4" Tek screws at 2" on center along the vertical edges and at the top. The bottom batten system was anchored with 1/4" Tek screws at 14" on center. The 1/2" opening was filled with Lock Glaze™ silicone. The window system was supported in the sub-frame on all four sides.

Test No. 8 - the eighth window specimen had a 7 mil, single ply film applied to the window. The film overlapped the frame and was battened on all four sides. The batten system was placed 1/4" from the glass and anchored with 1/4" Tek screws at 4" on center along the vertical edges and 14" on center at the top and bottom. The 1/4" opening was filled with Lock Glaze™ silicone. The window system was supported in the sub-frame on all four sides.

Test No. 9 - the ninth window specimen had a 19 mil, three ply film applied to the window. The film overlapped the frame and was battened on the top and bottom. The batten system was anchored with 1/4" Tek screws at 2" on center along the bottom and the top had a 2" reservoir of film secured to the cap plate with 1/4" Tek screws at 4" on center. The window system was supported in the sub-frame on all four sides.

A summary of the test results are shown in Table 1. The pressure-time histories are included in Appendix A.

Table 1. Summary of Test Results

Test No.	Film Thickness (mil)	Pressure (psi)	Duration (ms)	Impulse (psi-ms)	Hazard Level Confirmation	Results
1	7	4.1	36.6	72.8	High, 5	Window frame rotated out of sub-frame, film tore along CHB's batten system
2	7	4.0	30.1	58.5	High, 5	Film tore along vertical edges of CHB's batten system but remained in the frame, one shard impact 4" above the level 4 line
3	7	4.0	36.2	71.7	High, 5	Film tore horizontally at mid height and along vertical edges of Window Lock's batten system but remained in the frame, several shard impacts above the level 4 line
4	14	4.0	31.2	67.3	High, 5	Film tore along the right vertical edge and at the top of Window Lock's batten system but remained in the frame, several shard impacts above the level 4 line
5	12	4.0	31.2	67.3	High, 5	Film was battened along the vertical edges with CHB's batten system and was dislodged from frame
6	12	4.0	43.1	81.0	High, 5	Film tore along bottom edge and in the corners of CHB's batten system but remained in the frame, one shard impact 1" above the level 4 line
7	19	4.0	42.1	68.4	High, 5	Film tore along vertical edges and at the top of Window Lock's batten system but remained in the frame, several shard impacts above the level 4 line
8	7	4.1	25.5	60.8	High, 5	Framed window dislodged from the sub-frame and struck the witness panel
9	19	4.0	23.5	52.3	High, 5	Film was battened along the top and bottom with the top having a reservoir. The system remained in the frame, several shard impacts above the level 4 line