TEST 1 SUMMARY

Date:	12 January 1998
Nominal Charge Weight, lb ANFO:	600.0
Standoff to each structure, ft:	190
Avg. Measured Peak Pressure, psi:	4.2
Avg. Measured Positive Impulse, psi-ms:	28.4
Time of Detonation:	14:00
Ambient Temperature, deg F:	58.0

	Window 1	Window 2	Window 3	Window 4
Specimen Description	1/4-in. mono AG, Ultra 400, day-lite	1/4-in. mono AG, Ultra 400, 4-sided batten	1/4-in. mono AG, 7-mil film, 4-sided batten	1/4-in. mono AG, no film
Damage Description	Glazing failed and window left frame, landed 18 inches from front of structure	Glazing failed and film tore with most film retained in frame	Glazing failed and film tore but was retained in the frame, film pulled out of batten at left edge	Glazing failed and most glass entered the structure at high velocity
Glass Fragment Locations	Small dicing and a few fragments inside, no impact on witness panel, frags to 20 ft in front of structure, about 95-97% glass retained on film	Small dicing and a few fragments inside, no impact on witness panel, frags to 26 ft in front of structure, large piece of film and glass 12 inches from front of structure, about 40% glass retained on film	Small dicing and a few fragments inside, no impact on witness panel, about 5-10% glass retained on film, frags to 78 ft in front of structure	~95% glass entered structure with 5% outside to about 12 ft in front of structure, 98 impact on witness panel- 82 below 2-ft height and 16 above 2-ft height
Fragment Hazard to Occupants	Minor hazard to occupants within 10 ft behind window	Minor hazard to occupants within 10 ft behind window	Minor hazard to occupants within 10 ft behind window	Significant hazard to persons within 10-15 ft behind window
Condition	3-SHR	3-SHR	3-SHR	5

Test Notes:

1) Windows were mounted in heavy steel frames unless otherwise noted.
2) Window sizes for all steel framed windows were: pane = 48 x 66 inches; clear opening = 46 x 64 inches.
3) Window sizes for aluminum framed windows were: pane = 46-1/8 x 64-1/8 inches; clear opening = 45.5 inches x 63.5 inches.
4) AG = annealed glass, HSG = heat strengthened glass, TTG = thermally tempered glass.
5) Witness panels were located 116 inches behind window.
6) Percentages reported are percentage of all glass from a specimen unless otherwise noted.
7) The SHR stands for significant-hazard-reduction. This designation is used to distinguish a significantly reduced glass fragment hazard obtained with a protective window system versus a highly hazardous uncontrolled failure with no protective measure that is given the same GSA hazard condition. The SHR designation can be given for GSA conditions 3-5.

TEST 2 SUMMARY

Date:	13 January 1998
Nominal Charge Weight, lb ANFO:	600.0
Standoff to each structure, ft:	190
Avg. Measured Peak Pressure, psi:	4.1
Avg. Measured Positive Impulse, psi-ms:	28.7
Time of Detonation:	12:30
Ambient Temperature, deg F:	49.0

	Window 1	Window 2	Window 3	Window 4
Specimen Description	1/4-in. mono HSG, Ultra 400, 4-sided batten	1/4-in. mono TTG, Ultra 400, 4-sided batten, aluminum frame	1/4-in. mono AG, Ultra 400, 4-sided batten, aluminum frame	1/4-in. mono AG, Ultra 400, 2-vertical sided batten
Damage Description	Glazing failed and film tore but was retained in frame	Glazing failed and film tore in one corner but was retained in frame, aluminum frame bent inward at jambs	Glazing failed and film tore across the middle with most film retained in frame, aluminum frame bent inward at jambs	Glazing failed and film tore, most film with glass attached landed about 34 inches in front of structure
Glass Fragment Locations	A few fragments inside, no impact on witness panel, frags to 73 ft in front of structure, about 30% glass retained on film	A few fragments inside, no impact on witness panel, frags to 42 ft in front of structure, about 20% glass retained on film	Several fragments inside structure, 7 impact on witness panel, about 5-10% glass retained on film, frags to 68 ft in front of structure, large piece film/glass to 15 ft in front of structure	A few fragments inside, no impact on witness panel, frags to 22 ft in front of structure
Fragment Hazard to Occupants	Minor hazard to occupants within 10 ft behind window	Minor hazard to occupants within 10 ft behind window	"hit or miss" hazard to persons within 10-15 ft behind window	Minor hazard to occupants within 10 ft behind window
Condition	3-SHR	3-SHR	5-SHR	3-SHR

Test Notes:

1) Windows were mounted in heavy steel frames unless otherwise noted.
2) Window sizes for all steel framed windows were: pane = 48 x 66 inches; clear opening = 46 x 64 inches.
3) Window sizes for aluminum framed windows were: pane = 46-1/8 x 64-1/8 inches; clear opening = 45.5 inches x 63.5 inches.
4) AG = annealed glass, HSG = heat strengthened glass, TTG = thermally tempered glass.
5) Witness panels were located 116 inches behind window.
6) Percentages reported are percentage of all glass from a specimen unless otherwise noted.
7) The SHR stands for significant-hazard-reduction. This designation is used to distinguish a significantly reduced glass fragment hazard obtained with a protective window system versus a highly hazardous uncontrolled failure with no protective measure that is given the same GSA hazard condition. The SHR designation can be given for GSA conditions 3-5.

TEST 3 SUMMARY

Date:	14 January 1998
Nominal Charge Weight, lb ANFO:	600.0
Standoff to each structure, ft:	165
Avg. Measured Peak Pressure, psi:	5.3
Avg. Measured Positive Impulse, psi-ms:	33.4
Time of Detonation:	12:00
Ambient Temperature, deg F:	46.0

	Window 1	Window 2	Window 3	Window 4
Specimen Description	1/4-in. mono TTG, Ultra 400, 4-sided batten	1/4-in. mono TTG, Ultra 600, 4-sided batten	1/4-in. mono HSG, Ultra 600, 4-sided batten	1/4-in. mono TTG, Ultra 400, day-lite
Damage Description	Glazing failed and film tore significantly but was retained in frame wadded at sill	Glazing failed and film was retained intact in frame, small tear in corner and 10-inch film pullout on right edge	Glazing failed and film tore at vertical edges with all film retained in frame	Glazing failed, window left frame and landed inside structure with one corner protruding to outside
Glass Fragment Locations	A few fragments inside to back of structure, no impact on witness panel, frags to 56 ft in front of structure	Dusting/small fragments on sill, frags to 43 ft in front of structure, about 50% glass retained on film	A few fragments inside to back of structure, no impact on witness panel, frags to 89 ft in front of structure, most glass left film on rebound	A few fragments inside to back of structure, no impact on witness panel, frags to 33 ft in front of structure
Fragment Hazard to Occupants	Minor hazard to occupants within 10 ft behind window	No hazard to occupants	Minor hazard to occupants within 10 ft behind window	Minor hazard to occupants within 10 ft behind window
Condition	3-SHR	2	3-SHR	3

Test Notes:

1) Windows were mounted in heavy steel frames unless otherwise noted.
2) Window sizes for all steel framed windows were: pane = 48 x 66 inches; clear opening = 46 x 64 inches.
3) Window sizes for aluminum framed windows were: pane = 46-1/8 x 64-1/8 inches; clear opening = 45.5 inches x 63.5 inches.
4) AG = annealed glass, HSG = heat strengthened glass, TTG = thermally tempered glass.
5) Witness panels were located 116 inches behind window.
6) Percentages reported are percentage of all glass from a specimen unless otherwise noted.
7) The SHR stands for significant-hazard-reduction. This designation is used to distinguish a significantly reduced glass fragment hazard obtained with a protective window system versus a highly hazardous uncontrolled failure with no protective measure that is given the same GSA hazard condition. The SHR designation can be given for GSA conditions 3-5.

TEST 4 SUMMARY

Date:	15 January 1998
Nominal Charge Weight, lb ANFO:	600.0
Standoff to each structure, ft:	190
Avg. Measured Peak Pressure, psi:	4.1
Avg. Measured Positive Impulse, psi-ms:	29.0
Time of Detonation:	12:30
Ambient Temperature, deg F:	51.8

	Window 1	Window 2	Window 3	Window 4
Specimen Description	1/4-in. mono AG, Ultra 600, 4-sided batten	1/4-in. mono TTG, Ultra 400, 4-sided wet glaze, aluminum frame	1/4-in. mono AG, Ultra 400, 4-sided wet glaze, aluminum frame	1/4-in. mono TTG, Ultra 400, 4-sided batten
Damage Description	Glazing failed and film tore in u-shape in the middle but was completely retained in frame	Glazing failed and film was retained intact in frame with no openings, aluminum frame bowed on all sides	Glazing failed and film was pulled from frame on top left corner with all film retained in frame, aluminum frame bowed on vertical edges	Glazing failed and film was retained intact in frame, film pulled out of batten about 22 inches each vertical edge
Glass Fragment Locations	A few fragments inside to back of structure, no impact on witness panel, frags to 44 ft in front of structure	No fragments inside structure, frags to 47 ft in front of structure, about 30% glass retained on film	A few fragments inside 2/3 to back of structure, no impact on witness panel, frags to 74 ft in front of structure, about 10-15% glass retained on film	Small dicing on floor almost to back of structure, no impact on witness panel, frags to 37 ft in front of structure, about 60% glass retained on film
Fragment Hazard to Occupants	Minor hazard to occupants within 10 ft behind window	No hazard to occupants	Minor hazard to occupants within 10 ft behind window	Minor hazard to occupants within 10 ft behind window
Condition	3	2	3-SHR	3-SHR

Test Notes:

1) Windows were mounted in heavy steel frames unless otherwise noted.
2) Window sizes for all steel framed windows were: pane = 48 x 66 inches; clear opening = 46 x 64 inches.
3) Window sizes for aluminum framed windows were: pane = 46-1/8 x 64-1/8 inches; clear opening = 45.5 inches x 63.5 inches.
4) AG = annealed glass, HSG = heat strengthened glass, TTG = thermally tempered glass.
5) Witness panels were located 116 inches behind window.
6) Percentages reported are percentage of all glass from a specimen unless otherwise noted.
7) The SHR stands for significant-hazard-reduction. This designation is used to distinguish a significantly reduced glass fragment hazard obtained with a protective window system versus a highly hazardous uncontrolled failure with no protective measure that is given the same GSA hazard condition. The SHR designation can be given for GSA conditions 3-5.

TEST 5 SUMMARY

Date:	16 January 1998
Nominal Charge Weight, lb ANFO:	600.0
Standoff Windows 1 and 4, ft:	122.2
Standoff Windows 2 and 3, ft:	121
Avg. Measured Peak Pressure, psi:	9.1
Avg. Measured Positive Impulse, psi-ms:	49.6
Time of Detonation:	11:30
Ambient Temperature, deg F:	49.0

	Window 1	Window 2	Window 3	Window 4
Specimen Description	3/8-in. mono TTG, Ultra 400, 4-sided batten	1/2-in. mono TTG, Ultra 600, 4-sided batten	1/2-in. mono TTG, Ultra 400, 4-sided batten	3/8-in. mono TTG, Ultra 400, day-lite
Damage Description	Glazing failed and film tore across top and right edge but retained in frame	Glazing failed and film was retained intact in frame with no openings	Glazing failed and film tore along right edge and a hole developed on left of window, all film retained in frame	Glazing failed and left frame in one piece with no tearing of film, landed 46 inches in front of structure
Glass Fragment Locations	A few fragments inside contained in front 2/3 of structure, no impact on witness panel, frags to 51 ft in front of structure, about 40-50% glass retained on film	No fragments inside structure, frags to 34 ft in front of structure, about 5-10% glass retained on film	Several fragments inside, 20 fragment impact on witness panel– 7 below 2-ft height, 13 above 2-ft height, about 5% glass retained on film	A few fragments inside back to mid structure, few frags to 23 ft in front of structure, about 90-95% glass retained on film
Fragment Hazard to Occupants	Minor hazard to occupants within 10 ft behind window	No hazard to occupants	Moderate "hit or miss" hazard to persons within 10-15 ft behind window	Minor hazard to occupants within 10 ft behind window
Condition	3	2	5-SHR	3-SHR

Test Notes:

1) Windows were mounted in heavy steel frames unless otherwise noted.
2) Window sizes for all steel framed windows were: pane = 48 x 66 inches; clear opening = 46 x 64 inches.
3) Window sizes for aluminum framed windows were: pane = 46-1/8 x 64-1/8 inches; clear opening = 45.5 inches x 63.5 inches.
4) AG = annealed glass, HSG = heat strengthened glass, TTG = thermally tempered glass.
5) Witness panels were located 116 inches behind window.
6) Percentages reported are percentage of all glass from a specimen unless otherwise noted.
7) The SHR stands for significant-hazard-reduction. This designation is used to distinguish a significantly reduced glass fragment hazard obtained with a protective window system versus a highly hazardous uncontrolled failure with no protective measure that is given the same GSA hazard condition. The SHR designation can be given for GSA conditions 3-5.

TEST 6 SUMMARY

Date:	19 January 1998
Nominal Charge Weight, lb ANFO:	600.0
Standoff Windows 1 and 4, ft:	122.2
Standoff Windows 2 and 3, ft:	121
Avg. Measured Peak Pressure, psi:	9.0
Avg. Measured Positive Impulse, psi-ms:	49.6
Time of Detonation:	12:30
Ambient Temperature, deg F:	50.8

	Window 1	Window 2	Window 3	Window 4
Specimen Description	1/4-in. mono TTG, Ultra 400, day-lite	1/4-in TTG + 1/2-inch air gap + 1/4-inch TTG, Ultra 400, 4-sided batten	1/4-in TTG + 1/2-inch air gap + 1/4-inch TTG, Ultra 600, 4-sided batten	1/4-in TTG + 1/2-inch air gap + 1/4-inch TTG, no film
Damage Description	Glazing failed, film tore but left frame in one piece and impacted witness panel	Glazing failed and film tore along right and bottom edge, film retained in frame	Glazing failed and film retained intact in frame with no openings	Glazing failed and most glass entered the structure at high velocity
Glass Fragment Locations	Window impact mark at 30-inch height, >100 impact on witness panel, few frags to 12 ft in front of structure, 70-80% glass retained on film	Few fragments inside structure, no impact on back wall, frags from window 2 & 3 undiscernible – scatter to 61 ft in front of structure, about 80% glass from inner lite retained on film	No glass inside structure, frags from window 2 & 3 undiscernible – scatter to 61 ft in front of structure, 20% glass from inner lite retained on film	130 impact on witness panel – 72 above 2-ft height, 58 below 2-ft height, less than 20% glass outside to 22 ft in front of structure
Fragment Hazard to Occupants	Significant hazard to persons within 10-15 ft behind window	Minor hazard to occupants within 10 ft behind window	No hazard to occupants	Significant hazard to persons within 10-15 ft behind window
Condition	5	3-SHR	2	5

Test Notes:

1) Windows were mounted in heavy steel frames unless otherwise noted.
2) Window sizes for all steel framed windows were: pane = 48 x 66 inches; clear opening = 46 x 64 inches.
3) Window sizes for aluminum framed windows were: pane = 46-1/8 x 64-1/8 inches; clear opening = 45.5 inches x 63.5 inches.
4) AG = annealed glass, HSG = heat strengthened glass, TTG = thermally tempered glass.
5) Witness panels were located 116 inches behind window.
6) Percentages reported are percentage of all glass from a specimen unless otherwise noted.
7) The SHR stands for significant-hazard-reduction. This designation is used to distinguish a significantly reduced glass fragment hazard obtained with a protective window system versus a highly hazardous uncontrolled failure with no protective measure that is given the same GSA hazard condition. The SHR designation can be given for GSA conditions 3-5.