ABS Consulting
AN ABS GROUP COMPANY

MADICO

Shock Tube Testing of CL-700 & LCL-800 Film with C-Bond Adhesive

May 2011
San Antonio, Texas

ABS Consulting Project Number 2548874

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Table of Contents

Introduction

ABSG Consulting, Inc. (ABS Consulting) conducted testing of various window systems for Madico Inc. (Madico). Table 1 lists the tested films. Tests were conducted in accordance with testing protocol in ASTM F1642-04[1] and US General Services Administration (GSA)[2]. The objective of the testing was to determine the performance of window systems subjected to blast loads required to meet the Unified Facilities Criteria (UFC)[3] and GSA requirements. Testing was conducted at the ABS Consulting facilities in San Antonio, Texas, USA. Testing was performed on April 4-14 of 2011.

Table 1. Tested Window Systems

Test Group	No. Windows Tested	Model #	Description
C-Bond	5	LCL800	25 gsm, 0.008 in. thick, C-Bond Adhesive
C-Bond	5	CL700	25 gsm, 0.008 in. thick, C-Bond Adhesive

Test Approach

Blast loads were applied using a "shock tube" as shown in Figure 1. This device uses a sudden burst of compressed air to create a blast pulse, which travels down the tube and is applied to the test specimen which is secured to the end of the tube. An enclosure (test cubicle) is attached to the end of the tube. The blast load creates a specified positive blast pressure and impulse on the test specimens. Negative phase blast loads may occur but the system is not designed to produce a negative pulse typical of a high explosive load. Testing commenced with blast loads designed to meet the various threat – standoff combinations as described in the UFC. The same blast pressure was applied to each specimen.

[1] ASTM Standard, F 1642-04, "Standard Test Method for Glazing and Glazing Systems Subject to Airblast Loadings," ASTM Book of ASTM Standards, Vol. 04.07, March 2004.
[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] Department of Defense (DoD), Unified Facilities Criteria (UFC) UFC4-010-01, "DoD Minimum Antiterrorism Standards for Buildings," DoD, October 2003.

Figure 1. ABS Consulting Shock Tube Apparatus

Fixtures and Specimens

Madico provided the windows fully assembled. ABS Consulting personnel measured framing and glazing dimensions and confirmed glass type for all window assemblies. The typical layup consisted of a 1/4-in thick lite of annealed glass with a single sheet of film attached to the frame with Madico FrameGard or Dow 995 wet glaze on all four sides.

Window frame assemblies were installed into the shock tube. Steel angles and plates were used to support the frame to prevent lateral displacement. This configuration simulates a window system installed in the field through the head and sill only.
Figure 2 shows a window mounted in the ABS shock tube. A close-up view of the shock tube mounting restraint is shown in Figure 3.

Figure 2. Window Mounted in Test Fixture

Figure 3. Close-up View of Mounting Restraints

The test enclosure, nominally 10 feet deep, 10 feet wide and 10 feet tall, was placed flush with the end of the tube. A bulkhead plate on the end of the tube prevented blast pressures from

wrapping around the structure and reaching the back side of the window. This represents a typical window installation on an exterior wall. 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.

Blast pressure gauges (gauges 1-5) measuring applied pressure were mounted on the shock tube bulkhead facing the oncoming blast wave, immediately adjacent to the test specimen (see Figure 4). A blast gauge (gauge 6) was also mounted inside the test cubicle to measure internal incident blast pressure. Blast pressures gauges were PCB 102A piezoelectric type calibrated for 0-10 psi peak pressure range. Pressure waveforms were recorded by a Yokagawa DL series digital scope sampling at a minimum of 500 kHz.

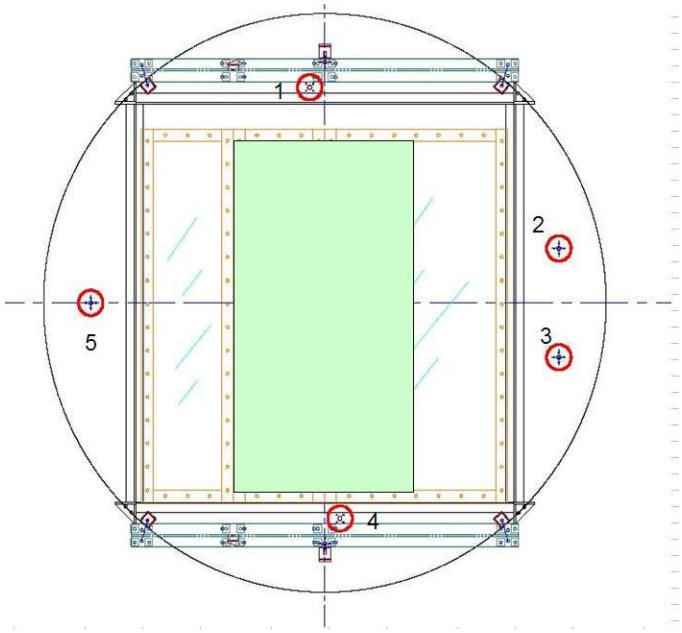

Figure 4. Pressure Gauge Locations

Test Procedure

Testing was conducted in accordance with ASTM F1642-04 and the GSA "Standard Test Method for Windows and Glazing Systems Subject to Dynamic Overpressure Loadings" dated January 1, 2003. The objective of the testing is to determine the performance of the windows as defined in Table 2.1 and 2.2 in the UFC. Blast loads were selected to encompass specified charge weights and standoffs as defined by the UFC, nominally 5.8 psi/41 psi-ms. Window performance conditions were assigned in accordance with the performance criteria in ASTM 1642 and the GSA test protocol. None of the windows were certified per ASTM 1642. This standard requires a minimum of three identical windows to be tested.

Ambient and glass temperatures were recorded at 30 minutes and 5 minutes prior to each test. Photographs were taken of test specimens and the test setup prior to and following each test to

document window performance. Appendix B contains photographs taken of the test specimen throughout the testing.

Following each test, glass fragments were collected and the unified dimensions of fragments projected into the test cubicle were determined for classification per the ASTM 1642 protocol. Fragments striking and embedding in the witness panel were collected and documented. Frame deflections were recorded and performance of framing was documented. Performance conditions for each test item were assigned and recorded in accordance with ASTM 1642-04 and the GSA criteria as shown in Figure 5 and Figure 6, respectively.

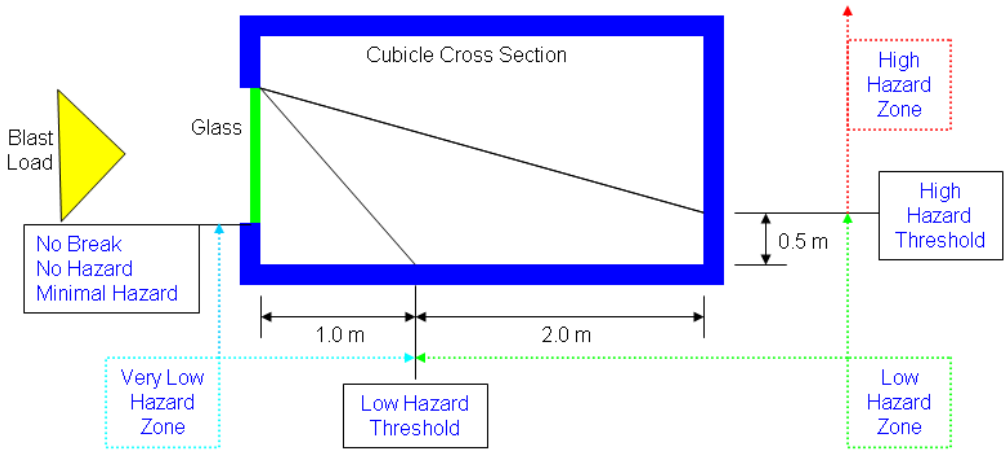

Figure 5. ASTM F1642-04 Performance Criteria

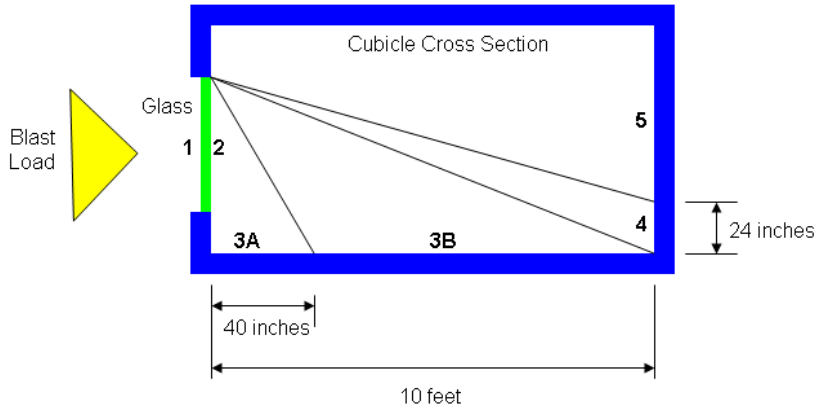

Figure 6. GSA Performance Conditions

Results

This report contains the test results for the testing performed for Madico using C-Bond film conducted on April 4-14 of 2011. Detailed information is included in the appendices.

Appendix A contains a data sheet for each test specimen. The data sheets contain the following information:

- Detailed description of the unit including the frame, glazing, and attachment into the shock tube.
- Description of the test conditions.
- Detailed description of the performance condition for both ASTM and GSA criteria.
- A pretest and post test photograph.
- A graph of the applied blast history.

Appendix B contains a photographic log for each test. Appendix C includes two tables summarizing the window details, applied test loads and window responses.

Approved:

Jerry Collinsworth
Project Engineer
Extreme Loads and Structural Risk
San Antonio, Texas

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ABS Shock Tube Testing Report

Pretest Information

Test Information

Client:	Madico
Model Number:	LCL800
Specimen Number:	01
Description:	Film with C-Bond
Test Date:	4/12/2011
Test Number:	01
Project Number	2548874
Report Date	Jun-11
Test Location:	ABS Test Range
Test Director:	J. Collinsworth

Test Method:
- GSA "Standard Testing Method for Windows and Glazing Systems Subject to Dynamic Overpressure Loadings"
- ASTM F-1642-04 "Standard Test Method for Glazing and Glazing Systems Subjected to Airblast Loadings"

Notes: LCL-800 Film / C-Bond with 4-side Dow 995 Wet Glaze Fixed Window - 1/4" Annealed Glass

Frame Information

Width (in):	51.5
Height (in):	69.5
Frame Width (in):	4.50
Material:	Aluminum
Frame Support:	Supported at Head and Sill in ABS Subframe

Glazing Information

Multiple Lites? No

	Lite 1	Lite 2	Lite 3
Width (in):	48.0		
Height (in):	66.0		
IGU?	No	Air Gap (in):	NA

Thickness (in): 1/4
Film: LCL800, 0.0080 in
Notes: Dow 995 (4 sides)

Temperature

Ambient (F):	75
Glass Surface (F):	80

Blast Pressure Information

	Gauge Number 1	2	3	4	5	Average	Cubicle
Peak Reflected Pressure (psi)	6.69	6.21	6.17	7.07		6.5	0.10
Positive Phase Impulse (psi-ms)	44.7	43.8	44.2	44.8		44.4	
Positive Phase Duration (ms)	20.5	20.4	20.8	20.6		20.6	

Glazing Damage Summary

	0 - 40 in	40 - 120 in
Notes:	Frags	Frags < 100g
United Dimension (in):	Multiple	<10

	Interior	Perimeter	Sum
Tears and Pullout:	7%	80%	87%

	Low Hazard/Zone 4	High Hazard/Zone 5
Witness Panel Perforations/Indents:	None	None
Witness Panel Penetrations:	None	None

Notes: Glazing fractured and silicone failed along the sill, head and one jamb. The filmed glass remained attached to one frame jamb. Silicone failure was predominately cohesive. No glass impacts on the witness panel.

GSA Performance Condition: **3B**
ASTM F-1642 Hazard Level: **Very Low**

Test Certification

GSA Performance Condition: **3B**
ASTM F-1642 Hazard Level: **Very Low**

Specimen Number: 01
Other Test No.:

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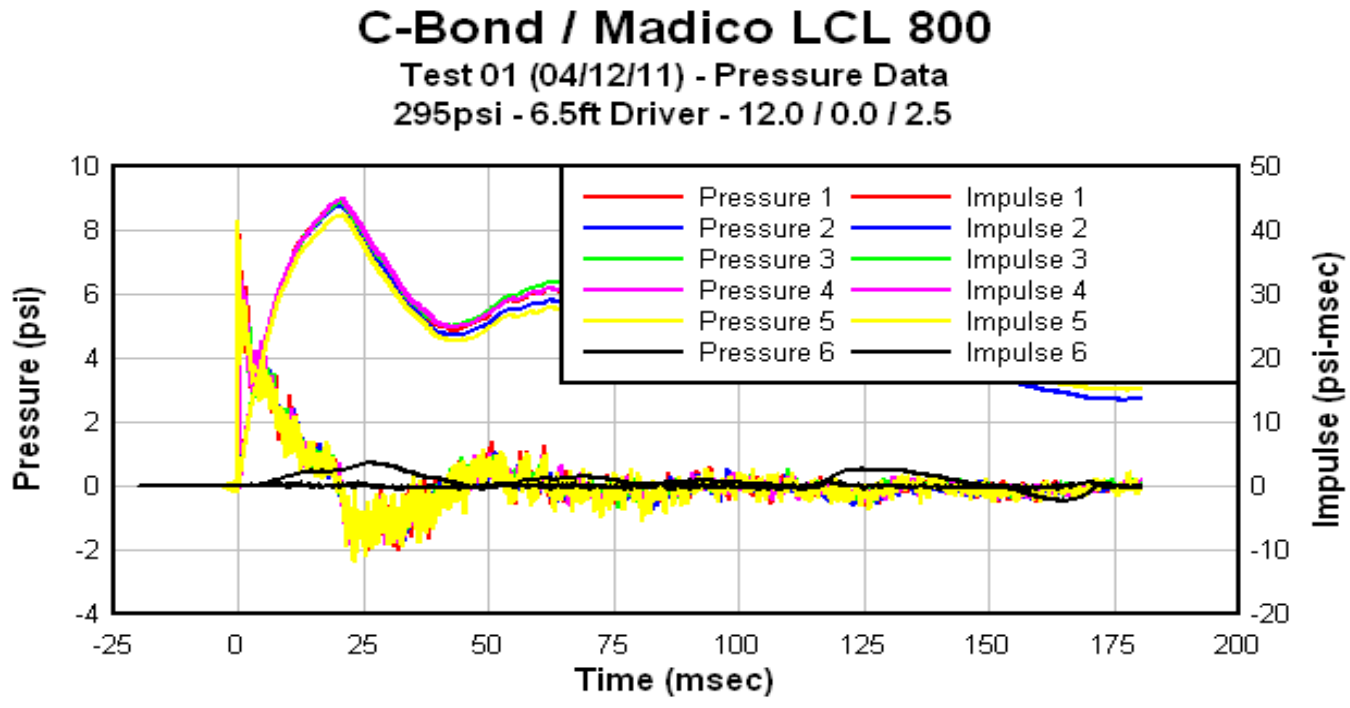
Photographs and Blast Trace

Pre-Test Photograph

Post-Test Photograph

Blast Trace



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ABS Shock Tube Testing Report

Pretest Information

Test Information

Client:	Madico
Model Number:	LCL800
Specimen Number:	02
Description:	Film with C-Bond
Test Date:	4/12/2011
Test Number:	02
Project Number	2548874
Report Date	Jun-11
Test Location:	ABS Test Range
Test Director:	J. Collinsworth

Test Method:
- GSA "Standard Testing Method for Windows and Glazing Systems Subject to Dynamic Overpressure Loadings"
- ASTM F-1642-04 "Standard Test Method for Glazing and Glazing Systems Subjected to Airblast Loadings"

Notes: LCL-800 Film / C-Bond with 4-side Dow 995 Wet Glaze Fixed Window - 1/4" Annealed Glass

Frame Information

Width (in):	51.5
Height (in):	69.5
Frame Width (in):	4.50
Material:	Aluminum
Frame Support:	Supported at Head and Sill in ABS Subframe

Glazing Information

Multiple Lites? No

	Lite 1	Lite 2	Lite 3
Width (in):	48.0		
Height (in):	66.0		
IGU?	No	Air Gap (in):	NA

Thickness (in): 1/4
Film: LCL800, 0.0080 in
Notes: Dow 995 (4 sides)

Temperature

Ambient (F):	75
Glass Surface (F):	80

Blast Pressure Information

	Gauge Number 1	2	3	4	5	Average	Cubicle
Peak Reflected Pressure (psi)	6.03	5.33	5.43	5.77		5.6	0.13
Positive Phase Impulse (psi-ms)	35.4	34.3	34.6	35.1		34.9	
Positive Phase Duration (ms)	20.4	20.3	20.8	20.8		20.6	

Glazing Damage Summary

	0 - 40 in	40 - 120 in
Notes:	None	None
United Dimension (in):	0	0

	Interior	Perimeter	Sum
Tears and Pullout:	0%	0%	0%

	Low Hazard/Zone 4	High Hazard/Zone 5
Witness Panel Perforations/Indents:	None	None
Witness Panel Penetrations:	None	None

Notes: Glazing fractured and film did not tear. No fragments entered the cubicle.

GSA Performance Condition: **2**
ASTM F-1642 Hazard Level: **No Hazard**

Test Certification

GSA Performance Condition: **2**
ASTM F-1642 Hazard Level: **No Hazard**

Specimen Number: 02
Other Test No.:

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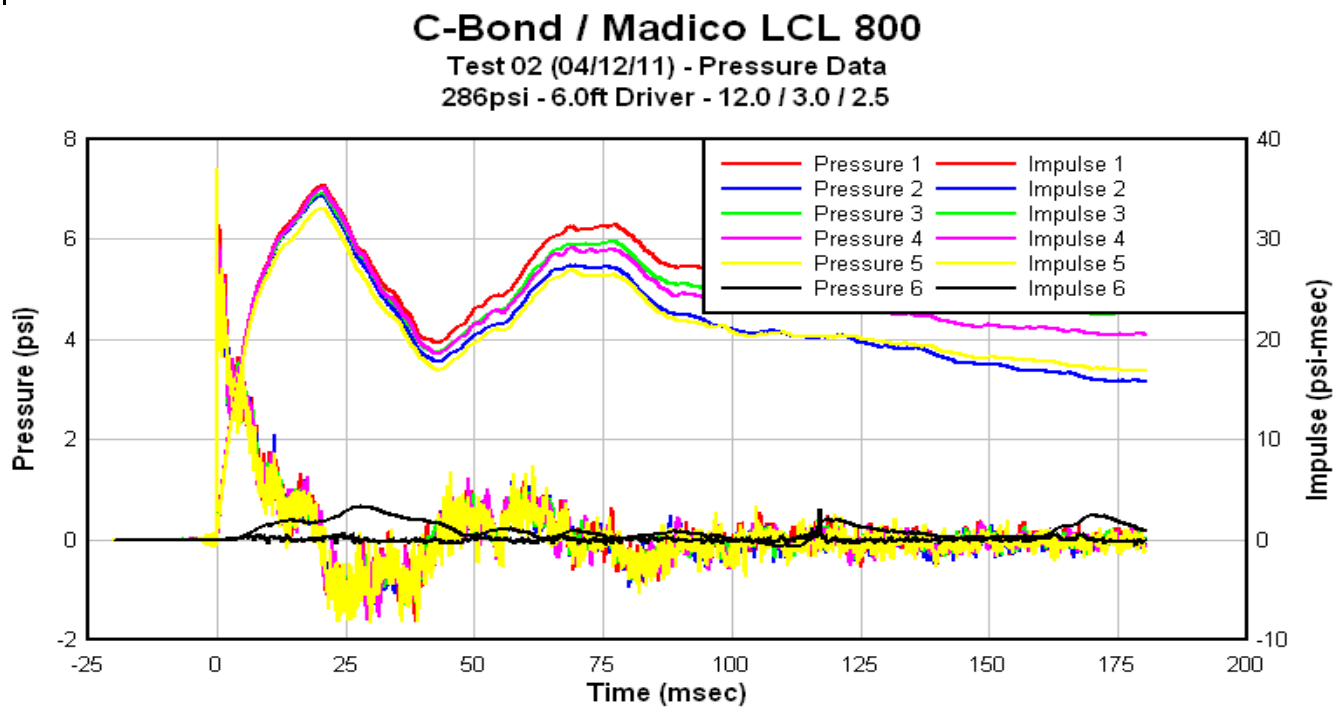
Photographs and Blast Trace

Pre-Test Photograph

Post-Test Photograph

Blast Trace



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ABS Shock Tube Testing Report

Pretest Information

Test Information

Client:	Madico
Model Number:	LCL800
Specimen Number:	03
Description:	Film with C-Bond
Test Date:	4/12/2011
Test Number:	03
Project Number	2548874
Report Date	Jun-11
Test Location:	ABS Test Range
Test Director:	J. Collinsworth

Test Method:
- GSA "Standard Testing Method for Windows and Glazing Systems Subject to Dynamic Overpressure Loadings"
- ASTM F-1642-04 "Standard Test Method for Glazing and Glazing Systems Subjected to Airblast Loadings"

Notes: LCL-800 Film / C-Bond with 4-side Dow 995 Wet Glaze Fixed Window - 1/4" Annealed Glass

Frame Information

Width (in):	51.5
Height (in):	69.5
Frame Width (in):	4.50
Material:	Aluminum
Frame Support:	Supported at Head and Sill in ABS Subframe

Glazing Information

Multiple Lites? No

	Lite 1	Lite 2	Lite 3
Width (in):	48.0		
Height (in):	66.0		
IGU?	No	Air Gap (in):	NA

Thickness (in): 1/4
Film: LCL800, 0.0080 in
Notes: Dow 995 (4 sides)

Temperature

Ambient (F):	80
Glass Surface (F):	82

Blast Pressure Information

	Gauge Number 1	2	3	4	5	Average	Cubicle
Peak Reflected Pressure (psi)	5.93	6.00	5.50	6.08		5.9	0.10
Positive Phase Impulse (psi-ms)	35.0	34.1	34.2	34.7		34.5	
Positive Phase Duration (ms)	20.3	20.2	20.6	20.5		20.4	

Glazing Damage Summary

	0 - 40 in	40 - 120 in
Notes:	Small Frags	Frags < 100g
United Dimension (in):	4	1.75

	Interior	Perimeter	Sum
Tears and Pullout:	2%	25%	27%

	Low Hazard/Zone 4	High Hazard/Zone 5
Witness Panel Perforations/Indents:	None	None
Witness Panel Penetrations:	None	None

Notes: Glazing fractured and silicone failed cohesively along head and partially down each jamb. Three small interior tears were observed at corners. Fragments were released into the cubicle but no glass impacted the witness panel.

GSA Performance Condition: **3A** ASTM F-1642 Hazard Level: **Very Low**

Test Certification

GSA Performance Condition: **3A**

ASTM F-1642 Hazard Level: **Very Low**

Specimen Number: 03
Other Test No.:

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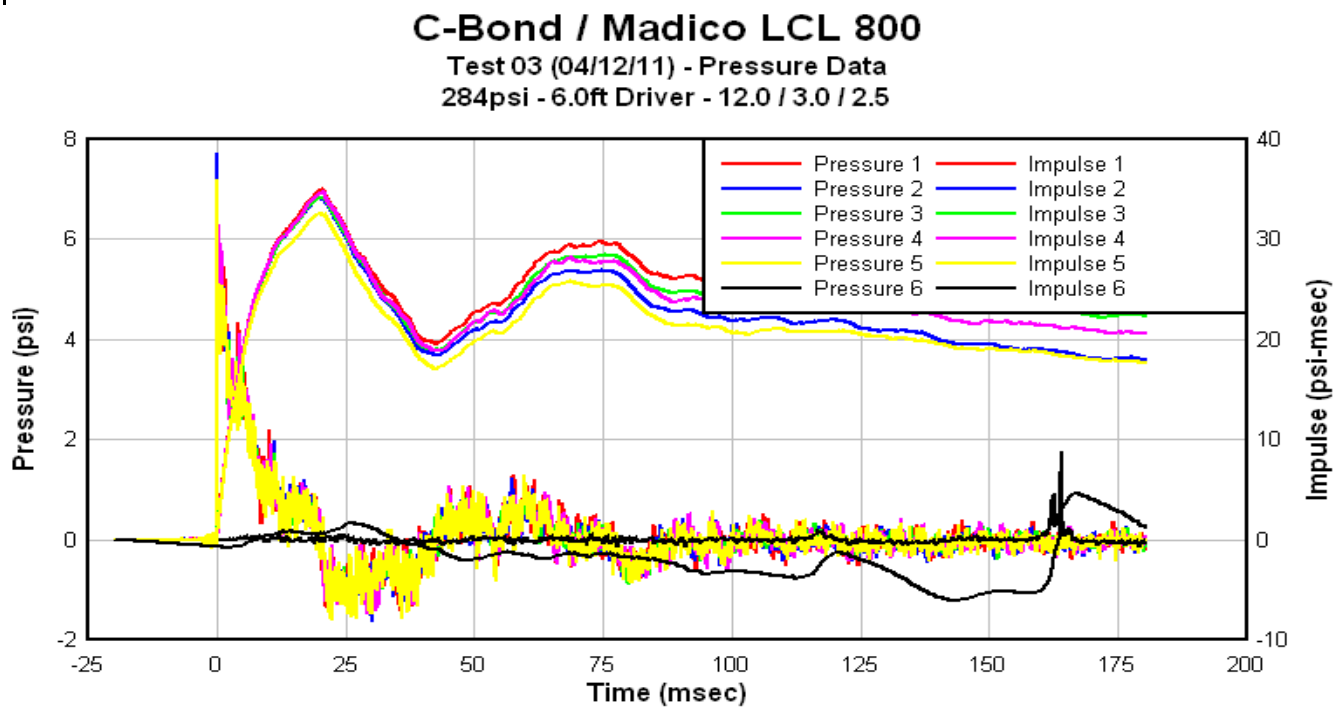
Photographs and Blast Trace

Pre-Test Photograph

Post-Test Photograph

Blast Trace



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ABS Shock Tube Testing Report

Pretest Information

Test Information

Client:	Madico
Model Number:	LCL800
Specimen Number:	04
Description:	Film with C-Bond
Test Date:	4/12/2011
Test Number:	04
Project Number	2548874
Report Date	Jun-11
Test Location:	ABS Test Range
Test Director:	J. Collinsworth

Test Method:
- GSA "Standard Testing Method for Windows and Glazing Systems Subject to Dynamic Overpressure Loadings"
- ASTM F-1642-04 "Standard Test Method for Glazing and Glazing Systems Subjected to Airblast Loadings"

Notes: LCL-800 Film / C-Bond with 4-side Dow 995 Wet Glaze Fixed Window - 1/4" Annealed Glass

Frame Information

Width (in):	51.5
Height (in):	69.5
Frame Width (in):	4.50
Material:	Aluminum
Frame Support:	Supported at Head and Sill in ABS Subframe

Glazing Information

Multiple Lites? No

	Lite 1	Lite 2	Lite 3
Width (in):	48.0		
Height (in):	66.0		
IGU?	No	Air Gap (in):	NA

Thickness (in): 1/4
Film: LCL800, 0.0080 in
Notes: Dow 995 (4 sides)

Temperature

Ambient (F):	84
Glass Surface (F):	86

Blast Pressure Information

	Gauge Number 1	2	3	4	5	Average	Cubicle
Peak Reflected Pressure (psi)	6.02	5.12	5.13	6.07		5.6	0.08
Positive Phase Impulse (psi-ms)	33.2	32.3	32.5	33.1		32.8	
Positive Phase Duration (ms)	20.2	20.4	20.6	20.3		20.4	

Glazing Damage Summary

	0 - 40 in	40 - 120 in
Notes:	Small Fragment	None
United Dimension (in):	1	0

	Interior	Perimeter	Sum
Tears and Pullout:	0%	10%	10%

	Low Hazard/Zone 4	High Hazard/Zone 5
Witness Panel Perforations/Indents:	None	None
Witness Panel Penetrations:	None	None

Notes: Glazing fractured and silicone failed cohesively along 21" in one corner. No measurable fragments were released into the cubicle but no glass impacted the witness panel.

GSA Performance Condition: **2**
ASTM F-1642 Hazard Level: **Minimal**

Test Certification

GSA Performance Condition: **2**

ASTM F-1642 Hazard Level: **Minimal**

Specimen Number: 04
Other Test No.:

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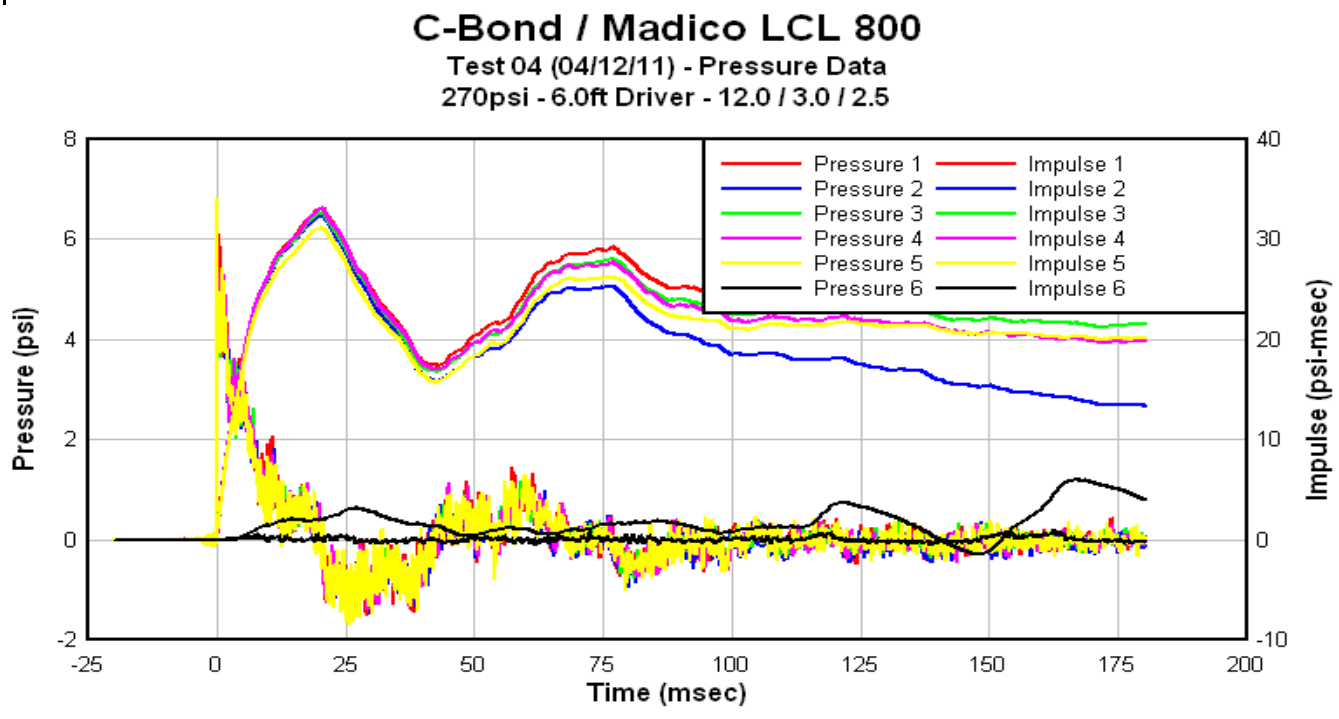
Photographs and Blast Trace

Pre-Test Photograph

Post-Test Photograph

Blast Trace



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ABS Shock Tube Testing Report

Pretest Information

Test Information

Client:	Madico
Model Number:	LCL800
Specimen Number:	05
Description:	Film with C-Bond
Test Date:	4/12/2011
Test Number:	05
Project Number	2548874
Report Date	Jun-11
Test Location:	ABS Test Range
Test Director:	J. Collinsworth

Test Method:
- GSA "Standard Testing Method for Windows and Glazing Systems Subject to Dynamic Overpressure Loadings"
- ASTM F-1642-04 "Standard Test Method for Glazing and Glazing Systems Subjected to Airblast Loadings"

Notes: LCL-800 Film / C-Bond with 4-side Dow 995 Wet Glaze Fixed Window - 1/4" Annealed Glass

Frame Information

Width (in):	51.5
Height (in):	69.5
Frame Width (in):	4.50
Material:	Aluminum
Frame Support:	Supported at Head and Sill in ABS Subframe

Glazing Information

Multiple Lites? No

	Lite 1	Lite 2	Lite 3
Width (in):	48.0		
Height (in):	66.0		
IGU?	No	Air Gap (in):	NA

Thickness (in): 1/4
Film: LCL800, 0.0080 in
Notes: Dow 995 (4 sides)

Temperature

Ambient (F):	84
Glass Surface (F):	87.5

Blast Pressure Information

	Gauge Number 1	2	3	4	5	Average	Cubicle
Peak Reflected Pressure (psi)	7.64	6.78	5.90	6.87		6.8	0.09
Positive Phase Impulse (psi-ms)	40.2	39.9	39.8	40.2		40.0	
Positive Phase Duration (ms)	20.3	20.4	20.7	20.4		20.5	

Glazing Damage Summary

	0 - 40 in	40 - 120 in
Notes:	Fragments	Fragments
United Dimension (in):	>10	>10

	Interior	Perimeter	Sum
Tears and Pullout:	0%	70%	70%

	Low Hazard/Zone 4	High Hazard/Zone 5
Witness Panel Perforations/Indents:	>10	>5
Witness Panel Penetrations:		

Notes: Glazing fractured and silicone failed along the head and over 60% of the jambs. The filmed glass folded over into cubicle. Silicone failure was predominately cohesive. Large number of fragment impacts were recorded on the witness panel.

GSA Performance Condition: **5**
ASTM F-1642 Hazard Level: **High**

Test Certification

GSA Performance Condition: **5**
ASTM F-1642 Hazard Level: **High**

Specimen Number: 05
Other Test No.:

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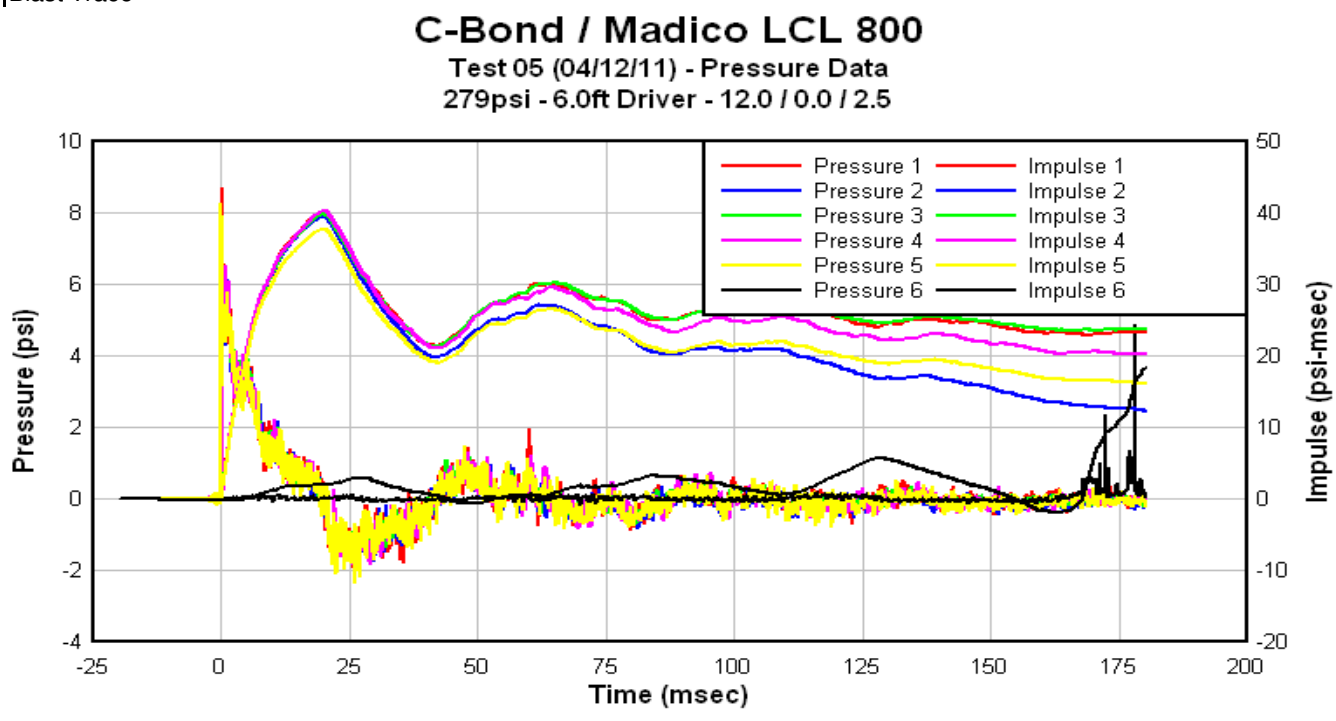
Photographs and Blast Trace

Pre-Test Photograph

Post-Test Photograph

Blast Trace



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ABS Shock Tube Testing Report

Pretest Information

Test Information

Client:	Madico
Model Number:	CL700-XSR
Specimen Number:	06
Description:	Film with C-Bond
Test Date:	4/13/2011
Test Number:	06
Project Number	2548874
Report Date	Jun-11
Test Location:	ABS Test Range
Test Director:	J. Collinsworth

Test Method:
- GSA "Standard Testing Method for Windows and Glazing Systems Subject to Dynamic Overpressure Loadings"
- ASTM F-1642-04 "Standard Test Method for Glazing and Glazing Systems Subjected to Airblast Loadings"

Notes: CL-700-XSR Film / C-Bond with 4-side FrameGard Fixed Window - 1/4" Annealed Glass

Frame Information

Width (in):	51.5
Height (in):	69.5
Frame Width (in):	4.50
Material:	Aluminum
Frame Support:	Supported at Head and Sill in ABS Subframe

Glazing Information

Multiple Lites? No

	Lite 1	Lite 2	Lite 3
Width (in):	48.0		
Height (in):	66.0		
IGU?	No	Air Gap (in):	NA

Thickness (in): 1/4
Film: CL700-XSR, 0.0070 in
Notes: FrameGard anchored on 4 sides with 1/4" x 1/4" TEK screws at 3" O.C.

Temperature

Ambient (F):	61
Glass Surface (F):	64

Blast Pressure Information

	Gauge Number 1	2	3	4	5	Average	Cubicle
Peak Reflected Pressure (psi)	5.27	4.59	4.74	5.58		5.0	0.14
Positive Phase Impulse (psi-ms)	28.1	28.4	27.7	28.2		28.1	
Positive Phase Duration (ms)	20.2	20.5	20.8	20.6		20.5	

Glazing Damage Summary

	0 - 40 in	40 - 120 in
Notes:	Dusting	Frags < 100g
United Dimension (in):	0	2

	Interior	Perimeter	Sum
Tears and Pullout:	15%	2%	17%

	Low Hazard/Zone 4	High Hazard/Zone 5
Witness Panel Perforations/Indents:	5	None
Witness Panel Penetrations:	None	None

Notes: Glazing fractured and film tore in 3 corners. Two tears were 3" long and the third was 40". Perforations in the witness panel were below 24".

GSA Performance Condition: **4**
ASTM F-1642 Hazard Level: **Low Hazard**

Test Certification

GSA Performance Condition: **4**
ASTM F-1642 Hazard Level: **Low Hazard**

Specimen Number: 06
Other Test No.:

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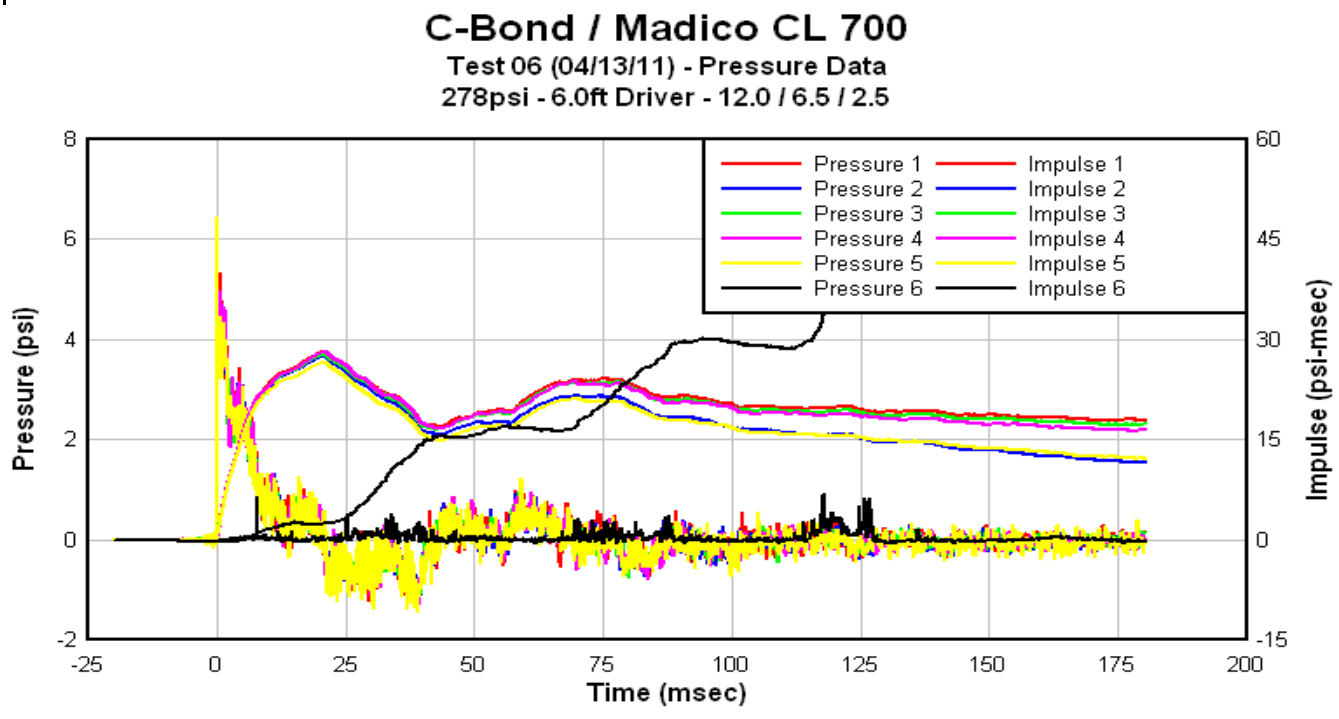
Photographs and Blast Trace

Pre-Test Photograph

Post-Test Photograph

Blast Trace



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ABS Shock Tube Testing Report

Pretest Information

Test Information

Client:	Madico
Model Number:	CL700-XSR
Specimen Number:	07
Description:	Film with C-Bond
Test Date:	4/13/2011
Test Number:	07
Project Number	2548874
Report Date	Jun-11
Test Location:	ABS Test Range
Test Director:	J. Collinsworth

Test Method:
- GSA "Standard Testing Method for Windows and Glazing Systems Subject to Dynamic Overpressure Loadings"
- ASTM F-1642-04 "Standard Test Method for Glazing and Glazing Systems Subjected to Airblast Loadings"

Notes: CL-700-XSR Film / C-Bond with 4-side FrameGard Fixed Window - 1/4" Annealed Glass

Frame Information

Width (in):	51.5
Height (in):	69.5
Frame Width (in):	4.50
Material:	Aluminum
Frame Support:	Supported at Head and Sill in ABS Subframe

Glazing Information

Multiple Lites? No

	Lite 1	Lite 2	Lite 3
Width (in):	48.0		
Height (in):	66.0		
IGU?	No	Air Gap (in):	NA

Thickness (in): 1/4
Film: CL700-XSR, 0.0070 in
Notes: FrameGard anchored on 4 sides with 1/4" x 1/4" TEK screws at 3" O.C.

Temperature

Ambient (F):	71
Glass Surface (F):	75

Blast Pressure Information

	Gauge Number 1	2	3	4	5	Average	Cubicle
Peak Reflected Pressure (psi)	6.23	5.50	5.52	5.46		5.7	No Data
Positive Phase Impulse (psi-ms)	37.2	36.4	36.7	37.3		36.9	
Positive Phase Duration (ms)	20.6	20.8	20.5	20.5		20.6	

Glazing Damage Summary

	0 - 40 in	40 - 120 in
Notes:	Dusting	Small Frags
United Dimension (in):	2	None

	Interior	Perimeter	Sum
Tears and Pullout:	1%	10%	11%

	Low Hazard/Zone 4	High Hazard/Zone 5
Witness Panel Perforations/Indents:	None	None
Witness Panel Penetrations:	None	None

Notes: Glazing fractured and film tore along perimeter near 3 corners. Longest tear was 15". Minimal fragments entered the cubicle and no there were no glass impact on the witness panel.

GSA Performance Condition: **2**
ASTM F-1642 Hazard Level: **Minimal**

Test Certification

GSA Performance Condition: **2**
ASTM F-1642 Hazard Level: **Minimal**

Specimen Number: 07
Other Test No.:

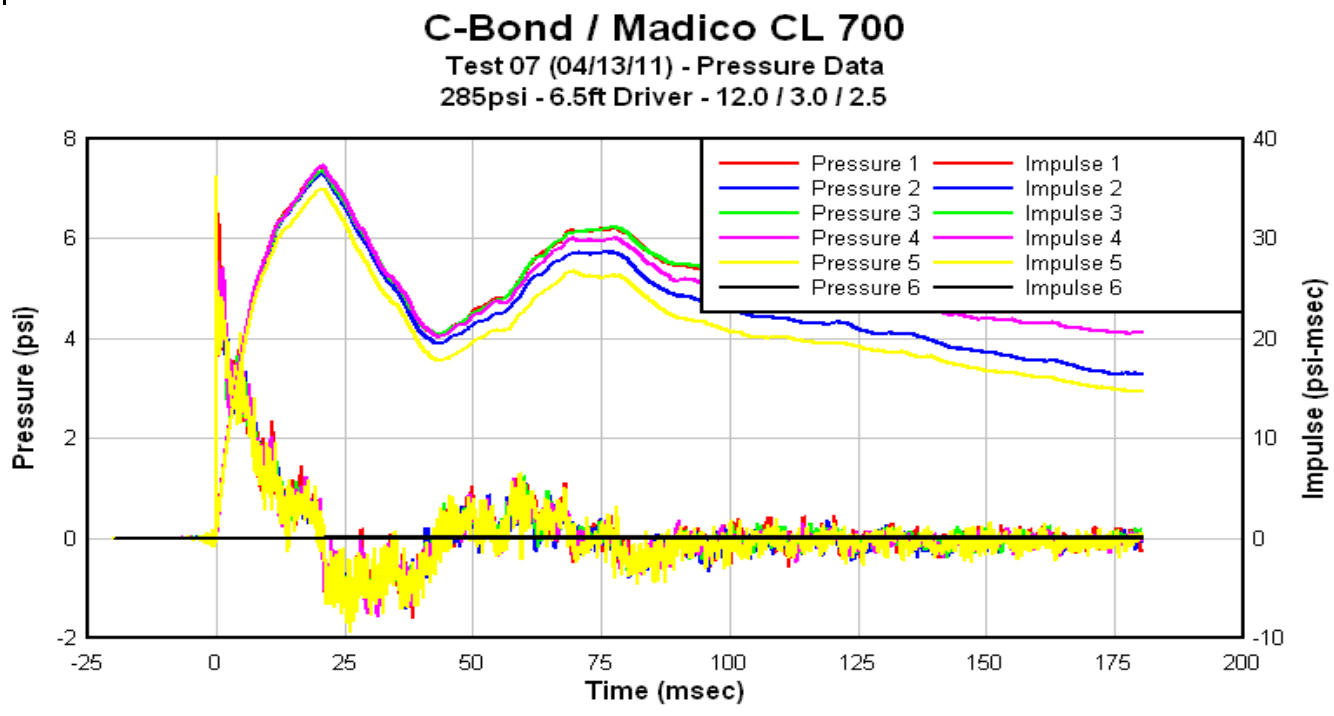
ABS Consulting
AN ABS GROUP COMPANY

Photographs and Blast Trace

Pre-Test Photograph

Post-Test Photograph

Blast Trace



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ABS Shock Tube Testing Report

Pretest Information

Test Information

Client:	Madico
Model Number:	CL700-XSR
Specimen Number:	08
Description:	Film with C-Bond
Test Date:	4/13/2011
Test Number:	08
Project Number	2548874
Report Date	Jun-11
Test Location:	ABS Test Range
Test Director:	J. Collinsworth

Test Method:
- GSA "Standard Testing Method for Windows and Glazing Systems Subject to Dynamic Overpressure Loadings"
- ASTM F-1642-04 "Standard Test Method for Glazing and Glazing Systems Subjected to Airblast Loadings"

Notes: CL-700-XSR Film / C-Bond with 4-side FrameGard Fixed Window - 1/4" Annealed Glass

Frame Information

Width (in):	51.5
Height (in):	69.5
Frame Width (in):	4.50
Material:	Aluminum
Frame Support:	Supported at Head and Sill in ABS Subframe

Glazing Information

Multiple Lites? No

	Lite 1	Lite 2	Lite 3
Width (in):	48.0		
Height (in):	66.0		
IGU?	No	Air Gap (in):	NA

Thickness (in): 1/4
Film: CL700-XSR, 0.0070 in
Notes: FrameGard anchored on 4 sides with 1/4" x 1/4" TEK screws at 3" O.C.

Temperature

Ambient (F):	75
Glass Surface (F):	79

Blast Pressure Information

	Gauge Number 1	2	3	4	5	Average	Cubicle
Peak Reflected Pressure (psi)	5.93	5.34	5.34	5.95		5.6	0.10
Positive Phase Impulse (psi-ms)	36.7	35.6	36.0	36.6		36.2	
Positive Phase Duration (ms)	20.3	20.4	20.6	20.6		20.5	

Glazing Damage Summary

	0 - 40 in	40 - 120 in
Notes:	Dusting & Frags	Small Frags
United Dimension (in):	<1	11

	Interior	Perimeter	Sum
Tears and Pullout:	25%	12%	37%

	Low Hazard/Zone 4	High Hazard/Zone 5
Witness Panel Perforations/Indents:	Multiple	32
Witness Panel Penetrations:	None	None

Notes: Glazing fractured and film split open from top corner to opposite side a mid-height. A large number of fragments were released into the cubicle and numerous impacts were recorded on the witness panel.

GSA Performance Condition: **5** ASTM F-1642 Hazard Level: **High**

Test Certification

GSA Performance Condition: **5**

ASTM F-1642 Hazard Level: **High**

Specimen Number: 08
Other Test No.:

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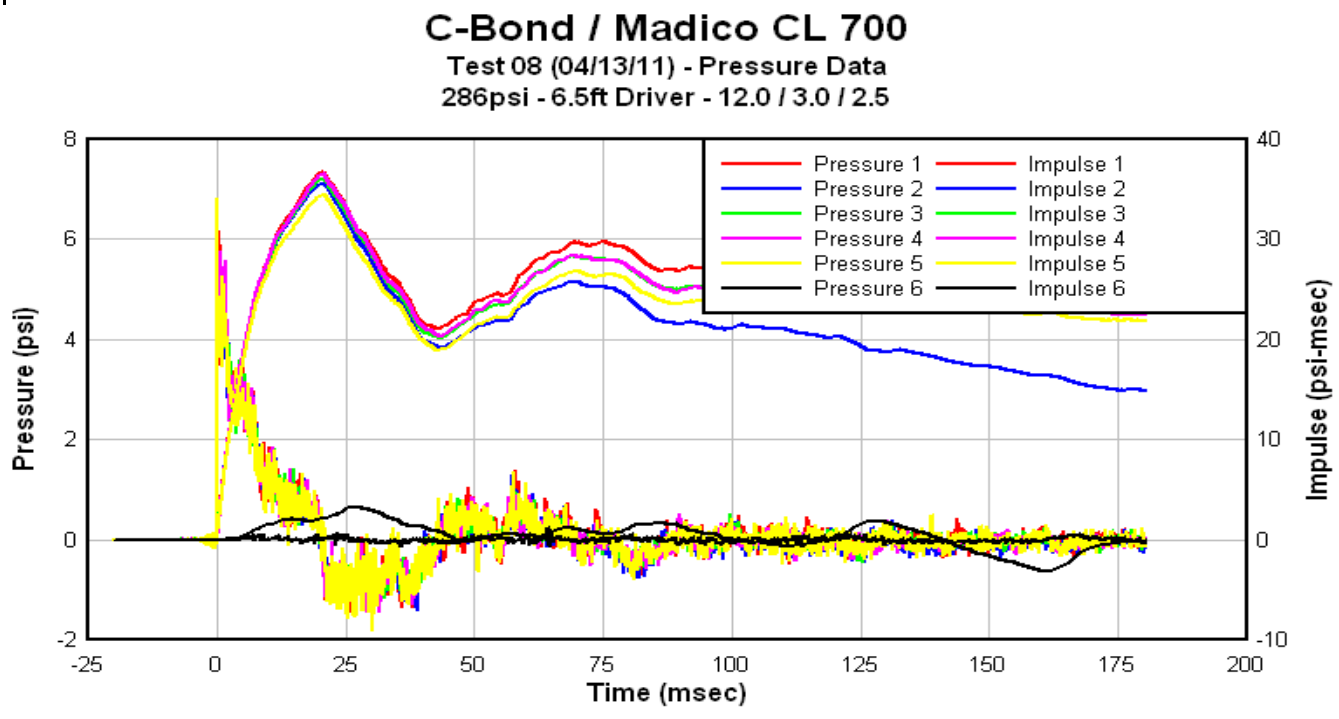
Photographs and Blast Trace

Pre-Test Photograph

Post-Test Photograph

Blast Trace



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ABS Shock Tube Testing Report

Pretest Information

Test Information

Client:	Madico
Model Number:	CL700-XSR
Specimen Number:	09
Description:	Film with C-Bond
Test Date:	4/13/2011
Test Number:	09
Project Number	2548874
Report Date	Jun-11
Test Location:	ABS Test Range
Test Director:	J. Collinsworth

Test Method:
- GSA "Standard Testing Method for Windows and Glazing Systems Subject to Dynamic Overpressure Loadings"
- ASTM F-1642-04 "Standard Test Method for Glazing and Glazing Systems Subjected to Airblast Loadings"

Notes: CL-700-XSR Film / C-Bond with 4-side FrameGard Fixed Window - 1/4" Annealed Glass

Frame Information

Width (in):	51.5
Height (in):	69.5
Frame Width (in):	4.50
Material:	Aluminum
Frame Support:	Supported at Head and Sill in ABS Subframe

Glazing Information

Multiple Lites? No

	Lite 1	Lite 2	Lite 3
Width (in):	48.0		
Height (in):	66.0		
IGU?	No	Air Gap (in):	NA

Thickness (in): 1/4
Film: CL700-XSR, 0.0070 in
Notes: FrameGard anchored on 4 sides with 1/4" x 1/4" TEK screws at 3" O.C.

Temperature

Ambient (F):	83
Glass Surface (F):	86

Blast Pressure Information

	Gauge Number 1	2	3	4	5	Average	Cubicle
Peak Reflected Pressure (psi)	5.92	5.42	5.26	5.91		5.6	0.09
Positive Phase Impulse (psi-ms)	31.2	30.6	30.8	31.3		31.0	
Positive Phase Duration (ms)	20.2	20.1	20.4	20.3		20.3	

Glazing Damage Summary

	0 - 40 in	40 - 120 in
Notes:	Light Dusting	
United Dimension (in):	0	0

	Interior	Perimeter	Sum
Tears and Pullout:	2%	2%	4%

	Low Hazard/Zone 4	High Hazard/Zone 5
Witness Panel Perforations/Indents:	None	None
Witness Panel Penetrations:	None	None

Notes: Glazing fractured and small film tears were observed in all corners. Only dusting was projected into the cubicle. No glass impacts were recorded on the witness panel.

GSA Performance Condition: **2**
ASTM F-1642 Hazard Level: **Minimal**

Test Certification

GSA Performance Condition: **2**
ASTM F-1642 Hazard Level: **Minimal**

Specimen Number: 09
Other Test No.:

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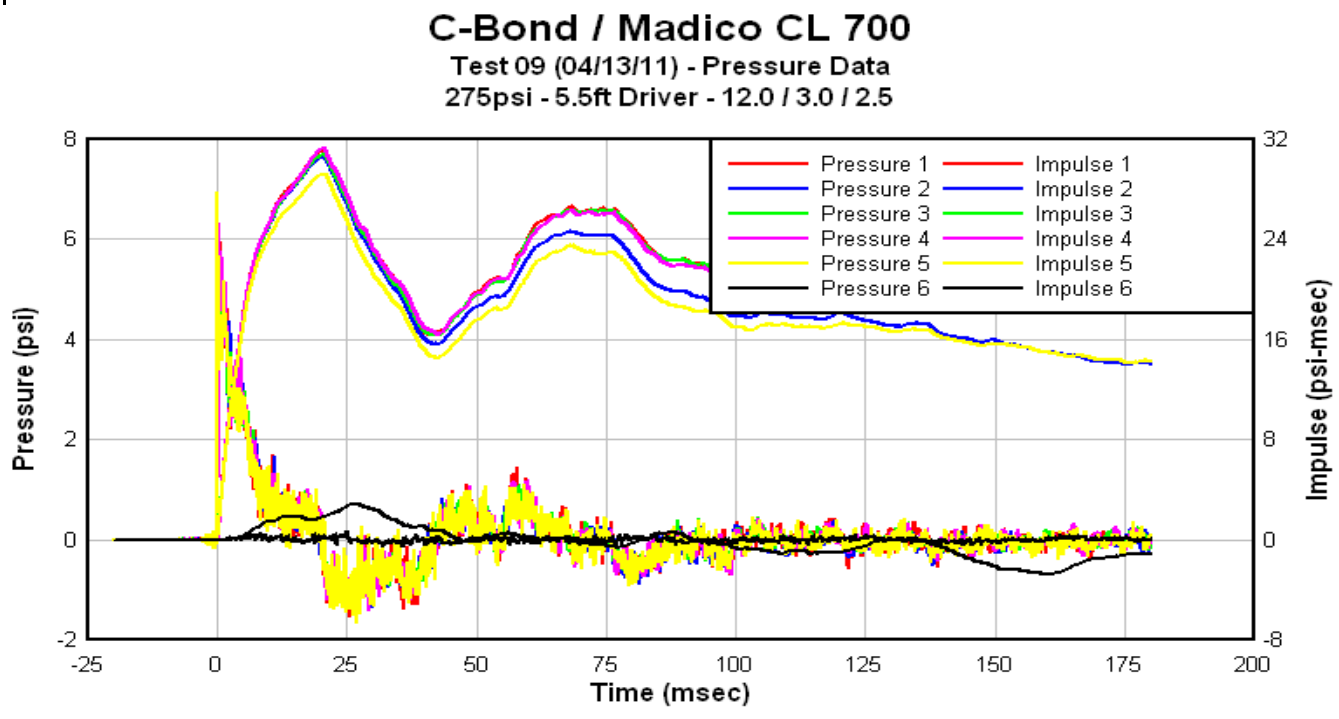
Photographs and Blast Trace

Pre-Test Photograph

Post-Test Photograph

Blast Trace



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ABS Shock Tube Testing Report

Pretest Information

Test Information

Client:	Madico
Model Number:	CL700-XSR
Specimen Number:	10
Description:	Film with C-Bond
Test Date:	4/13/2011
Test Number:	10
Project Number	2548874
Report Date	Jun-11
Test Location:	ABS Test Range
Test Director:	J. Collinsworth

Test Method:
- GSA "Standard Testing Method for Windows and Glazing Systems Subject to Dynamic Overpressure Loadings"
- ASTM F-1642-04 "Standard Test Method for Glazing and Glazing Systems Subjected to Airblast Loadings"

Notes: CL-700-XSR Film / C-Bond with 4-side FrameGard Fixed Window - 1/4" Annealed Glass

Frame Information

Width (in):	51.5
Height (in):	69.5
Frame Width (in):	4.50
Material:	Aluminum
Frame Support:	Supported at Head and Sill in ABS Subframe

Glazing Information

Multiple Lites? No

	Lite 1	Lite 2	Lite 3
Width (in):	48.0		
Height (in):	66.0		
IGU?	No	Air Gap (in):	NA

Thickness (in): 1/4
Film: CL700-XSR, 0.0070 in
Notes: FrameGard anchored on 4 sides with 1/4" x 1/4" TEK screws at 3" O.C.

Temperature

Ambient (F):	84.5
Glass Surface (F):	87

Blast Pressure Information

	Gauge Number 1	2	3	4	5	Average	Cubicle
Peak Reflected Pressure (psi)	5.49	5.16	5.31	5.87		5.5	0.09
Positive Phase Impulse (psi-ms)	30.2	29.6	29.6	30.2		29.9	
Positive Phase Duration (ms)	20.2	20.3	20.4	20.3		20.3	

Glazing Damage Summary

	0 - 40 in	40 - 120 in
Notes:	Frags	Frags
United Dimension (in):	3	4

	Interior	Perimeter	Sum
Tears and Pullout:	0%	9%	9%

	Low Hazard/Zone 4	High Hazard/Zone 5
Witness Panel Perforations/Indents:	4	None
Witness Panel Penetrations:	None	None

Notes: Glazing fractured and film tore near 3 corners. Longest tear was 15". Five fragments entered the cubicle and 4 perforations were recorded on the witness panel below 24".

GSA Performance Condition: **3B**
ASTM F-1642 Hazard Level: **Low**

Test Certification

GSA Performance Condition: **3B**
ASTM F-1642 Hazard Level: **Low**

Specimen Number: 10
Other Test No.:

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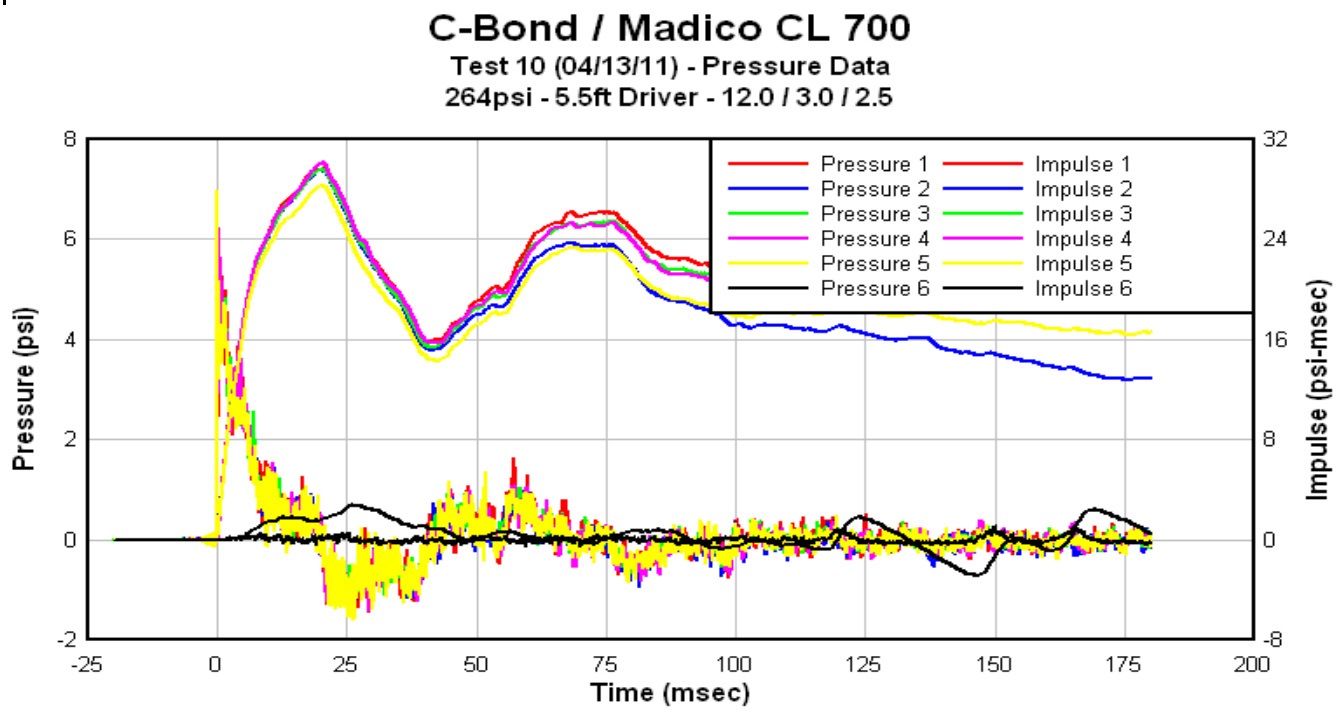
Photographs and Blast Trace

Pre-Test Photograph

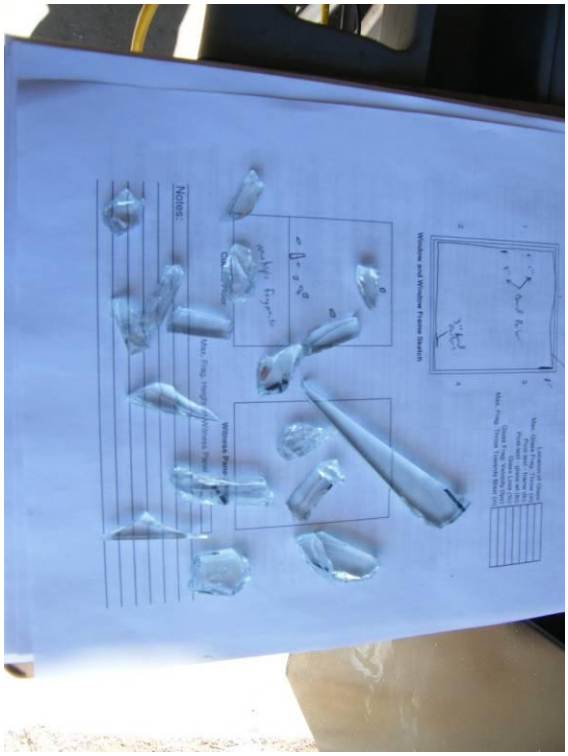
Post-Test Photograph

Blast Trace



Pre Test 01

Post Test 01

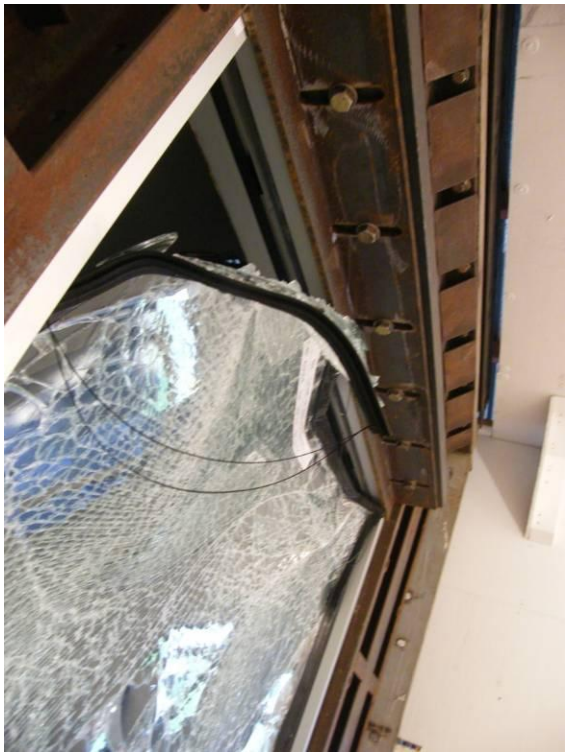


Pre Test 02

Post Test 02

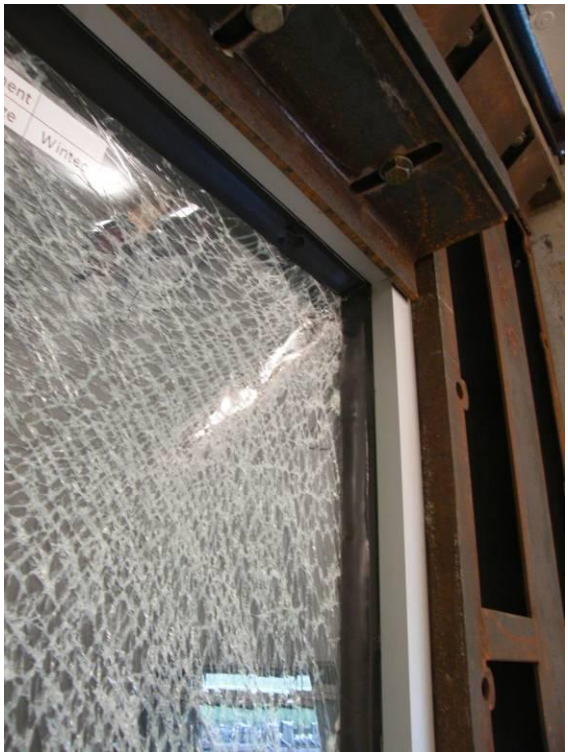
Pre Test 03

Post Test 03



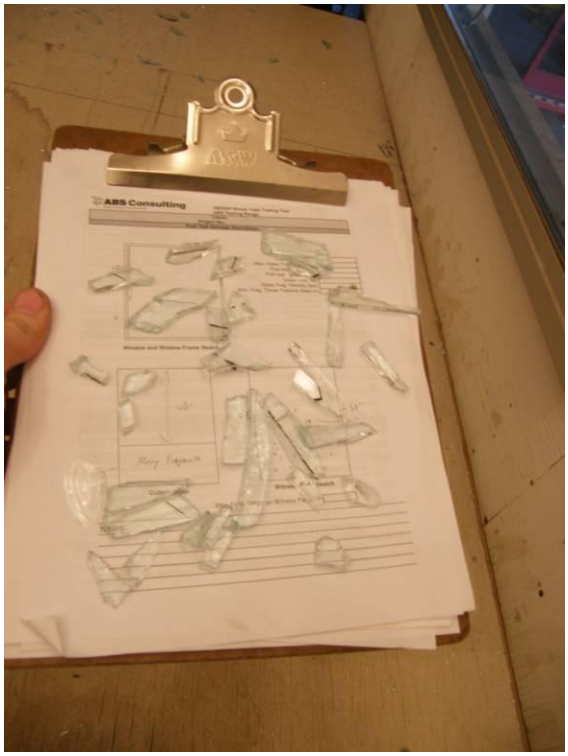
Pre Test 04

Post Test 04



Pre Test 05

Post Test 05

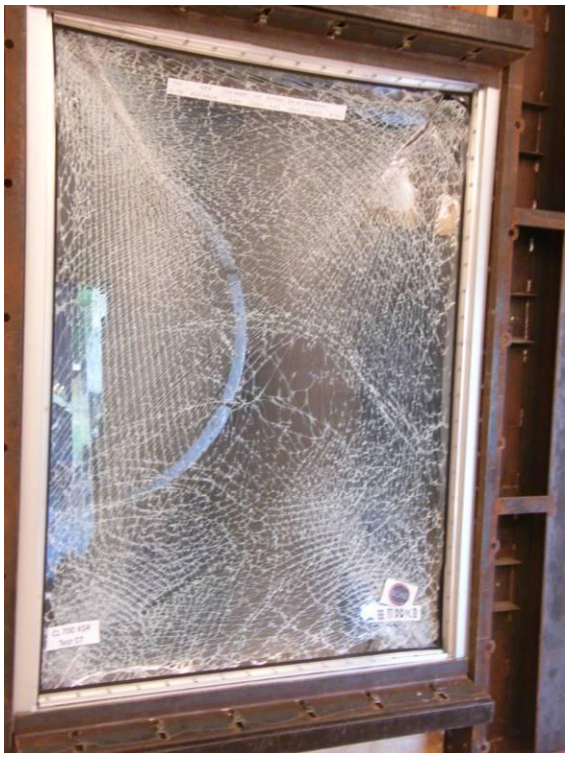


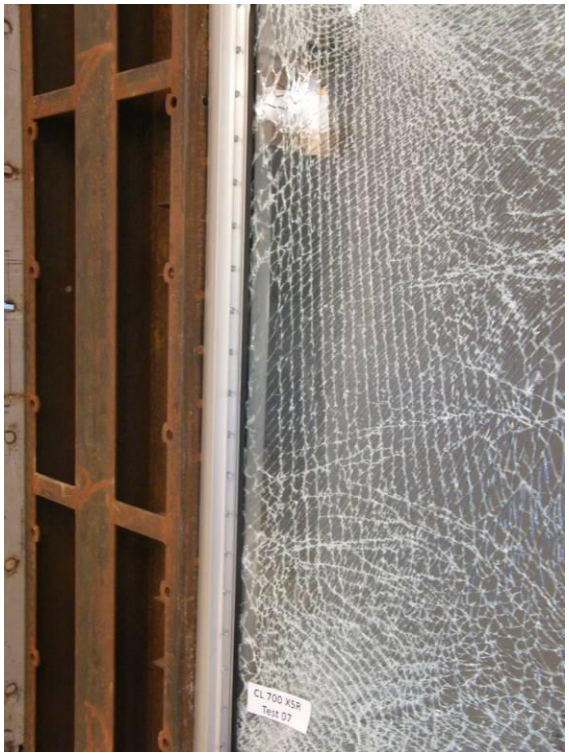
Pre Test 06

Post Test 06

Pre Test 07

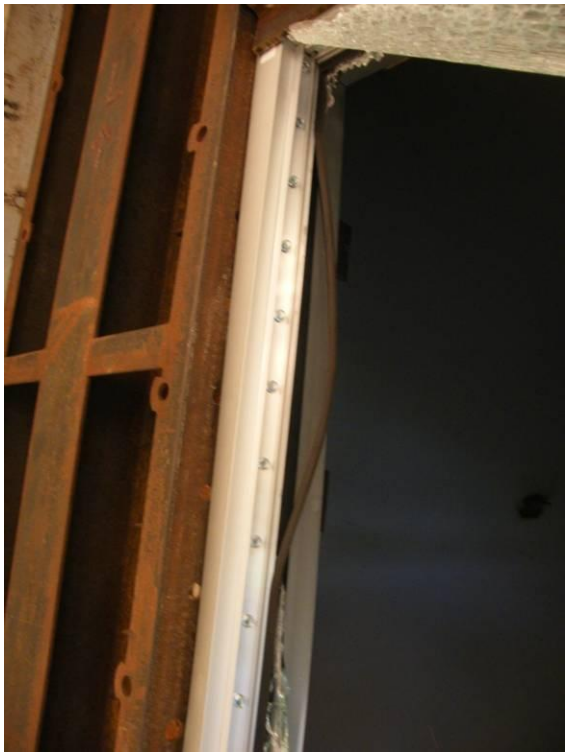
Post Test 07





Pre Test 08

Post Test 08



Pre Test 09

Post Test 09

Pre Test 10

Post Test 10

Table 1. Response Summary

Test Number	Date	Model Number	Window Description	Anchorage	Film Thickness [in]	Frame Width [in]	Frame Height [in]	Glazing Response	
								GSA Performance	ASTM F1642 Hazard Level
1	4/12/2011	LCL800 C-Bond	1/4" Fixed	Wet Glaze (4 sides) with Dow 995	0.008	51.50	69.50	3B	Very Low
2	4/12/2011	LCL800 C-Bond	1/4" Fixed	Wet Glaze (4 sides) with Dow 995	0.008	51.50	69.50	2	No Hazard
3	4/12/2011	LCL800 C-Bond	1/4" Fixed	Wet Glaze (4 sides) with Dow 995	0.008	51.50	69.50	3A	Very Low
4	4/12/2011	LCL800 C-Bond	1/4" Fixed	Wet Glaze (4 sides) with Dow 995	0.008	51.50	69.50	2	Minimal
5	4/12/2011	LCL800 C-Bond	1/4" Fixed	Wet Glaze (4 sides) with Dow 995	0.008	51.50	69.50	5	High
6	4/13/2011	CL700 C-Bond	1/4" Fixed	Frame Guard (4 Sides) Screws 3" O.C.	0.007	51.50	69.50	4	Low
7	4/13/2011	CL700 C-Bond	1/4" Fixed	Frame Guard (4 Sides) Screws 3" O.C.	0.007	51.50	69.50	2	Minimal
8	4/13/2011	CL700 C-Bond	1/4" Fixed	Frame Guard (4 Sides) Screws 3" O.C.	0.007	51.50	69.50	5	High
9	4/13/2011	CL700 C-Bond	1/4" Fixed	Frame Guard (4 Sides) Screws 3" O.C.	0.007	51.50	69.50	2	Minimal
10	4/13/2011	CL700 C-Bond	1/4" Fixed	Frame Guard (4 Sides) Screws 3" O.C.	0.007	51.50	69.50	3B	Low

Table 2. Load Summary

Test #	Date	Time	Pressure (psi)				Impulse (psi-ms)				Average	
			Gauge 1	Gauge 2	Gauge 3	Gauge 4	Gauge 1	Gauge 2	Gauge 3	Gauge 4	P (psi)	I (psi-ms)
1	4/12/2011	11:00 AM	6.69	6.21	6.17	7.07	44.67	43.80	44.24	44.83	6.54	44.39
2	4/12/2011	12:00 PM	6.03	5.33	5.43	5.77	35.42	34.31	34.60	35.14	5.64	34.87
3	4/12/2011	2:00 PM	5.93	6.00	5.50	6.08	34.99	34.08	34.16	34.72	5.88	34.49
4	4/12/2011	3:00 PM	6.02	5.12	5.13	6.07	33.18	32.27	32.53	33.13	5.59	32.78
5	4/12/2011	4:15 PM	7.64	6.78	5.90	6.87	40.18	39.89	39.78	40.24	6.80	40.02
6	4/13/2011	10:00 AM	5.27	4.59	4.74	5.58	28.12	28.40	27.66	28.17	5.05	28.09
7	4/13/2011	11:15 AM	6.23	5.50	5.52	5.46	37.19	36.42	36.72	37.30	5.68	36.91
8	4/13/2011	12:30 PM	5.93	5.34	5.34	5.95	36.72	35.59	35.99	36.57	5.64	36.22
9	4/13/2011	2:30 PM	5.92	5.42	5.26	5.91	31.21	30.56	30.77	31.31	5.63	30.96
10	4/13/2011	12:00 AM	5.49	5.16	5.31	5.87	30.16	29.58	29.60	30.18	5.46	29.88