Architectural Testing

ASTM F1642-04/GSA TS01
TEST REPORT

Report No.: A9873.02-122-12

Rendered to:

3M Company
Saint Paul, Minnesota

PRODUCT TYPE: Blast Resistant Double Pane Windows in Aluminum Frames

SERIES/MODEL: 1) Laminated Glass models
RW001U001, RW001U003, RW001U005, and RW001U007

2) Safety and Security Film models (3M™ Ultra S600)
RW001U002, RW001U004, RW001U006, and RW001U008

SPECIFICATION: ASTM F 1642-04, *Standard Test Method for Glazing and Glazing Systems Subject to Airblast Loading.*

GSA-TS01-2003, *US General Services Administration Standard Test Method for Glazing and Window Systems Subject to Dynamic Overpressure Loadings.*

This report contains in its entirety:

Cover Page: 11 pages
Report Body: 45 pages
Test Facility: 1 page
Pressure-Time Plots: 72 pages
Photographs: 72 pages
Drawings: Drawings have been removed for client confidentiality.

Digitally Signed by: Brady W. McNaughton
2011.09.20 15:45:35 -04'00'

Test Dates: 06/21/11
Through: 06/28/11
Report Date: 09/19/11
Test Record Retention End Date: 06/28/15

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Summary of Results – by Window Type

Insulated Glass Windows – Laminated Glass[1]				
Window Type	**Product Code**	**Blast Load (nominal)**	**ASTM F1642 Rating**	**GSA-TS01 Rating**
Fixed	RW001U0001	6 psi, 41 psi*msec	Minimal Hazard	2
Fixed / Casement	RW001U0003	6 psi, 41 psi*msec	Minimal Hazard	2
Fixed / Project	RW001U0005	10 psi, 89 psi*msec	Minimal Hazard	2
Fixed / Sliding	RW001U0007	6 psi, 41 psi*msec	Minimal Hazard	2

Insulated Glass Windows -- 3M™ Ultra S600 Safety and Security Window Film[2]				
Window Type	**Product Code**	**Blast Load (nominal)**	**ASTM F1642 Rating**	**GSA-TS01 Rating**
Fixed	RW001U0002	6 psi, 41 psi*msec	No Hazard	2
Fixed / Casement	RW001U0004	10 psi, 89 psi*msec	Minimal Hazard	2
Fixed / Project	RW001U0006	10 psi, 89 psi*msec	No Break	1
Fixed / Sliding	RW001U0008	6 psi, 41 psi*msec	Minimal Hazard	2

[1] Laminated Glass Windows comprised of 1/4" heat strengthened glass on exterior pane; 1/2" air gap; laminated annealed glass on interior pane (1/8" annealed glass, 0.030" PVB interlayer, 1/8" annealed glass). Interior pane glazed into frame bite with Dow Corning 983 structural silicone sealant.

[2] Windows incorporating fragment retention window film comprised of 1/4" heat strengthened glass on exterior pane; 1/2" air gap; 1/4" annealed glass on interior pane with 3M™ Ultra S600 window film applied. Window film professionally wet-applied to surface #4, edge-to-edge, prior to mounting glass into frame. Interior pane wet glazed into frame bite with Dow Corning 983 structural silicone sealant.

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Summary of Results – All Test Specimens

Test Specimen #	Window Description	Protective Layer	Average Blast Load (pressure, impulse)	ASTM F1642 Rating	GSA-TS01 Rating
1	Fixed	Laminated Glass	7.3 psi, 47 psi*msec	Minimal Hazard	2
2	Fixed	Laminated Glass	6.7 psi, 45 psi*msec	Minimal Hazard	2
3	Fixed	Laminated Glass	10.7 psi, 87 psi*msec	High Hazard	5
4	Fixed	Laminated Glass	7.5 psi, 49 psi*msec	Minimal Hazard	2
5	Fixed	Laminated Glass	10.8 psi, 58 psi*msec	High Hazard	5
6	Fixed	3M™ Ultra S600 Window Film	7.0 psi, 46 psi*msec	Minimal Hazard	2
7	Fixed	3M™ Ultra S600 Window Film	10.6 psi, 88 psi*msec	Low Hazard	5
8	Fixed	3M™ Ultra S600 Window Film	7.4 psi, 49 psi*msec	No Hazard	2
9	Fixed	3M™ Ultra S600 Window Film	7.5 psi, 48 psi*msec	No Hazard	2
10	Fixed	3M™ Ultra S600 Window Film	7.3 psi, 48 psi*msec	No Hazard	2
11	Fixed / Casement	Laminated Glass	6.8 psi, 43 psi*msec	No Break	1
12	Fixed / Casement	Laminated Glass	10.9 psi, 92 psi*msec	Minimal Hazard	2
13	Fixed / Casement	Laminated Glass	10.7 psi, 88 psi*msec	High Hazard	5
14	Fixed / Casement	Laminated Glass	7.2 psi, 47 psi*msec	Minimal Hazard	2
15	Fixed / Casement	Laminated Glass	10.5 psi, 89 psi*msec	Low Hazard	5
16	Fixed / Casement	3M™ Ultra S600 Window Film	11.0 psi, 91 psi*msec	Minimal Hazard	2
17	Fixed / Casement	3M™ Ultra S600 Window Film	10.8 psi, 89 psi*msec	Minimal Hazard	2
18	Fixed / Casement	3M™ Ultra S600 Window Film	10.8 psi, 90 psi*msec	Minimal Hazard	2
19	Fixed / Project Out	Laminated Glass	10.4 psi, 89 psi*msec	Minimal Hazard	2
20	Fixed / Project Out	Laminated Glass	10.3 psi, 89 psi*msec	Minimal Hazard	2
21	Fixed / Project Out	Laminated Glass	10.3 psi, 89 psi*msec	No Break	1
22	Fixed / Project Out	Laminated Glass	10.9 psi, 89 psi*msec	No Break	1
23	Fixed / Project Out	Laminated Glass	10.3 psi, 89 psi*msec	Minimal Hazard	2
24	Fixed / Project Out	3M™ Ultra S600 Window Film	10.3 psi, 89 psi*msec	No Break	1
25	Fixed / Project Out	3M™ Ultra S600 Window Film	10.8 psi, 89 psi*msec	No Break	1
26	Fixed / Project Out	3M™ Ultra S600 Window Film	10.1 psi, 89 psi*msec	No Break	1
27	Fixed / Sliding	Laminated Glass	7.4 psi, 46 psi*msec	Minimal Hazard	2
28	Fixed / Sliding	Laminated Glass	10.8 psi, 89 psi*msec	Minimal Hazard	3b
29	Fixed / Sliding	Laminated Glass	10.9 psi, 89 psi*msec	High Hazard	5
30	Fixed / Sliding	Laminated Glass	7.6 psi, 49 psi*msec	Minimal Hazard	2
31	Fixed / Sliding	Laminated Glass	7.1 psi, 47 psi*msec	No Hazard	2
32	Fixed / Sliding	3M™ Ultra S600 Window Film	10.9 psi, 90 psi*msec	Low Hazard	5
33	Fixed / Sliding	3M™ Ultra S600 Window Film	7.5 psi, 49 psi*msec	Minimal Hazard	2
34	Fixed / Sliding	3M™ Ultra S600 Window Film	7.1 psi, 47 psi*msec	Minimal Hazard	2
35	Fixed / Sliding	3M™ Ultra S600 Window Film	7.4 psi, 48 psi*msec	No Break	1
36	Fixed / Sliding	3M™ Ultra S600 Window Film	4.6 psi, 30 psi*msec	Minimal Hazard	2

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Summary of Results – Fixed Window, Laminated Glass

Title	Summary of Results	
Client Specimen	**RW001U0001 (1)**	**RW001U0001 (2)**
Test Specimen Number	1	2
Protective Layer	0.030" PVB interlayer	0.030" PVB interlayer
Window Type	Fixed	Fixed
ASTM Hazard Rating	Minimal Hazard	Minimal Hazard
GSA Performance Condition	2	2
Average Peak Reflected Pressure	7.3 psi	6.7 psi
Average Positive Phase Impulse	47 psi*msec	44 psi*msec
Average Positive Phase Duration	13 msec	13 msec

Title	Summary of Results	
Client Specimen	**RW001U0001 (3)**	**RW001U0001 (4)**
Test Specimen Number	3	4
Protective Layer	0.030" PVB interlayer	0.030" PVB interlayer
Window Type	Fixed	Fixed
ASTM Hazard Rating	High Hazard	Minimal Hazard
GSA Performance Condition	5	2
Average Peak Reflected Pressure	10.7 psi	7.5 psi
Average Positive Phase Impulse	87 psi*msec	49 psi*msec
Average Positive Phase Duration	15 msec	13 msec

Title	Summary of Results
Client Specimen	**RW001U0001 (5)**
Test Specimen Number	5
Protective Layer	0.030" PVB interlayer
Window Type	Fixed
ASTM Hazard Rating	High Hazard
GSA Performance Condition	5
Average Peak Reflected Pressure	10.8 psi
Average Positive Phase Impulse	58 psi*msec
Average Positive Phase Duration	12 msec

Architectural Testing

Summary of Results - Fixed Window, 3M™ Ultra S600 Window Film

Title	Summary of Results	
Client Specimen	**RW001U0002 (1)**	**RW001U0002 (2)**
Test Specimen Number	6	7
Protective Layer	3M™ Ultra S600 Window Film	3M™ Ultra S600 Window Film
Window Type	Fixed	Fixed
ASTM Hazard Rating	Minimal Hazard	Low Hazard
GSA Performance Condition	2	5
Average Peak Reflected Pressure	7 psi	10.6 psi
Average Positive Phase Impulse	46 psi*msec	88 psi*msec
Average Positive Phase Duration	14 msec	16 msec

Title	Summary of Results	
Client Specimen	**RW001U0002 (3)**	**RW001U0002 (4)**
Test Specimen Number	8	9
Protective Layer	3M™ Ultra S600 Window Film	3M™ Ultra S600 Window Film
Window Type	Fixed	Fixed
ASTM Hazard Rating	No Hazard	No Hazard
GSA Performance Condition	2	2
Average Peak Reflected Pressure	7.4 psi	7.5 psi
Average Positive Phase Impulse	49 psi*msec	48 psi*msec
Average Positive Phase Duration	13 msec	13 msec

Title	Summary of Results
Client Specimen	**RW001U0002 (5)**
Test Specimen Number	10
Protective Layer	3M™ Ultra S600 Window Film
Window Type	Fixed
ASTM Hazard Rating	No Hazard
GSA Performance Condition	2
Average Peak Reflected Pressure	7.3 psi
Average Positive Phase Impulse	48 psi*msec
Average Positive Phase Duration	13 msec

Architectural Testing

Summary of Results - Fixed/Casement Window, Laminated Glass

Title	Summary of Results	
Client Specimen	**RW001U0003 (1-A)**	**RW001U0003 (1-B)**
Test Specimen Number	11	12
Protective Layer	0.030" PVB interlayer	0.030" PVB interlayer
Window Type	Fixed / Casement	Fixed / Casement
ASTM Hazard Rating	No Break	Minimal Hazard
GSA Performance Condition	1	2
Average Peak Reflected Pressure	6.8 psi	10.9 psi
Average Positive Phase Impulse	43 psi*msec	92 psi*msec
Average Positive Phase Duration	13 msec	15 msec

Title	Summary of Results	
Client Specimen	**RW001U0003 (2)**	**RW001U0003 (3)**
Test Specimen Number	13	14
Protective Layer	0.030" PVB interlayer	0.030" PVB interlayer
Window Type	Fixed / Casement	Fixed / Casement
ASTM Hazard Rating	High Hazard	Minimal Hazard
GSA Performance Condition	5	2
Average Peak Reflected Pressure	10.7 psi	7.2 psi
Average Positive Phase Impulse	88 psi*msec	47 psi*msec
Average Positive Phase Duration	16 msec	13 msec

Title	Summary of Results
Client Specimen	**RW001U0003 (4)**
Test Specimen Number	15
Protective Layer	0.030" PVB interlayer
Window Type	Fixed / Casement
ASTM Hazard Rating	Low Hazard
GSA Performance Condition	5
Average Peak Reflected Pressure	10.5 psi
Average Positive Phase Impulse	15 psi*msec
Average Positive Phase Duration	89 msec

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Summary of Results – Fixed/Casement Window, 3M™ Ultra S600 Window Film

Title	Summary of Results	
Client Specimen	**RW001U0004 (1)**	**RW001U0004 (2)**
Test Specimen Number	16	17
Protective Layer	3M™ Ultra S600 Window Film	3M™ Ultra S600 Window Film
Window Type	Fixed / Casement	Fixed / Casement
ASTM Hazard Rating	Minimal Hazard	Minimal Hazard
GSA Performance Condition	2	2
Average Peak Reflected Pressure	11 psi	10.8 psi
Average Positive Phase Impulse	91 psi*msec	89 psi*msec
Average Positive Phase Duration	15 msec	15 msec

Title	Summary of Results
Client Specimen	**RW001U0004 (3)**
Test Specimen Number	18
Protective Layer	3M™ Ultra S600 Window Film
Window Type	Fixed / Casement
ASTM Hazard Rating	Minimal Hazard
GSA Performance Condition	2
Average Peak Reflected Pressure	10.8 psi
Average Positive Phase Impulse	90 psi*msec
Average Positive Phase Duration	16 msec

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Summary of Results - Fixed/Project Out Window, Laminated Glass

Title	Summary of Results	
Client Specimen	**RW001U0005 (1)**	**RW001U0005 (2)**
Test Specimen Number	19	20
Protective Layer	0.030" PVB interlayer	0.030" PVB interlayer
Window Type	Fixed / Project Out	Fixed / Project Out
ASTM Hazard Rating	Minimal Hazard	Minimal Hazard
GSA Performance Condition	2	2
Average Peak Reflected Pressure	10.4 psi	10.3 psi
Average Positive Phase Impulse	89 psi*msec	89 psi*msec
Average Positive Phase Duration	16 msec	15 msec

Title	Summary of Results	
Client Specimen	**RW001U0005 (3)**	**RW001U0005 (4)**
Test Specimen Number	21	22
Protective Layer	0.030" PVB interlayer	0.030" PVB interlayer
Window Type	Fixed / Project Out	Fixed / Project Out
ASTM Hazard Rating	No Break	No Break
GSA Performance Condition	1	1
Average Peak Reflected Pressure	10.3 psi	7.1 psi
Average Positive Phase Impulse	89 psi*msec	47 psi*msec
Average Positive Phase Duration	15 msec	13 msec

Title	Summary of Results
Client Specimen	**RW001U0005 (5)**
Test Specimen Number	23
Protective Layer	0.030" PVB interlayer
Window Type	Fixed / Project Out
ASTM Hazard Rating	Minimal Hazard
GSA Performance Condition	2
Average Peak Reflected Pressure	10.3 psi
Average Positive Phase Impulse	89 psi*msec
Average Positive Phase Duration	15 msec

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Summary of Results – Fixed/Project Out Window, 3M™ Ultra S600 Window Film

Title	Summary of Results	
Client Specimen	**RW001U0006 (1-A)**	**RW001U0006 (1-B)**
Test Specimen Number	24	25
Protective Layer	3M™ Ultra S600 Window Film	3M™ Ultra S600 Window Film
Window Type	Fixed / Project Out	Fixed / Project Out
ASTM Hazard Rating	No Break	No Break
GSA Performance Condition	1	1
Average Peak Reflected Pressure	10.3 psi	10.8 psi
Average Positive Phase Impulse	89 psi*msec	89 psi*msec
Average Positive Phase Duration	15 msec	16 msec

Title	Summary of Results
Client Specimen	**RW001U0006 (2)**
Test Specimen Number	26
Protective Layer	3M™ Ultra S600 Window Film
Window Type	Fixed / Project Out
ASTM Hazard Rating	No Break
GSA Performance Condition	1
Average Peak Reflected Pressure	10.1 psi
Average Positive Phase Impulse	89 psi*msec
Average Positive Phase Duration	15 msec

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Summary of Results -- Fixed/Sliding Window, Laminated Glass

Title	Summary of Results	
Client Specimen	**RW001U0007 (1)**	**RW001U0007 (2)**
Test Specimen Number	27	28
Protective Layer	0.030" PVB interlayer	0.030" PVB interlayer
Window Type	Fixed / Sliding	Fixed / Sliding
ASTM Hazard Rating	Minimal Hazard	Minimal Hazard
GSA Performance Condition	2	3b
Average Peak Reflected Pressure	7.4 psi	10.8 psi
Average Positive Phase Impulse	46 psi*msec	89 psi*msec
Average Positive Phase Duration	13 msec	15 msec

Title	Summary of Results	
Client Specimen	**RW001U0007 (3)**	**RW001U0007 (4)**
Test Specimen Number	29	30
Protective Layer	0.030" PVB interlayer	0.030" PVB interlayer
Window Type	Fixed / Sliding	Fixed / Sliding
ASTM Hazard Rating	High Hazard	Minimal Hazard
GSA Performance Condition	5	2
Average Peak Reflected Pressure	10.9 psi	7.6 psi
Average Positive Phase Impulse	89 psi*msec	49 psi*msec
Average Positive Phase Duration	15 msec	13 msec

Title	Summary of Results
Client Specimen	**RW001U0007 (5)**
Test Specimen Number	31
Protective Layer	0.030" PVB interlayer
Window Type	Fixed / Sliding
ASTM Hazard Rating	No Hazard
GSA Performance Condition	2
Average Peak Reflected Pressure	7.1 psi
Average Positive Phase Impulse	47 psi*msec
Average Positive Phase Duration	13 msec

Architectural Testing

Summary of Results -- Fixed/Sliding Window, 3M™ Ultra S600 Window Film

Title	Summary of Results	
Client Specimen	**RW001U0008 (1)**	**RW001U0008 (2)**
Test Specimen Number	32	33
Protective Layer	3M™ Ultra S600 Window Film	3M™ Ultra S600 Window Film
Window Type	Fixed / Sliding	Fixed / Sliding
ASTM Hazard Rating	Low Hazard	Minimal Hazard
GSA Performance Condition	5	2
Average Peak Reflected Pressure	10.9 psi	7.5 psi
Average Positive Phase Impulse	90 psi*msec	49 psi*msec
Average Positive Phase Duration	15 msec	13 msec

Title	Summary of Results	
Client Specimen	**RW001U0008 (3)**	**RW001U0008 (4)**
Test Specimen Number	34	35
Protective Layer	3M™ Ultra S600 Window Film	3M™ Ultra S600 Window Film
Window Type	Fixed / Sliding	Fixed / Sliding
ASTM Hazard Rating	Minimal Hazard	No Break
GSA Performance Condition	2	1
Average Peak Reflected Pressure	7.1 psi	7.4 psi
Average Positive Phase Impulse	47 psi*msec	48 psi*msec
Average Positive Phase Duration	13 msec	13 msec

Title	Summary of Results
Client Specimen	**RW001U0008 (5)**
Test Specimen Number	36
Protective Layer	3M™ Ultra S600 Window Film
Window Type	Fixed / Sliding
ASTM Hazard Rating	Minimal Hazard
GSA Performance Condition	2
Average Peak Reflected Pressure	4.6 psi
Average Positive Phase Impulse	30 psi*msec
Average Positive Phase Duration	14 msec
Note	Film was cut away with razor blade along perimeter of daylite opening to simulate a "daylite" film application, with no film anchoring mechanism).

Test Completion Date: 06/28/2011

Reference must be made to Report No. A9873.02-122-12, dated 09/19/11 for complete test specimen description and detailed test results.

1.0 Report Issued To: 3M Company
3M Renewable Energy Division
Saint Paul, Minnesota 55144

2.0 Test Laboratory: Architectural Testing, Inc.
130 Derry Court
York, Pennsylvania 17406
717-764-7700

3.0 Project Summary:

3.1 Product Type: Blast Resistant Double Pane Windows in Aluminum Frames

3.2 Series/Model:

3.2.1 RW001U001 - 1500 x 1200 mm Fixed Window, Laminated Glass

3.2.2 RW001U002 - 1500 x 1200 mm Fixed Window, 3M Ultra S600 window film

3.2.3 RW001U003 - 1500 x 1200 mm Fixed/Casement Window, Laminated Glass

3.2.4 RW001U004 - 1500 x 1200 mm Fixed/Casement Window, 3M Ultra S600 window film

3.2.5 RW001U005 - 800 x 1200 mm Fixed/Project Window, Laminated Glass

3.2.6 RW001U006 - 800 x 1200 mm Fixed/Project Window, 3M Ultra S600 window film

3.2.7 RW001U007 - 1500 x 1200 mm Fixed/Sliding Window, Laminated Glass

3.2.8 RW001U008 - 1500 x 1200 mm Fixed/Sliding Window, 3M Ultra S600 window film

3.3 Compliance Statement: Results obtained are tested values and were secured by using the designated test method(s). This report does not constitute certification of this product nor an opinion or endorsement by this laboratory. It is the exclusive property of the client so named herein and relates only to the specimens tested. This report may not be reproduced, except in full, without the written approval of Architectural Testing, Inc.

3.4 Test Dates: 06-21-2011 through 06-28-2011

3.5 Test Facility: Architectural Testing, Inc.'s shock tube is housed in a 10,000 square foot state-of-the-art test facility located in York, Pennsylvania. Blast loadings are produced on the specimen to simulate the effects of a high explosive charge at a specified standoff distance. Shock waves are generated by the sudden rupturing of a thin aluminum membrane. The shock wave expands as it travels down the tube, and impacts the target with a specific positive pressure and impulse. A photograph of the shock tube is provided in Figure #1 of Appendix A.

3.6 Test Sample Source: The test specimens were provided by the client. Representative samples of the test specimen(s) will be retained by Architectural Testing for a minimum of four years from the test completion date.

3.7 Drawing Reference: The test specimen drawings have been reviewed by Architectural Testing and are representative of the test specimen(s) reported herein. Test specimen construction was verified by Architectural Testing per the drawings submitted. Drawings for this report have been removed for client confidentiality. Drawings for the report will be retained by Architectural Testing for a period of four years.

3.8 Data Acquisition: In accordance with ASTM F 1642-04 and GSA TS01, four reflective pressure transducers are utilized to record data at a 1MHz sample rate. Two reflective pressure transducers are located on the specimen holder at the top and right side (when viewed from the interior). A third pressure transducer is located on the shell to the exterior of the specimen, and a fourth is located in the witness chamber, directly to the interior of the specimen holder. A sketch of the specimen holder and corresponding reflective pressure sensor locations are provided in Figure #2 of Appendix A.

3.9 List of Official Observers:

Name	Company
Steve Kuncio	3M
Donghoon Donald Kwak	3M
Paul Neumann	3M
Jeff Lander	Architectural Testing, Inc.
Brady McNaughton, P.E.	Architectural Testing, Inc.
Scott Kramer	Architectural Testing, Inc.

4.0 Test Specification(s):

ASTM F 1642-04, *Standard Test Method for Glazing and Glazing Systems Subject to Airblast Loading.*

GSA-TS01-2003, *US General Services Administration Standard Test Method for Glazing and Window Systems Subject to Dynamic Overpressure Loadings.*

5.0 Test Specimen Description: The following descriptions apply to all specimens.

5.1 Product Sizes:

Specimens 1-10 (Aluminum Fixed Windows)

Measured Dimensions	Width mm (inches)	Height mm (inches)
Overall size	1500 (59)	1200 (47-1/4)
Fixed Day Lite Opening	1380 (54-5/16)	1080 (42-1/2)
Vent Glazing Size	N/A	N/A

Specimens 11-18 (Aluminum Fixed/Casement Windows)

Measured Dimensions	Width mm (inches)	Height mm (inches)
Overall size	1500 (59)	1200 (47-1/4)
Fixed Day Lite Opening	659 (26)	1080 (42-1/2)
Vent Glazing Size	624 (24-9/16)	1045 (41-1/8)

Specimens 19-26 (Aluminum Fixed/Project Out Windows)

Measured Dimensions	Width mm (inches)	Height mm (inches)
Overall size	800 (31-1/2)	1200 (47-1/4)
Fixed Day Lite Opening	680 (26-3/4)	509 (20)
Vent Glazing Size	645 (25-3/8)	474 (18-5/8)

Specimens 27-36 (Aluminum Horizontal Sliding Windows)

Measured Dimensions	Width mm (inches)	Height mm (inches)
Overall size	1500 (59)	1200 (47-1/4)
Fixed Day Lite Opening	664 (26-1/8)	1042 (41)
Vent Glazing Size	631 (24-13/16)	989 (39)

5.0 Test Specimen Description: (Continued)

5.2 Frame Construction:

Specimens 1-10 (Aluminum Fixed Windows)

Frame Member	Material	Description
All frame members	Aluminum	Extruded, thermally improved aluminum

	Joinery Type	Detail
All corners	Coped and butted	Frame corners are coped and butted and secured with one M6 x 2.0 by 34mm long flat head screw and two M6 x 2.0 by 34mm long hex head screws

Specimens 11-26 (Aluminum Fixed/Project Out & Casement Windows)

Frame Member	Material	Description
All frame members	Aluminum	Extruded, thermally improved aluminum

	Joinery Type	Detail
All corners	Coped and butted	Secured with one M6 x 2.0 by 34mm long flat head screw and two M6 x 2.0 by 34mm long hex head screws
Intermediate vertical	Coped and butted	Secured with eight M6 x 2.0 by 34mm long hex head screws

Specimens 27-36 (Aluminum Horizontal Sliding Windows)

Frame Member	Material	Description
All frame members	Aluminum	Extruded, thermally improved aluminum

	Joinery Type	Detail
All corners	Coped and butted	Secured with two M6 x 2.0 by 34mm long hex head screw
Intermediate vertical	Coped and butted	Secured with two M6 x 2.0 by 34mm long hex head screws

5.0 Test Specimen Description: (Continued)

5.3 Sash/Vent Construction:

Specimens 11-26 (Aluminum Fixed/Project Out & Casement Windows)

Sash Member	Material	Description
Active Vent	Aluminum	Extruded, thermally improved aluminum

	Joinery Type	Detail
All corners	Mitered	Mitered, keyed and staked corners

Specimens 27-36 (Aluminum Horizontal Sliding Windows)

Sash Member	Material	Description
Active Sash	Aluminum	Extruded, thermally improved aluminum

	Joinery Type	Detail
All corners	Mitered	Mitered, keyed and staked corners

5.0 Test Specimen Description: (Continued)

5.4 Glazing:

Specimens 1-5, 11-15, 19-23, 27-31

Glass Type	Interior Lite	Interlayer Material	Interlayer Thickness	Exterior Lite	Glazing Bite
24mm IG	6mm Lam. (2) 3mm A.G.	PVB	0.76mm (0.030")	6mm H.S.	19mm *

*Project out vents utilized a 41mm glazing bite.

Spacer: Aluminum; desiccant filled; 12 mm air space.

Specimens 6-10, 16-18, 24-26, 32-36

Glass Type	Interior Lite	Film Material	Interior Film Thickness	Exterior Lite	Glazing Bite
24mm IG	6mm A.G.	3M Ultra S600	0.15 mm (0.006")	6mm H.S.	19mm *

*Project out vents utilized a 41mm glazing bite.

Spacer: Aluminum; desiccant filled; 12 mm air space.

Glazing Method: All glazing was set from the exterior onto a bed of silicone sealant and adhesive tape. The glazing was secured with a snap fit glazing clip and rubber weather-strip gasket and silicone sealant.
Note: All film was included in the glazing bite/securement of the glass.
Project out vent sashes did not utilize an exterior securement.

5.5 Hardware:

Description	Quantity	Location
Aluminum turn handle	1	Fixed/Casement Vent (Specimens 11-18)
Barrel hinges	3	Fixed/Casement Vent (Specimens 11-18)
Aluminum turn handle	1	Fixed/Project Out Vent (Specimens 19-26)
Barrel hinges	2	Fixed/ Project Out Vent (Specimens 19-26)
Auto lock	1	Horizontal Sliding Sash (Specimens 27-36)

5.6 Reinforcement:

Location	Material
Fixed/Casement Vertical Fixed Stile (Specimens 11-18)	Welded Steel

6.0 Installation:

All test specimens utilized steel "J" shaped anchor plates. Each anchor plate was fit into a cavity of the window frame and secured to the window frame with four M5 x 1.25 by 21mm long pan head screws, extending through the anchor plate into the window frame. Each plate utilized two M12 x 1.75 by 45mm long bolts with flat plate washers, lock washer and nut to secure the anchor plate to the steel buck. Anchor plate bolts were located 50mm from each side of the plate and 100mm on center. For the 1500mm wide by 1200mm tall windows, anchor plates were located at 200mm and 600mm in from each end at the head and sill and at 400mm in from each end at the jambs. For the 800mm wide by 1200mm tall windows, anchor plates were located at 200mm in from each end at the head and sill and at 400mm in from each end at the jambs.

7.0 Test Results: The results are tabulated as follows.

Test Specimen #1: Aluminum Fixed Window, Laminated Glass

Description	Results
Ambient Temperature	79°F
Glazing Temperature	79°F
ASTM Hazard Rating	**Minimal Hazard**
GSA Performance Condition	**2**

Peak Positive Pressure	
Top Pressure	7.1. psi
Right Pressure	8.0 psi
Shell Pressure	6.9 psi
Average Pressure	**7.3 psi**
Witness Chamber Pressure	No pressure rise

Peak Positive Phase Duration	
Top Duration	13 msec
Right Duration	14 msec
Shell Duration	13 msec
Average Duration	**13 msec**

Peak Positive Phase Impulse	
Top Impulse	48 psi*msec
Right Impulse	47 psi*msec
Shell Impulse	47 psi*msec
Average Impulse	**47 psi*msec**

Glazing Response	
Exterior Lite	Fractured
Interior Lite	Fractured
Glazing Pullout Length and Location	None
Glazing Tearing	None

Witness Chamber Results
A dusting of glass was deposited on the witness chamber floor.

Pressure-time plots are presented in Appendix B. Pre-test and post-test photographs are provided in Appendix C.

7.0 Test Results: (Continued)

Test Specimen #2: Aluminum Fixed Window, Laminated Glass

Description	Results
Ambient Temperature	78°F
Glazing Temperature	79°F
ASTM Hazard Rating	**Minimal Hazard**
GSA Performance Condition	**2**

Peak Positive Pressure	
Top Pressure	6.6 psi
Right Pressure	7.2 psi
Shell Pressure	6.3 psi
Average Pressure	**6.7 psi**
Witness Chamber Pressure	No pressure rise

Peak Positive Phase Duration	
Top Duration	13 msec
Right Duration	13 msec
Shell Duration	13 msec
Average Duration	**13 msec**

Peak Positive Phase Impulse	
Top Impulse	45 psi*msec
Right Impulse	45 psi*msec
Shell Impulse	44 psi*msec
Average Impulse	**45 psi*msec**

Glazing Response	
Exterior Lite	Fractured
Interior Lite	Fractured
Glazing Pullout Length and Location	None
Glazing Tearing	None

Witness Chamber Results
A dusting of glass was deposited on the witness chamber floor.

Pressure-time plots are presented in Appendix B. Pre-test and post-test photographs are provided in Appendix C.

7.0 Test Results: (Continued)

Test Specimen #3: Aluminum Fixed Window, Laminated Glass

Description	Results
Ambient Temperature	84°F
Glazing Temperature	86°F
ASTM Hazard Rating	**High Hazard**
GSA Performance Condition	**5**

Peak Positive Pressure	
Top Pressure	10.6 psi
Right Pressure	11.4 psi
Shell Pressure	10.0 psi
Average Pressure	**10.7 psi**
Witness Chamber Pressure	0.77 psi

Peak Positive Phase Duration	
Top Duration	15 msec
Right Duration	16 msec
Shell Duration	15 msec
Average Duration	**15 msec**

Peak Positive Phase Impulse	
Top Impulse	88 psi*msec
Right Impulse	88 psi*msec
Shell Impulse	86 psi*msec
Average Impulse	**87 psi*msec**

Glazing Response	
Exterior Lite	Fractured
Interior Lite	Fractured
Glazing Pullout Length and Location	100% Full DLO perimeter
Glazing Tearing	None

Witness Chamber Results
Full de-glazing of the window. The witness panel was penetrated into the second layer of foam. The entire glazing lite was on the witness chamber floor.

Pressure-time plots are presented in Appendix B. Pre-test and post-test photographs are provided in Appendix C.

7.0 Test Results: (Continued)

Test Specimen #4: Aluminum Fixed Window, Laminated Glass

Description	Results
Ambient Temperature	80°F
Glazing Temperature	80°F
ASTM Hazard Rating	**Minimal Hazard**
GSA Performance Condition	**2**

Peak Positive Pressure	
Top Pressure	7.8 psi
Right Pressure	7.8 psi
Shell Pressure	7.0 psi
Average Pressure	**7.5 psi**
Witness Chamber Pressure	No pressure rise

Peak Positive Phase Duration	
Top Duration	13 msec
Right Duration	14 msec
Shell Duration	13 msec
Average Duration	**13 msec**

Peak Positive Phase Impulse	
Top Impulse	49 psi*msec
Right Impulse	49 psi*msec
Shell Impulse	48 psi*msec
Average Impulse	**49 psi*msec**

Glazing Response	
Exterior Lite	Fractured
Interior Lite	Fractured
Glazing Pullout Length and Location	None
Glazing Tearing	None

Witness Chamber Results
A dusting of glass was deposited on the witness chamber floor.

Pressure-time plots are presented in Appendix B. Pre-test and post-test photographs are provided in Appendix C.

7.0 Test Results: (Continued)

Test Specimen #5: Aluminum Fixed Window, Laminated Glass

Description	Results
Ambient Temperature	77°F
Glazing Temperature	78°F
ASTM Hazard Rating	**High Hazard**
GSA Performance Condition	**5**

Peak Positive Pressure	
Top Pressure	10.7 psi
Right Pressure	11.1 psi
Shell Pressure	10.6 psi
Average Pressure	**10.8 psi**
Witness Chamber Pressure	0.5 psi

Peak Positive Phase Duration	
Top Duration	12 msec
Right Duration	13 msec
Shell Duration	12 msec
Average Duration	**12 msec**

Peak Positive Phase Impulse	
Top Impulse	58 psi*msec
Right Impulse	58 psi*msec
Shell Impulse	57 psi*msec
Average Impulse	**58 psi*msec**

Glazing Response	
Exterior Lite	Fractured
Interior Lite	Fractured
Glazing Pullout Length and Location	None
Glazing Tearing	Horizontal tear full width at center Vertical tear half height at center

Witness Chamber Results
Multiple impacts above 24" mark. Two impacts into second layer of the witness panel.

Pressure-time plots are presented in Appendix B. Pre-test and post-test photographs are provided in Appendix C.

7.0 Test Results: (Continued)

Test Specimen #6: Aluminum Fixed Window, 3M™ Ultra S600 Window Film

Description	Results
Ambient Temperature	81°F
Glazing Temperature	81°F
ASTM Hazard Rating	**Minimal Hazard**
GSA Performance Condition	**2**

Peak Positive Pressure	
Top Pressure	7.0 psi
Right Pressure	7.5 psi
Shell Pressure	6.4 psi
Average Pressure	**7.0 psi**
Witness Chamber Pressure	No pressure rise

Peak Positive Phase Duration	
Top Duration	13 msec
Right Duration	14 msec
Shell Duration	14 msec
Average Duration	**14 msec**

Peak Positive Phase Impulse	
Top Impulse	46 psi*msec
Right Impulse	46 psi*msec
Shell Impulse	45 psi*msec
Average Impulse	**46 psi*msec**

Glazing Response	
Exterior Lite	Fractured
Interior Lite	Fractured
Glazing Pullout Length and Location	None
Glazing Tearing	Small tear at corner

Witness Chamber Results
A light dusting of glass was deposited on the witness chamber floor.

Pressure-time plots are presented in Appendix B. Pre-test and post-test photographs are provided in Appendix C.

7.0 Test Results: (Continued)

Test Specimen #7: Aluminum Fixed Window, 3M™ Ultra S600 Window Film

Description	Results
Ambient Temperature	80°F
Glazing Temperature	79°F
ASTM Hazard Rating	**Low Hazard**
GSA Performance Condition	**5**

Peak Positive Pressure	
Top Pressure	10.6 psi
Right Pressure	11.4 psi
Shell Pressure	9.9 psi
Average Pressure	**10.6 psi**
Witness Chamber Pressure	0.48 psi

Peak Positive Phase Duration	
Top Duration	16 msec
Right Duration	16 msec
Shell Duration	15 msec
Average Duration	**16 msec**

Peak Positive Phase Impulse	
Top Impulse	87 psi*msec
Right Impulse	88 psi*msec
Shell Impulse	88 psi*msec
Average Impulse	**88 psi*msec**

Glazing Response	
Exterior Lite	Fractured
Interior Lite	Fractured
Glazing Pullout Length and Location	None
Glazing Tearing	39" horizontal tear top of glazing. 34" vertical tear, and 20" horizontal tear at bottom of glazing

Witness Chamber Results
Multiple fragments were located within the 1m-3m lines with s sum total united dimension of more than 10". Approximately 11 fragment indents located below the 20" line. Several fragment indents above the 24" line.

Pressure-time plots are presented in Appendix B. Pre-test and post-test photographs are provided in Appendix C.

7.0 Test Results: (Continued)

Test Specimen #8: Aluminum Fixed Window, 3M™ Ultra S600 Window Film

Description	Results
Ambient Temperature	79°F
Glazing Temperature	81°F
ASTM Hazard Rating	**No Hazard**
GSA Performance Condition	**2**

Peak Positive Pressure	
Top Pressure	7.7 psi
Right Pressure	7.6 psi
Shell Pressure	7.0 psi
Average Pressure	**7.4 psi**
Witness Chamber Pressure	No pressure rise

Peak Positive Phase Duration	
Top Duration	13 msec
Right Duration	14 msec
Shell Duration	13 msec
Average Duration	**13 msec**

Peak Positive Phase Impulse	
Top Impulse	49 psi*msec
Right Impulse	49 psi*msec
Shell Impulse	48 psi*msec
Average Impulse	**49 psi*msec**

Glazing Response	
Exterior Lite	Fractured
Interior Lite	Fractured
Glazing Pullout Length and Location	None
Glazing Tearing	None

Witness Chamber Results
No debris was observed.

Pressure-time plots are presented in Appendix B. Pre-test and post-test photographs are provided in Appendix C.

7.0 Test Results: (Continued)

Test Specimen #9: Aluminum Fixed Window, 3M™ Ultra S600 Window Film

Description	Results
Ambient Temperature	80°F
Glazing Temperature	81°F
ASTM Hazard Rating	**No Hazard**
GSA Performance Condition	**2**

Peak Positive Pressure	
Top Pressure	7.7 psi
Right Pressure	7.6 psi
Shell Pressure	7.1 psi
Average Pressure	**7.5 psi**
Witness Chamber Pressure	No pressure rise

Peak Positive Phase Duration	
Top Duration	13 msec
Right Duration	14 msec
Shell Duration	13 msec
Average Duration	**13 msec**

Peak Positive Phase Impulse	
Top Impulse	48 psi*msec
Right Impulse	48 psi*msec
Shell Impulse	47 psi*msec
Average Impulse	**48 psi*msec**

Glazing Response	
Exterior Lite	Fractured
Interior Lite	Fractured
Glazing Pullout Length and Location	None
Glazing Tearing	None

Witness Chamber Results
No debris was observed.

Pressure-time plots are presented in Appendix B. Pre-test and post-test photographs are provided in Appendix C.

7.0 Test Results: (Continued)

Test Specimen #10: Aluminum Fixed Window, 3M™ Ultra S600 Window Film

Description	Results
Ambient Temperature	76°F
Glazing Temperature	77°F
ASTM Hazard Rating	**No Hazard**
GSA Performance Condition	**2**

Peak Positive Pressure	
Top Pressure	7.3 psi
Right Pressure	7.7 psi
Shell Pressure	7.0 psi
Average Pressure	**7.3 psi**
Witness Chamber Pressure	No pressure rise

Peak Positive Phase Duration	
Top Duration	13 msec
Right Duration	13 msec
Shell Duration	13 msec
Average Duration	**13 msec**

Peak Positive Phase Impulse	
Top Impulse	48 psi*msec
Right Impulse	49 psi*msec
Shell Impulse	48 psi*msec
Average Impulse	**48 psi*msec**

Glazing Response	
Exterior Lite	Fractured
Interior Lite	Fractured
Glazing Pullout Length and Location	None
Glazing Tearing	None

Witness Chamber Results
No debris was observed.

Pressure-time plots are presented in Appendix B. Pre-test and post-test photographs are provided in Appendix C.

7.0 Test Results: (Continued)

Test Specimen #11: Aluminum Fixed/Casement Window, Laminated Glass

Description	Results
Ambient Temperature	82°F
Glazing Temperature	84°F
ASTM Hazard Rating	**No Break**
GSA Performance Condition	**1**

Peak Positive Pressure	
Top Pressure	6.9 psi
Right Pressure	7.3 psi
Shell Pressure	6.3 psi
Average Pressure	**6.8 psi**
Witness Chamber Pressure	No pressure rise

Peak Positive Phase Duration	
Top Duration	13 msec
Right Duration	13 msec
Shell Duration	13 msec
Average Duration	**13 msec**

Peak Positive Phase Impulse	
Top Impulse	44 psi*msec
Right Impulse	43 psi*msec
Shell Impulse	43 psi*msec
Average Impulse	**43 psi*msec**

Glazing Response	
Exterior Lite	Unbroken
Interior Lite	Unbroken
Glazing Pullout Length and Location	None
Glazing Tearing	None

Witness Chamber Results
No visible damage. No debris was observed.

Pressure-time plots are presented in Appendix B. Pre-test and post-test photographs are provided in Appendix C.

7.0 Test Results: (Continued)

Test Specimen #12: Aluminum Fixed/Casement Window, Laminated Glass

Description	Results
Ambient Temperature	83°F
Glazing Temperature	85°F
ASTM Hazard Rating	**Minimal Hazard**
GSA Performance Condition	**2**

Peak Positive Pressure	
Top Pressure	10.6 psi
Right Pressure	11.6 psi
Shell Pressure	10.5 psi
Average Pressure	**10.9 psi**
Witness Chamber Pressure	No pressure rise

Peak Positive Phase Duration	
Top Duration	15 msec
Right Duration	16 msec
Shell Duration	15 msec
Average Duration	**15 msec**

Peak Positive Phase Impulse	
Top Impulse	93 psi*msec
Right Impulse	92 psi*msec
Shell Impulse	92 psi*msec
Average Impulse	**92 psi*msec**

Glazing Response	
Exterior Lite	Fixed Fractured Sash Unbroken
Interior Lite	Fixed Fractured Sash Fractured
Glazing Pullout Length and Location	None
Glazing Tearing	None

Witness Chamber Results
A dusting of glass was deposited on the witness chamber floor. Slight frame damage was observed at the vertical stile head connection.

Pressure-time plots are presented in Appendix B. Pre-test and post-test photographs are provided in Appendix C.

7.0 Test Results: (Continued)

Test Specimen #13: Aluminum Fixed/Casement Window, Laminated Glass

Description	Results
Ambient Temperature	86°F
Glazing Temperature	87°F
ASTM Hazard Rating	**High Hazard**
GSA Performance Condition	**5**

Peak Positive Pressure	
Top Pressure	10.6 psi
Right Pressure	11.2 psi
Shell Pressure	10.4 psi
Average Pressure	**10.7 psi**
Witness Chamber Pressure	No pressure rise

Peak Positive Phase Duration	
Top Duration	16 msec
Right Duration	16 msec
Shell Duration	15 msec
Average Duration	**16 msec**

Peak Positive Phase Impulse	
Top Impulse	88 psi*msec
Right Impulse	88 psi*msec
Shell Impulse	87 psi*msec
Average Impulse	**88 psi*msec**

Glazing Response	
Exterior Lite	Sash Unbroken Fixed Fractured
Interior Lite	Sash Unbroken Fixed Fractured
Glazing Pullout Length and Location	None
Glazing Tearing	Full length horizontal tear at center Full length vertical tear at mullion

Witness Chamber Results
Active sash unbroken. Fixed lite tore, impacts on witness panel above 24" mark. Several impacts penetrated into the second layer of foam.

Pressure-time plots are presented in Appendix B. Pre-test and post-test photographs are provided in Appendix C.

7.0 Test Results: (Continued)

Test Specimen #14: Aluminum Fixed/Casement Window, Laminated Glass

Description	Results
Ambient Temperature	85°F
Glazing Temperature	86°F
ASTM Hazard Rating	**Minimal Hazard**
GSA Performance Condition	**2**

Peak Positive Pressure	
Top Pressure	7.1 psi
Right Pressure	7.5 psi
Shell Pressure	6.9 psi
Average Pressure	**7.2 psi**
Witness Chamber Pressure	No pressure rise

Peak Positive Phase Duration	
Top Duration	13 msec
Right Duration	13 msec
Shell Duration	13 msec
Average Duration	**13 msec**

Peak Positive Phase Impulse	
Top Impulse	47 psi*msec
Right Impulse	47 psi*msec
Shell Impulse	46 psi*msec
Average Impulse	**47 psi*msec**

Glazing Response	
Exterior Lite	Sash Unbroken Fixed Unbroken
Interior Lite	Sash Unbroken Fixed Fractured
Glazing Pullout Length and Location	None
Glazing Tearing	None

Witness Chamber Results
A dusting of glass was deposited on the witness chamber floor.

Pressure-time plots are presented in Appendix B. Pre-test and post-test photographs are provided in Appendix C.

7.0 Test Results: (Continued)

Test Specimen #15: Aluminum Fixed/Casement Window, Laminated Glass

Description	Results
Ambient Temperature	76°F
Glazing Temperature	77°F
ASTM Hazard Rating	**Low Hazard**
GSA Performance Condition	**5**

Peak Positive Pressure	
Top Pressure	10.1 psi
Right Pressure	11.0 psi
Shell Pressure	10.3 psi
Average Pressure	**10.5 psi**
Witness Chamber Pressure	No pressure rise

Peak Positive Phase Duration	
Top Duration	15 msec
Right Duration	16 msec
Shell Duration	15 msec
Average Duration	**15 msec**

Peak Positive Phase Impulse	
Top Impulse	89 psi*msec
Right Impulse	89 psi*msec
Shell Impulse	88 psi*msec
Average Impulse	**89 psi*msec**

Glazing Response	
Exterior Lite	Fixed Fractured Sash Unbroken
Interior Lite	Fixed Fractured Sash Fractured
Glazing Pullout Length and Location	None
Glazing Tearing	13" tear in fixed lite

Witness Chamber Results
Multiple impacts observed above the 24" mark. No penetrations into the second layer of the witness panel.

Pressure-time plots are presented in Appendix B. Pre-test and post-test photographs are provided in Appendix C.

7.0 Test Results: (Continued)

Test Specimen #16: Fixed/Casement Window, 3M™ Ultra S600 Window Film

Description	Results
Ambient Temperature	79°F
Glazing Temperature	81°F
ASTM Hazard Rating	**Minimal Hazard**
GSA Performance Condition	**2**

Peak Positive Pressure	
Top Pressure	11.1 psi
Right Pressure	11.7 psi
Shell Pressure	10.3 psi
Average Pressure	**11.0 psi**
Witness Chamber Pressure	No pressure rise

Peak Positive Phase Duration	
Top Duration	16 msec
Right Duration	15 msec
Shell Duration	15 msec
Average Duration	**15 msec**

Peak Positive Phase Impulse	
Top Impulse	91 psi*msec
Right Impulse	91 psi*msec
Shell Impulse	90 psi*msec
Average Impulse	**91 psi*msec**

Glazing Response	
Exterior Lite	Fractured
Interior Lite	Fractured
Glazing Pullout Length and Location	None
Glazing Tearing	1" tear at sash handle

Witness Chamber Results
A dusting of glass was deposited on the witness chamber floor.

Pressure-time plots are presented in Appendix B. Pre-test and post-test photographs are provided in Appendix C.

7.0 Test Results: (Continued)

Test Specimen #17: Fixed/Casement Window, 3M™ Ultra S600 Window Film

Description	Results
Ambient Temperature	78°F
Glazing Temperature	76°F
ASTM Hazard Rating	**Minimal hazard**
GSA Performance Condition	**2**

Peak Positive Pressure	
Top Pressure	11.1 psi
Right Pressure	11.4 psi
Shell Pressure	10.0 psi
Average Pressure	**10.8 psi**
Witness Chamber Pressure	No pressure rise

Peak Positive Phase Duration	
Top Duration	15 msec
Right Duration	15 msec
Shell Duration	15 msec
Average Duration	**15 msec**

Peak Positive Phase Impulse	
Top Impulse	89 psi*msec
Right Impulse	89 psi*msec
Shell Impulse	88 psi*msec
Average Impulse	**89 psi*msec**

Glazing Response	
Exterior Lite	Fractured
Interior Lite	Fractured
Glazing Pullout Length and Location	None
Glazing Tearing	1" tear at sash handle

Witness Chamber Results
A dusting of glass was deposited on the witness chamber floor.

Pressure-time plots are presented in Appendix B. Pre-test and post-test photographs are provided in Appendix C.

7.0 Test Results: (Continued)

Test Specimen #18: Fixed/Casement Window, 3M™ Ultra S600 Window Film

Description	Results
Ambient Temperature	80°F
Glazing Temperature	80°F
ASTM Hazard Rating	**Minimal Hazard**
GSA Performance Condition	**2**

Peak Positive Pressure	
Top Pressure	10.8 psi
Right Pressure	11.5 psi
Shell Pressure	10.2 psi
Average Pressure	**10.8 psi**
Witness Chamber Pressure	No pressure rise

Peak Positive Phase Duration	
Top Duration	16 msec
Right Duration	16 msec
Shell Duration	15 msec
Average Duration	**16 msec**

Peak Positive Phase Impulse	
Top Impulse	90 psi*msec
Right Impulse	90 psi*msec
Shell Impulse	89 psi*msec
Average Impulse	**90 psi*msec**

Glazing Response	
Exterior Lite	Sash Unbroken Fixed Fractured
Interior Lite	Sash Unbroken Fixed Fractured
Glazing Pullout Length and Location	None
Glazing Tearing	None

Witness Chamber Results
A dusting of glass was deposited on the witness chamber floor.

Pressure-time plots are presented in Appendix B. Pre-test and post-test photographs are provided in Appendix C.

7.0 Test Results: (Continued)

Test Specimen #19: Fixed/Project Out Window, Laminated Glass

Description	Results
Ambient Temperature	76°F
Glazing Temperature	77°F
ASTM Hazard Rating	**Minimal Hazard**
GSA Performance Condition	**2**

Peak Positive Pressure	
Top Pressure	10.3 psi
Right Pressure	11.0 psi
Shell Pressure	10.0 psi
Average Pressure	**10.4 psi**
Witness Chamber Pressure	No pressure rise

Peak Positive Phase Duration	
Top Duration	16 msec
Right Duration	15 msec
Shell Duration	16 msec
Average Duration	**16 msec**

Peak Positive Phase Impulse	
Top Impulse	89 psi*msec
Right Impulse	89 psi*msec
Shell Impulse	88 psi*msec
Average Impulse	**89 psi*msec**

Glazing Response	
Exterior Lite	Fixed Unbroken Sash Unbroken
Interior Lite	Fixed Fractured Sash Unbroken
Glazing Pullout Length and Location	None
Glazing Tearing	None

Witness Chamber Results
A dusting of glass was deposited on the witness chamber floor.

Pressure-time plots are presented in Appendix B. Pre-test and post-test photographs are provided in Appendix C.

7.0 Test Results: (Continued)

Test Specimen #20: Fixed/Project Out Window, Laminated Glass

Description	Results
Ambient Temperature	76°F
Glazing Temperature	76°F
ASTM Hazard Rating	**Minimal Hazard**
GSA Performance Condition	**2**

Peak Positive Pressure	
Top Pressure	10.6 psi
Right Pressure	10.6 psi
Shell Pressure	9.9 psi
Average Pressure	**10.3 psi**
Witness Chamber Pressure	No pressure rise

Peak Positive Phase Duration	
Top Duration	15 msec
Right Duration	16 msec
Shell Duration	15 msec
Average Duration	**15 msec**

Peak Positive Phase Impulse	
Top Impulse	89 psi*msec
Right Impulse	90 psi*msec
Shell Impulse	89 psi*msec
Average Impulse	**89 psi*msec**

Glazing Response	
Exterior Lite	Fixed Unbroken Sash Unbroken
Interior Lite	Fixed Fractured Sash Fractured
Glazing Pullout Length and Location	None
Glazing Tearing	None

Witness Chamber Results
A dusting of glass was deposited on the witness chamber floor.

Pressure-time plots are presented in Appendix B. Pre-test and post-test photographs are provided in Appendix C.

7.0 Test Results: (Continued)

Test Specimen #21: Fixed/Project Out Window, Laminated Glass

Description	Results
Ambient Temperature	81°F
Glazing Temperature	82°F
ASTM Hazard Rating	**No Break**
GSA Performance Condition	**1**

Peak Positive Pressure	
Top Pressure	10.7 psi
Right Pressure	10.4 psi
Shell Pressure	9.8 psi
Average Pressure	**10.3 psi**
Witness Chamber Pressure	No pressure rise

Peak Positive Phase Duration	
Top Duration	15 msec
Right Duration	15 msec
Shell Duration	15 msec
Average Duration	**15 msec**

Peak Positive Phase Impulse	
Top Impulse	89 psi*msec
Right Impulse	88 psi*msec
Shell Impulse	89 psi*msec
Average Impulse	**89 psi*msec**

Glazing Response	
Exterior Lite	Unbroken
Interior Lite	Unbroken
Glazing Pullout Length and Location	None
Glazing Tearing	None

Witness Chamber Results
No debris was observed.

Pressure-time plots are presented in Appendix B. Pre-test and post-test photographs are provided in Appendix C.

7.0 Test Results: (Continued)

Test Specimen #22: Fixed/Project Out Window, Laminated Glass

Description	Results
Ambient Temperature	82°F
Glazing Temperature	84°F
ASTM Hazard Rating	**No Break**
GSA Performance Condition	**1**

Peak Positive Pressure	
Top Pressure	11.5 psi
Right Pressure	10.8 psi
Shell Pressure	10.5 psi
Average Pressure	**10.9 psi**
Witness Chamber Pressure	No pressure rise

Peak Positive Phase Duration	
Top Duration	16 msec
Right Duration	15 msec
Shell Duration	15 msec
Average Duration	**15 msec**

Peak Positive Phase Impulse	
Top Impulse	90 psi*msec
Right Impulse	89 psi*msec
Shell Impulse	89 psi*msec
Average Impulse	**89 psi*msec**

Glazing Response	
Exterior Lite	Unbroken
Interior Lite	Unbroken
Glazing Pullout Length and Location	None
Glazing Tearing	None

Witness Chamber Results
No debris was observed.

Pressure-time plots are presented in Appendix B. Pre-test and post-test photographs are provided in Appendix C.

7.0 Test Results: (Continued)

Test Specimen #23: Fixed/Project Out Window, Laminated Glass

Description	Results
Ambient Temperature	83°F
Glazing Temperature	84°F
ASTM Hazard Rating	**Minimal Hazard**
GSA Performance Condition	**2**

Peak Positive Pressure	
Top Pressure	11.1 psi
Right Pressure	10.1 psi
Shell Pressure	9.7 psi
Average Pressure	**10.3 psi**
Witness Chamber Pressure	No pressure rise

Peak Positive Phase Duration	
Top Duration	15 msec
Right Duration	16 msec
Shell Duration	15 msec
Average Duration	**15 msec**

Peak Positive Phase Impulse	
Top Impulse	89 psi*msec
Right Impulse	89 psi*msec
Shell Impulse	88 psi*msec
Average Impulse	**89 psi*msec**

Glazing Response	
Exterior Lite	Fixed Unbroken Sash Unbroken
Interior Lite	Sash Fractured Fixed Unbroken
Glazing Pullout Length and Location	None
Glazing Tearing	None

Witness Chamber Results
A dusting of glass was deposited on the witness chamber floor.

Pressure-time plots are presented in Appendix B. Pre-test and post-test photographs are provided in Appendix C.

7.0 Test Results: (Continued)

Test Specimen #24: Fixed/Project Out Window, 3M™ Ultra S600 Window Film

Description	Results
Ambient Temperature	75°F
Glazing Temperature	76°F
ASTM Hazard Rating	**No Break**
GSA Performance Condition	**1**

Peak Positive Pressure	
Top Pressure	10.9 psi
Right Pressure	10.2 psi
Shell Pressure	9.8 psi
Average Pressure	**10.3 psi**
Witness Chamber Pressure	No pressure rise

Peak Positive Phase Duration	
Top Duration	15 msec
Right Duration	15 msec
Shell Duration	16 msec
Average Duration	**15 msec**

Peak Positive Phase Impulse	
Top Impulse	89 psi*msec
Right Impulse	89 psi*msec
Shell Impulse	88 psi*msec
Average Impulse	**89 psi*msec**

Glazing Response	
Exterior Lite	Unbroken
Interior Lite	Unbroken
Glazing Pullout Length and Location	None
Glazing Tearing	None

Witness Chamber Results
No debris was observed.

Pressure-time plots are presented in Appendix B. Pre-test and post-test photographs are provided in Appendix C.

7.0 Test Results: (Continued)

Test Specimen #25: Fixed/Project Out Window, 3M™ Ultra S600 Window Film

Description	Results
Ambient Temperature	77°F
Glazing Temperature	77°F
ASTM Hazard Rating	**No Break**
GSA Performance Condition	**1**

Peak Positive Pressure	
Top Pressure	11.3 psi
Right Pressure	11.0 psi
Shell Pressure	10.1 psi
Average Pressure	**10.8 psi**
Witness Chamber Pressure	No pressure rise

Peak Positive Phase Duration	
Top Duration	16 msec
Right Duration	16 msec
Shell Duration	15 msec
Average Duration	**16 msec**

Peak Positive Phase Impulse	
Top Impulse	89 psi*msec
Right Impulse	89 psi*msec
Shell Impulse	89 psi*msec
Average Impulse	**89 psi*msec**

Glazing Response	
Exterior Lite	Unbroken
Interior Lite	Unbroken
Glazing Pullout Length and Location	None
Glazing Tearing	None

Witness Chamber Results
No debris was observed.

Pressure-time plots are presented in Appendix B. Pre-test and post-test photographs are provided in Appendix C.

7.0 Test Results: (Continued)

Test Specimen #26: Fixed/Project Out Window, 3M™ Ultra S600 Window Film

Description	Results
Ambient Temperature	80°F
Glazing Temperature	81°F
ASTM Hazard Rating	**No Break**
GSA Performance Condition	**1**

Peak Positive Pressure	
Top Pressure	10.5 psi
Right Pressure	10.2 psi
Shell Pressure	9.7 psi
Average Pressure	**10.1 psi**
Witness Chamber Pressure	No pressure rise

Peak Positive Phase Duration	
Top Duration	15 msec
Right Duration	15 msec
Shell Duration	15 msec
Average Duration	**15 msec**

Peak Positive Phase Impulse	
Top Impulse	89 psi*msec
Right Impulse	89 psi*msec
Shell Impulse	88 psi*msec
Average Impulse	**89 psi*msec**

Glazing Response	
Exterior Lite	Unbroken
Interior Lite	Unbroken
Glazing Pullout Length and Location	None
Glazing Tearing	None

Witness Chamber Results
No debris was observed.

Pressure-time plots are presented in Appendix B. Pre-test and post-test photographs are provided in Appendix C.

7.0 Test Results: (Continued)

Test Specimen #27: Fixed/Sliding Window, Laminated Glass

Description	Results
Ambient Temperature	78°F
Glazing Temperature	79°F
ASTM Hazard Rating	**Minimal Hazard**
GSA Performance Condition	**2**

Peak Positive Pressure	
Top Pressure	7.2 psi
Right Pressure	7.5 psi
Shell Pressure	7.6 psi
Average Pressure	**7.4 psi**
Witness Chamber Pressure	No pressure rise

Peak Positive Phase Duration	
Top Duration	13 msec
Right Duration	14 msec
Shell Duration	13 msec
Average Duration	**13 msec**

Peak Positive Phase Impulse	
Top Impulse	46 psi*msec
Right Impulse	46 psi*msec
Shell Impulse	46 psi*msec
Average Impulse	**46 psi*msec**

Glazing Response	
Exterior Lite	Fixed Unbroken Sash Unbroken
Interior Lite	Fixed Fractured Sash Fractured
Glazing Pullout Length and Location	None
Glazing Tearing	None

Witness Chamber Results
A dusting of glass was deposited on the witness chamber floor.

Pressure-time plots are presented in Appendix B. Pre-test and post-test photographs are provided in Appendix C.

7.0 Test Results: (Continued)

Test Specimen #28: Fixed/Sliding Window, Laminated Glass

Description	Results
Ambient Temperature	85°F
Glazing Temperature	86°F
ASTM Hazard Rating	**Minimal Hazard**
GSA Performance Condition	**3b**

Peak Positive Pressure	
Top Pressure	10.8 psi
Right Pressure	11.4 psi
Shell Pressure	10.2 psi
Average Pressure	**10.8 psi**
Witness Chamber Pressure	No pressure rise

Peak Positive Phase Duration	
Top Duration	15 msec
Right Duration	15 msec
Shell Duration	15 msec
Average Duration	**15 msec**

Peak Positive Phase Impulse	
Top Impulse	89 psi*msec
Right Impulse	89 psi*msec
Shell Impulse	88 psi*msec
Average Impulse	**89 psi*msec**

Glazing Response	
Exterior Lite	Fractured
Interior Lite	Fractured
Glazing Pullout Length and Location	None
Glazing Tearing	Fixed: One 5" vertical tear at stile and one 6" horizontal tear at center

Witness Chamber Results
One fragment was located 11" from the back wall.

Pressure-time plots are presented in Appendix B. Pre-test and post-test photographs are provided in Appendix C.

7.0 Test Results: (Continued)

Test Specimen #29: Fixed/Sliding Window, Laminated Glass

Description	Results
Ambient Temperature	79°F
Glazing Temperature	80°F
ASTM Hazard Rating	**High Hazard**
GSA Performance Condition	**5**

Peak Positive Pressure	
Top Pressure	11.0 psi
Right Pressure	11.5 psi
Shell Pressure	10.3 psi
Average Pressure	**10.9 psi**
Witness Chamber Pressure	0.43 psi

Peak Positive Phase Duration	
Top Duration	15 msec
Right Duration	16 msec
Shell Duration	15 msec
Average Duration	**15 msec**

Peak Positive Phase Impulse	
Top Impulse	89 psi*msec
Right Impulse	89 psi*msec
Shell Impulse	88 psi*msec
Average Impulse	**89 psi*msec**

Glazing Response	
Exterior Lite	Fractured
Interior Lite	Fractured
Glazing Pullout Length and Location	None
Glazing Tearing	100% of DLO perimeter

Witness Chamber Results
Complete failure of fixed lite. Impacts in witness panel above the 24" mark.

Pressure-time plots are presented in Appendix B. Pre-test and post-test photographs are provided in Appendix C.

7.0 Test Results: (Continued)

Test Specimen #30: Fixed/Sliding Window, Laminated Glass

Description	Results
Ambient Temperature	84°F
Glazing Temperature	86°F
ASTM Hazard Rating	**Minimal Hazard**
GSA Performance Condition	**2**

Peak Positive Pressure	
Top Pressure	7.7 psi
Right Pressure	7.9psi
Shell Pressure	7.2 psi
Average Pressure	**7.6 psi**
Witness Chamber Pressure	No pressure rise

Peak Positive Phase Duration	
Top Duration	13 msec
Right Duration	13 msec
Shell Duration	13 msec
Average Duration	**13 msec**

Peak Positive Phase Impulse	
Top Impulse	49 psi*msec
Right Impulse	49 psi*msec
Shell Impulse	50 psi*msec
Average Impulse	**49 psi*msec**

Glazing Response	
Exterior Lite	Fixed Unbroken Sash Unbroken
Interior Lite	Fixed Fractured Sash Fractured
Glazing Pullout Length and Location	None
Glazing Tearing	None

Witness Chamber Results
A dusting of glass was deposited on the witness chamber floor.

Pressure-time plots are presented in Appendix B. Pre-test and post-test photographs are provided in Appendix C.

7.0 Test Results: (Continued)

Test Specimen #31: Fixed/Sliding Window, Laminated Glass

Description	Results
Ambient Temperature	79°F
Glazing Temperature	79°F
ASTM Hazard Rating	**No Hazard**
GSA Performance Condition	**2**

Peak Positive Pressure	
Top Pressure	7.1 psi
Right Pressure	7.4 psi
Shell Pressure	6.8 psi
Average Pressure	**7.1 psi**
Witness Chamber Pressure	No pressure rise

Peak Positive Phase Duration	
Top Duration	13 msec
Right Duration	13 msec
Shell Duration	13 msec
Average Duration	**13 msec**

Peak Positive Phase Impulse	
Top Impulse	47 psi*msec
Right Impulse	47 psi*msec
Shell Impulse	46 psi*msec
Average Impulse	**47 psi*msec**

Glazing Response	
Exterior Lite	Sash Unbroken Fixed Unbroken
Interior Lite	Sash Unbroken Fixed Fractured (Interior surface unbroken)
Glazing Pullout Length and Location	None
Glazing Tearing	None

Witness Chamber Results
No debris was observed.

Pressure-time plots are presented in Appendix B. Pre-test and post-test photographs are provided in Appendix C.

7.0 Test Results: (Continued)

Test Specimen #32: Fixed/Sliding Window, 3M™ Ultra S600 Window Film

Description	Results
Ambient Temperature	85°F
Glazing Temperature	87°F
ASTM Hazard Rating	**Low Hazard**
GSA Performance Condition	**5**

Peak Positive Pressure	
Top Pressure	11.0 psi
Right Pressure	11.6 psi
Shell Pressure	10.3 psi
Average Pressure	**10.9 psi**
Witness Chamber Pressure	0.47 psi

Peak Positive Phase Duration	
Top Duration	15 msec
Right Duration	15 msec
Shell Duration	16 msec
Average Duration	**15 msec**

Peak Positive Phase Impulse	
Top Impulse	91 psi*msec
Right Impulse	90 psi*msec
Shell Impulse	90 psi*msec
Average Impulse	**90 psi*msec**

Glazing Response	
Exterior Lite	Fractured
Interior Lite	Fractured
Glazing Pullout Length and Location	None
Glazing Tearing	1" tear of film at top corner of active sash

Witness Chamber Results
Approximately 4" sum total between 1m-3m. Approximately 8" sum total between the sill to 1m. One impact at 33" from the floor of the witness chamber.

Pressure-time plots are presented in Appendix B. Pre-test and post-test photographs are provided in Appendix C.

7.0 Test Results: (Continued)

Test Specimen #33: Fixed/Sliding Window, 3M™ Ultra S600 Window Film

Description	Results
Ambient Temperature	81°F
Glazing Temperature	83°F
ASTM Hazard Rating	**Minimal Hazard**
GSA Performance Condition	**2**

Peak Positive Pressure	
Top Pressure	7.7 psi
Right Pressure	7.8 psi
Shell Pressure	7.1 psi
Average Pressure	**7.5 psi**
Witness Chamber Pressure	No pressure rise

Peak Positive Phase Duration	
Top Duration	13 msec
Right Duration	14 msec
Shell Duration	13 msec
Average Duration	**13 msec**

Peak Positive Phase Impulse	
Top Impulse	49 psi*msec
Right Impulse	50 psi*msec
Shell Impulse	49 psi*msec
Average Impulse	**49 psi*msec**

Glazing Response	
Exterior Lite	Fixed Unbroken Sash Unbroken
Interior Lite	Fixed Fractured Sash Unbroken
Glazing Pullout Length and Location	None
Glazing Tearing	None

Witness Chamber Results
A dusting of glass was deposited on the witness chamber floor.

Pressure-time plots are presented in Appendix B. Pre-test and post-test photographs are provided in Appendix C.

7.0 Test Results: (Continued)

Test Specimen #34: Fixed/Sliding Window, 3M™ Ultra S600 Window Film

Description	Results
Ambient Temperature	84°F
Glazing Temperature	85°F
ASTM Hazard Rating	**Minimal Hazard**
GSA Performance Condition	**2**

Peak Positive Pressure	
Top Pressure	7.1 psi
Right Pressure	7.5 psi
Shell Pressure	6.8 psi
Average Pressure	**7.1 psi**
Witness Chamber Pressure	No pressure rise

Peak Positive Phase Duration	
Top Duration	13 msec
Right Duration	13 msec
Shell Duration	13 msec
Average Duration	**13 msec**

Peak Positive Phase Impulse	
Top Impulse	47 psi*msec
Right Impulse	48 psi*msec
Shell Impulse	47 psi*msec
Average Impulse	**47 psi*msec**

Glazing Response	
Exterior Lite	Fixed Unbroken Sash Unbroken
Interior Lite	Fixed Fractured Sash Fractured
Glazing Pullout Length and Location	None
Glazing Tearing	None

Witness Chamber Results
A dusting of glass was deposited on the witness chamber floor.

Pressure-time plots are presented in Appendix B. Pre-test and post-test photographs are provided in Appendix C.

7.0 Test Results: (Continued)

Test Specimen #35: Fixed/Sliding Window, 3M™ Ultra S600 Window Film

Description	Results
Ambient Temperature	85°F
Glazing Temperature	85°F
ASTM Hazard Rating	**No Break**
GSA Performance Condition	**1**

Peak Positive Pressure	
Top Pressure	7.7 psi
Right Pressure	7.8 psi
Shell Pressure	7.1 psi
Average Pressure	**7.4 psi**
Witness Chamber Pressure	No pressure rise

Peak Positive Phase Duration	
Top Duration	13 msec
Right Duration	13 msec
Shell Duration	12 msec
Average Duration	**13 msec**

Peak Positive Phase Impulse	
Top Impulse	48 psi*msec
Right Impulse	49 psi*msec
Shell Impulse	48 psi*msec
Average Impulse	**48 psi*msec**

Glazing Response	
Exterior Lite	Unbroken
Interior Lite	Unbroken
Glazing Pullout Length and Location	None
Glazing Tearing	None

Witness Chamber Results
No debris was observed.

Pressure-time plots are presented in Appendix B. Pre-test and post-test photographs are provided in Appendix C.

7.0 Test Results: (Continued)

Test Specimen #36: Fixed/Sliding Window, 3M™ Ultra S600 Window Film ***(NOTE: Film was cut away with razor blade along perimeter of daylite opening to simulate a "daylite" film application, with no film anchoring mechanism).***

Description	Results
Ambient Temperature	76°F
Glazing Temperature	77°F
ASTM Hazard Rating	**Minimal Hazard**
GSA Performance Condition	**2**
Peak Positive Pressure	
Top Pressure	4.5 psi
Right Pressure	4.9 psi
Shell Pressure	4.5 psi
Average Pressure	**4.6 psi**
Witness Chamber Pressure	No pressure rise
Peak Positive Phase Duration	
Top Duration	14 msec
Right Duration	13 msec
Shell Duration	14 msec
Average Duration	**14 msec**
Peak Positive Phase Impulse	
Top Impulse	30 psi*msec
Right Impulse	31 psi*msec
Shell Impulse	30 psi*msec
Average Impulse	**30 psi*msec**
Glazing Response	
Exterior Lite	Fixed Unbroken Sash Unbroken
Interior Lite	Fixed Unbroken Sash Fractured
Glazing Pullout Length and Location	None
Glazing Tearing	None

Witness Chamber Results
A dusting of glass was deposited on the witness chamber floor

Pressure-time plots are presented in Appendix B. Pre-test and post-test photographs are provided in Appendix C.

The service life of this report will expire on the stated Test Record Retention End Date, at which time such materials as drawings, data sheets, samples of test specimens, copies of this report, and any other pertinent project documentation, shall be discarded without notice.

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For ARCHITECTURAL TESTING, Inc.

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Joseph A. Reed, P.E.
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Brady W. McNaughton, P.E.
Program Manager

BWM:ddr/cmd

Attachments (pages): This report is complete only when all attachments listed are included.
- Appendix-A: Test Facility (1)
- Appendix-B: Pressure-Time Plots (72)
- Appendix-C: Photographs (72)
- Appendix-D: Drawings have been removed for client confidentiality.

This report produced from controlled document template ATI 00368, revised 07/01/11.

Revision Log

Rev. #	Date	Page(s)	Revision(s)
0	09/19/11	All	Original report issue

Appendix A

Test Facility

Figure #1
Shock Tube and Test Facility

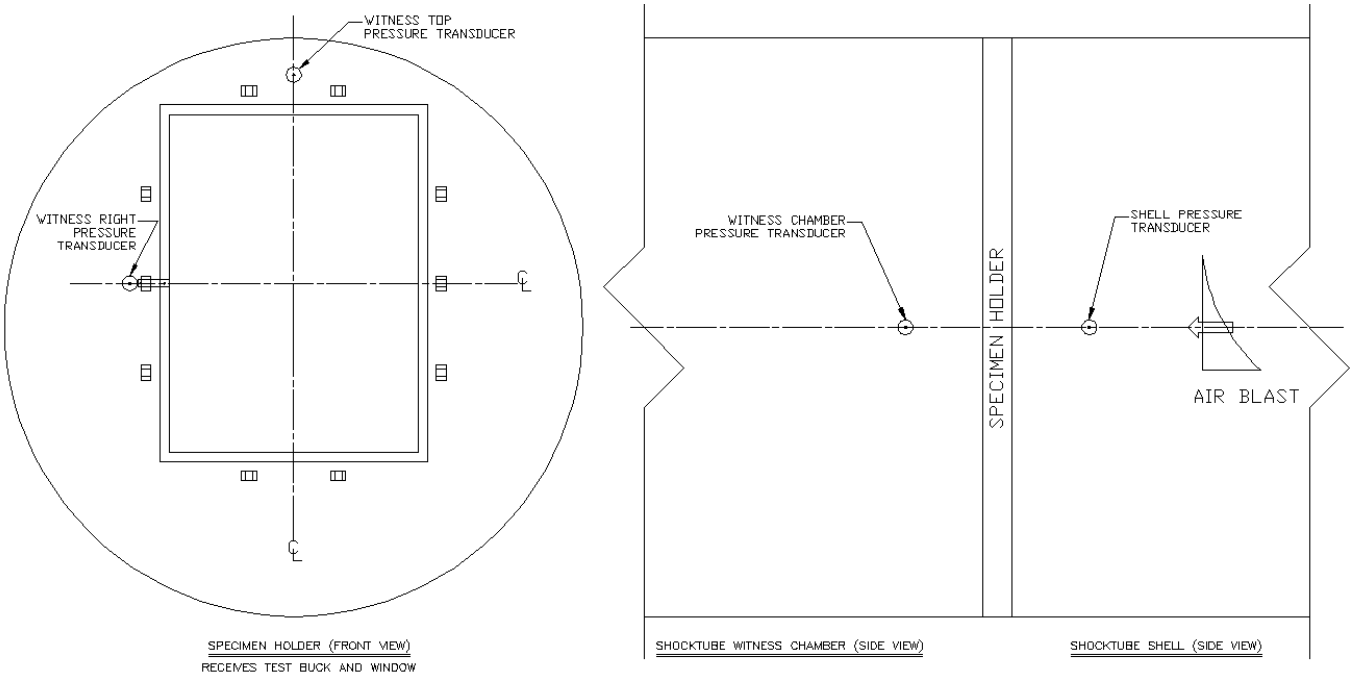
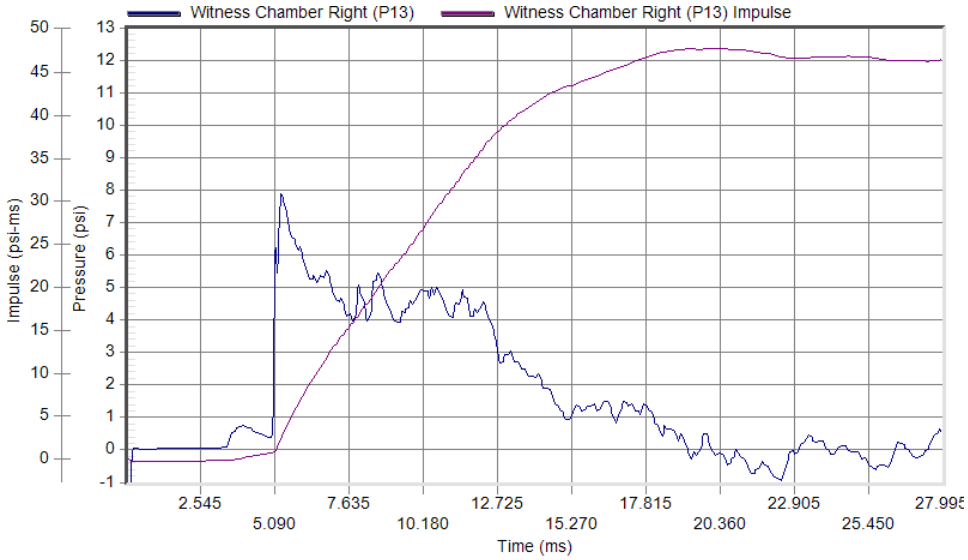


Figure #2
Pressure Sensor Locations

Appendix B

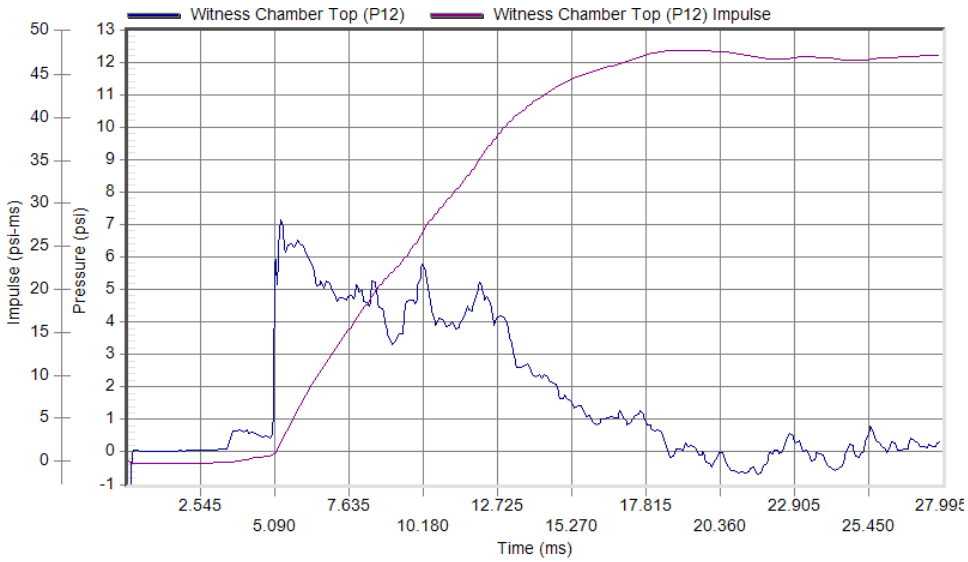
Pressure-Time Plots

Specimen #1



Peak Pressure: 7.94 psi at 5.32 ms
Duration: 13.93 ms

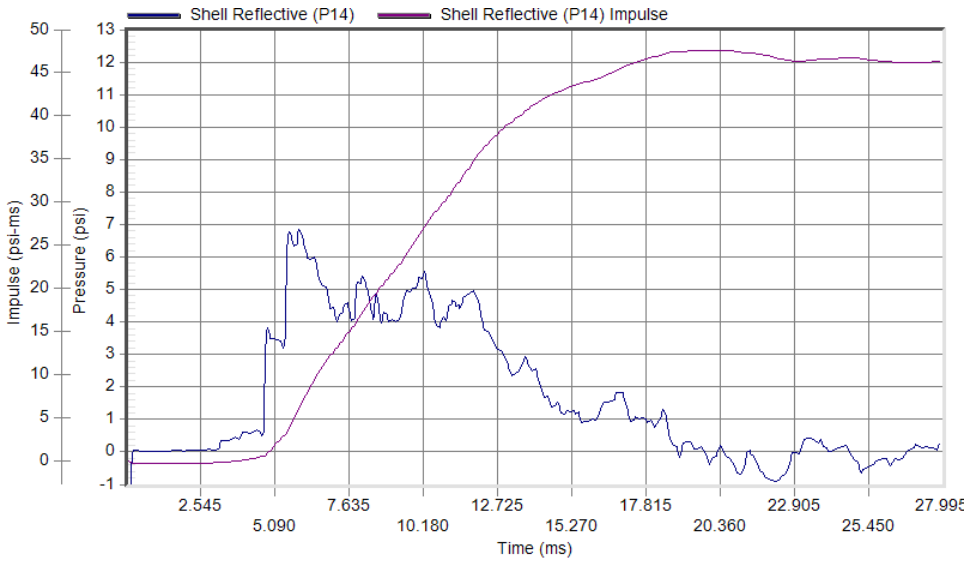
Test Date: 6/21/2011
Test Time: 9:24 am



Peak Pressure: 7.14 psi at 5.30 ms
Duration: 13.27 ms

Test Date: 6/21/2011
Test Time: 9:24 am

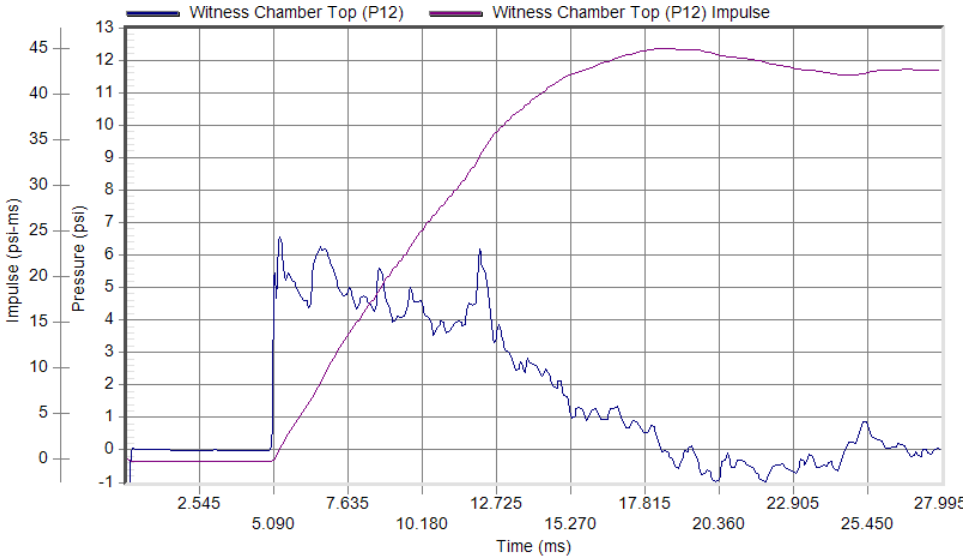
Specimen #1: (Continued)



Peak Pressure: 6.91 psi at 5.92 ms
Duration: 12.99 ms

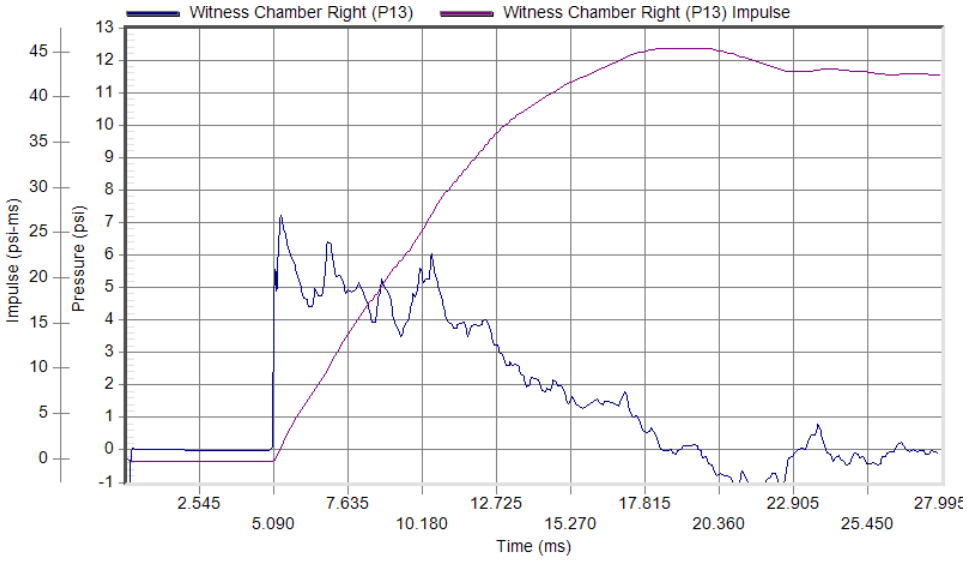
Test Date: 6/21/2011
Test Time: 9:24 am

Specimen #2



Peak Pressure: 6.61 psi at 5.30 ms
Duration: 13.04 ms

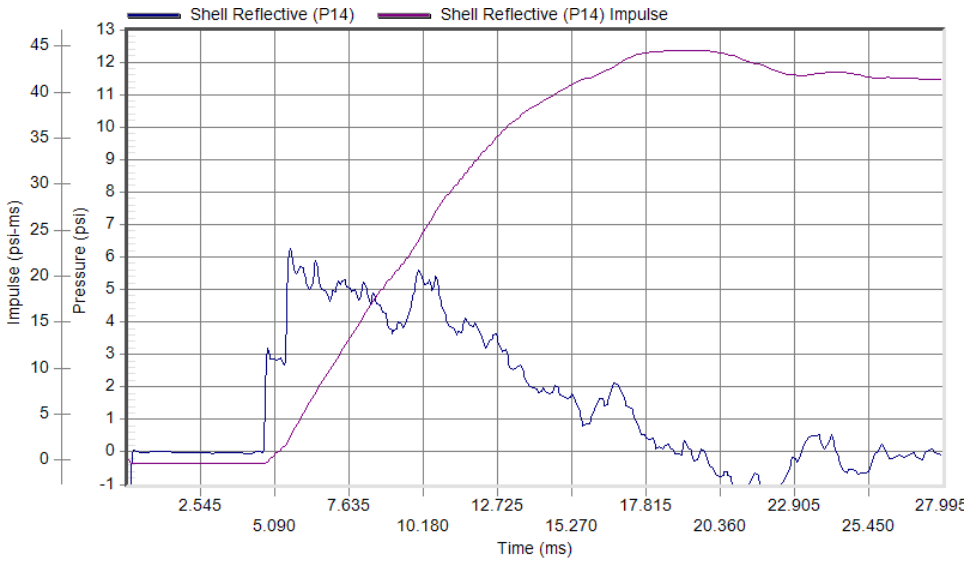
Test Date: 6/21/2011
Test Time: 10:37 am



Peak Pressure: 7.23 psi at 5.34 ms
Duration: 13.02 ms

Test Date: 6/21/2011
Test Time: 10:37 am

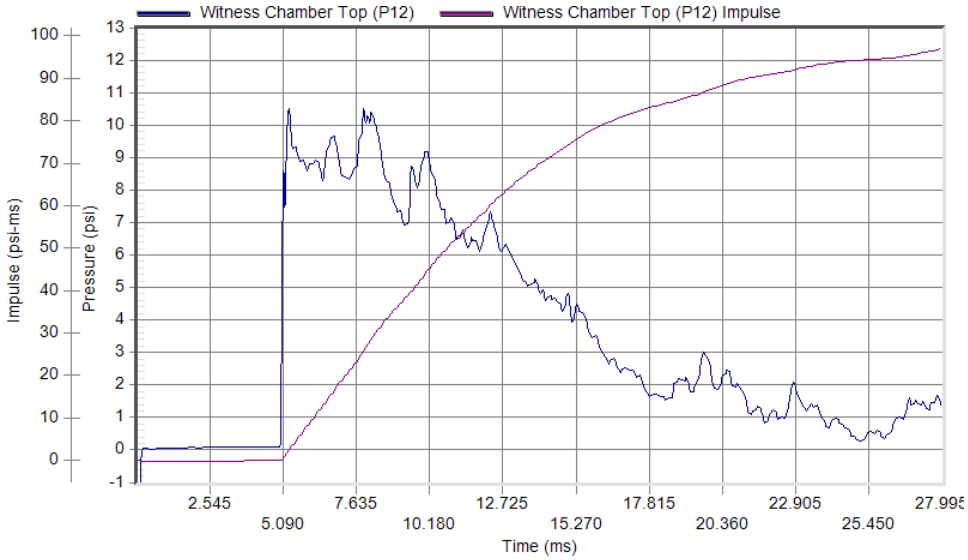
Specimen #2: (Continued)



Peak Pressure: 6.25 psi at 5.61 ms
Duration: 12.57 ms

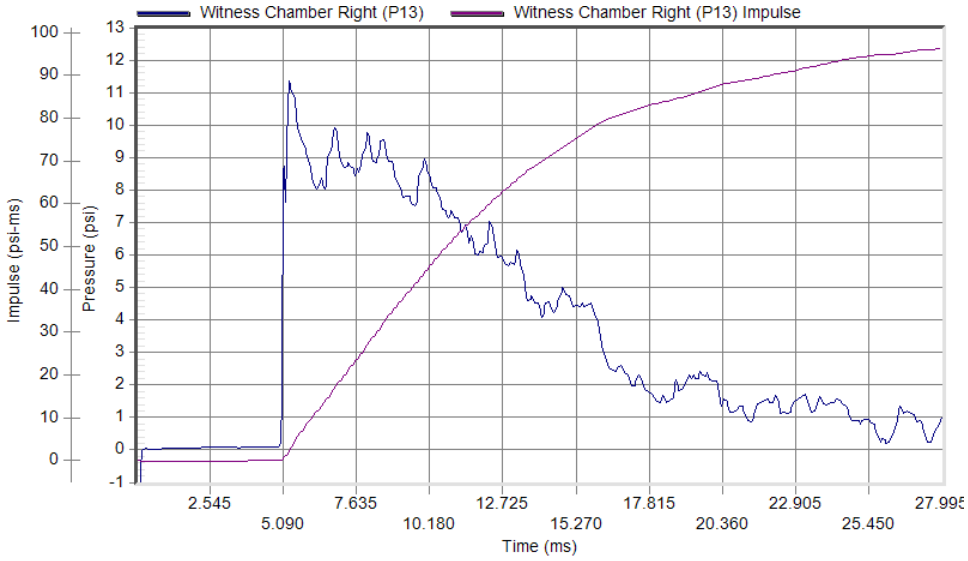
Test Date: 6/21/2011
Test Time: 10:37 am

Specimen #3



Peak Pressure: 10.58 psi at 7.90 ms
Duration: 20.13 ms

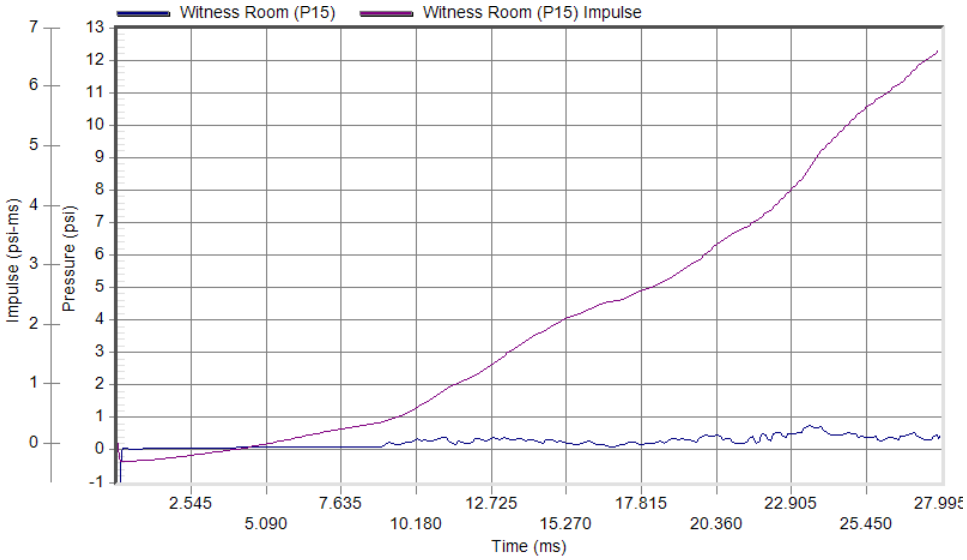
Test Date: 6/22/2011
Test Time: 1:38 pm



Peak Pressure: 11.35 psi at 5.33 ms
Duration: 20.60 ms

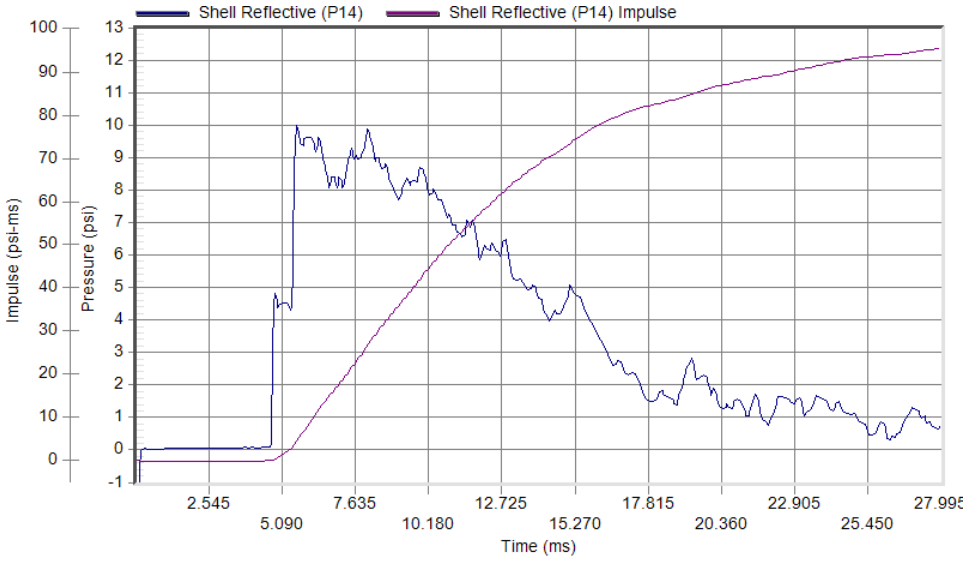
Test Date: 6/22/2011
Test Time: 1:38 pm

Specimen #3: (Continued)



Peak Pressure: 0.77 psi at 23.52 ms
Duration: 0.00 ms

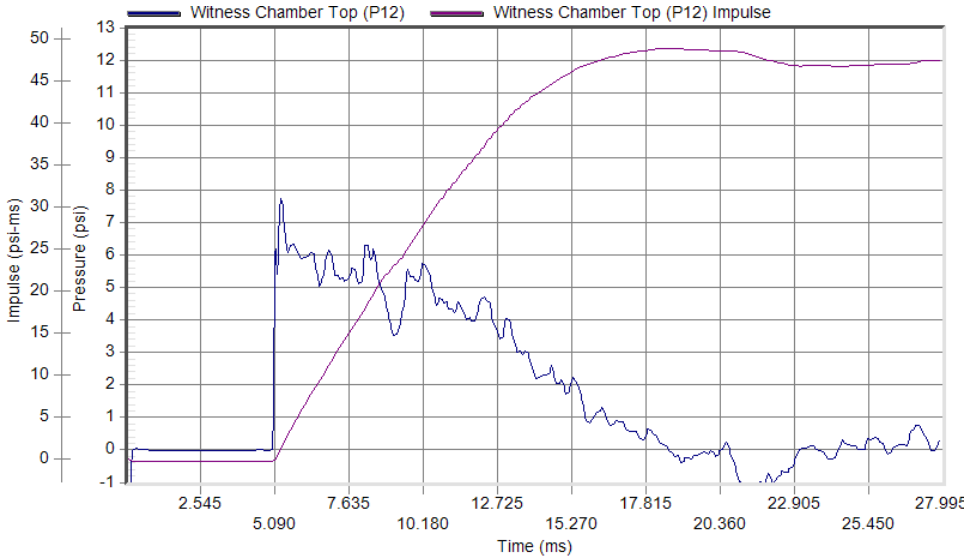
Test Date: 6/22/2011
Test Time: 1:38 pm



Peak Pressure: 9.97 psi at 5.62 ms
Duration: 0.00 ms

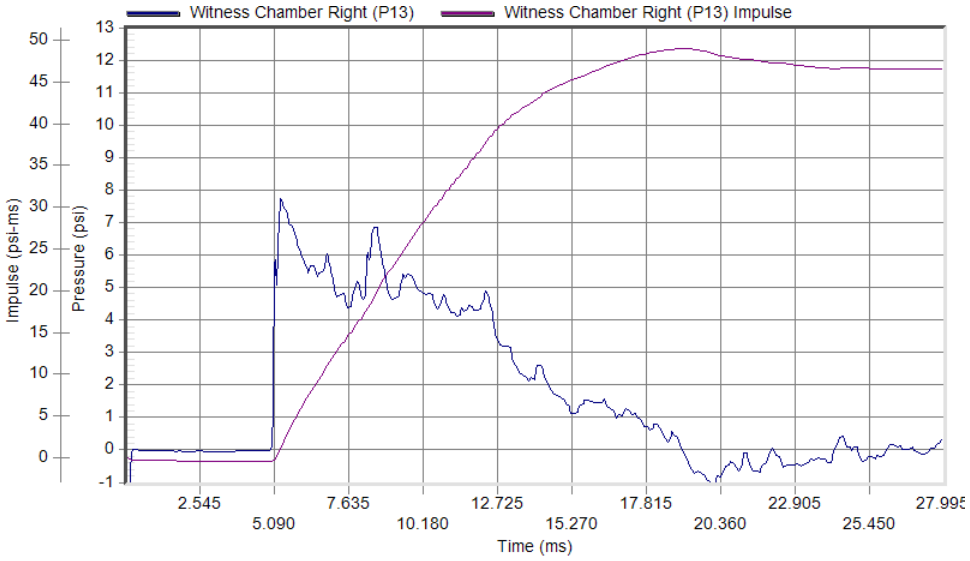
Test Date: 6/22/2011
Test Time: 1:38 pm

Specimen #4



Peak Pressure: 7.82 psi at 5.31 ms
Duration: 13.25 ms

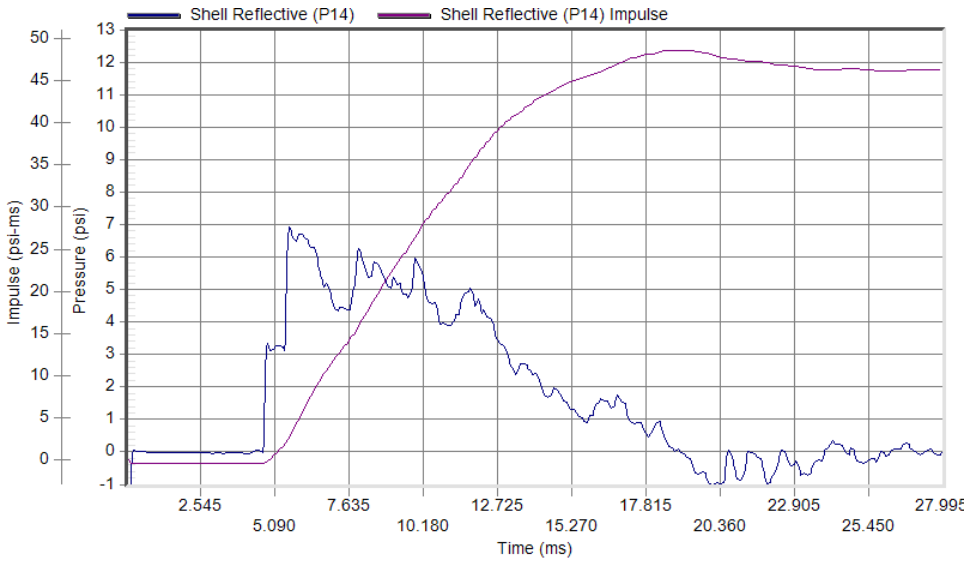
Test Date: 6/24/2011
Test Time: 9:30 am



Peak Pressure: 7.81 psi at 5.33 ms
Duration: 13.70 ms

Test Date: 6/24/2011
Test Time: 9:30 am

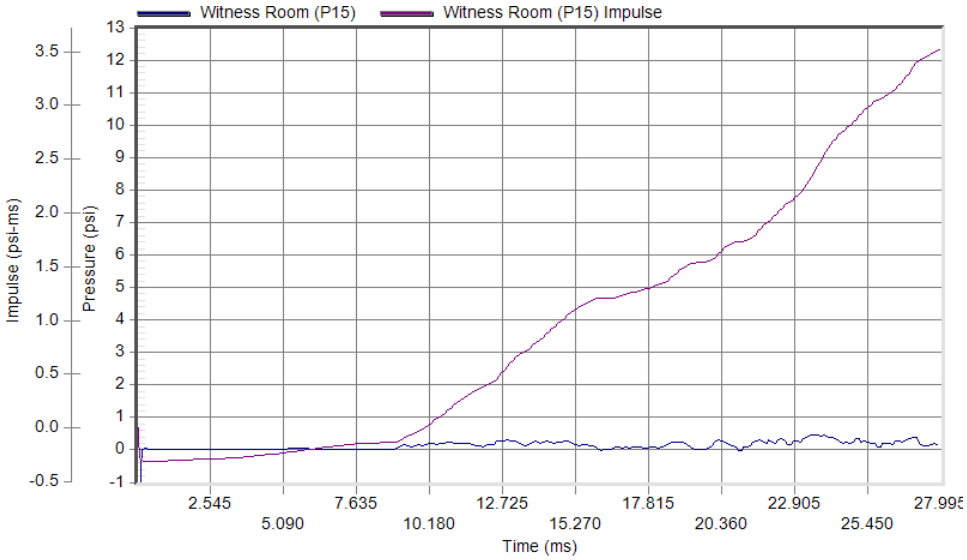
Specimen #4: (Continued)



Peak Pressure: 6.95 psi at 5.61 ms
Duration: 13.16 ms

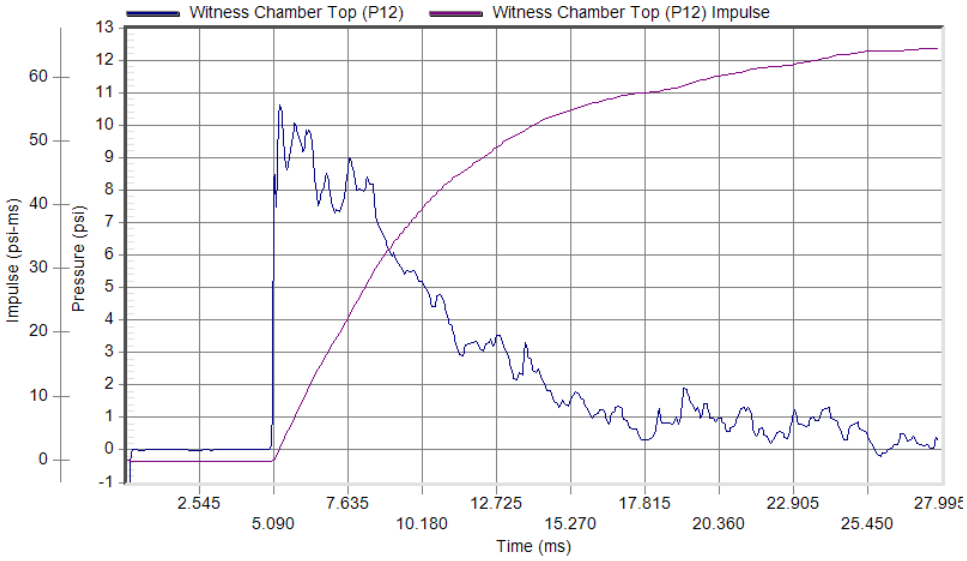
Test Date: 6/24/2011
Test Time: 9:30 am

Specimen #5



Peak Pressure: 0.50 psi at 23.61 ms
Duration: 2.18 ms

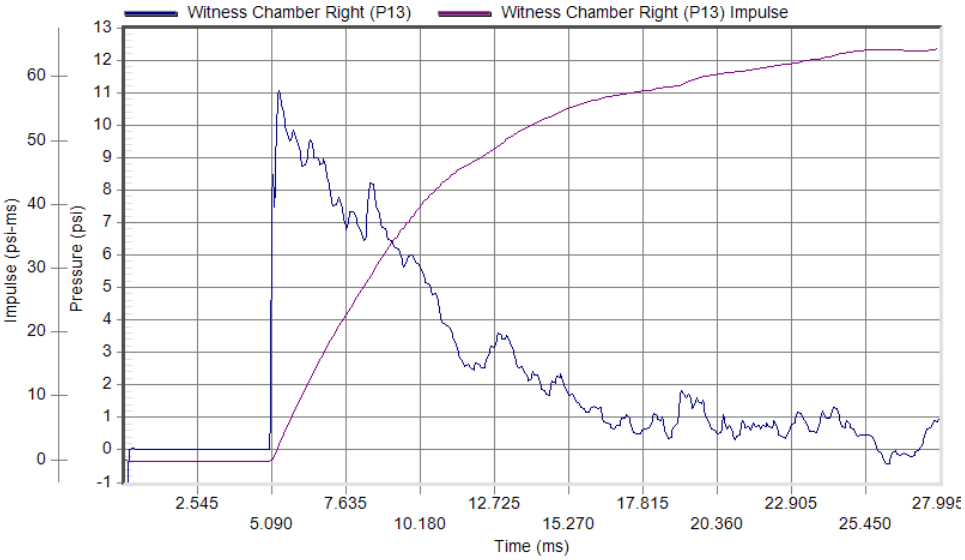
Test Date: 6/27/2011
Test Time: 8:49 am



Peak Pressure: 10.70 psi at 5.31 ms
Duration: 20.37 ms

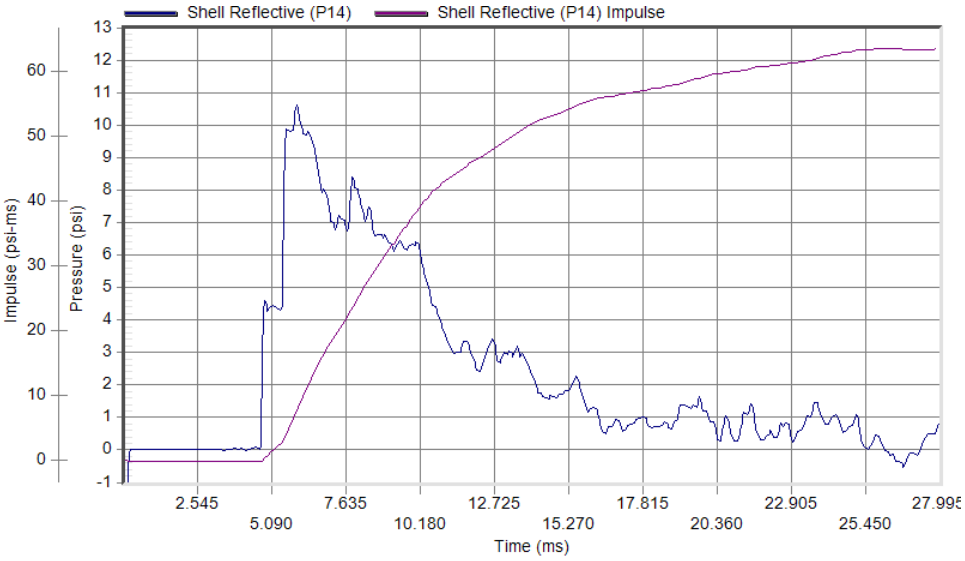
Test Date: 6/27/2011
Test Time: 8:49 am

Specimen #5: (Continued)



Peak Pressure: 11.12 psi at 5.33 ms
Duration: 20.51 ms

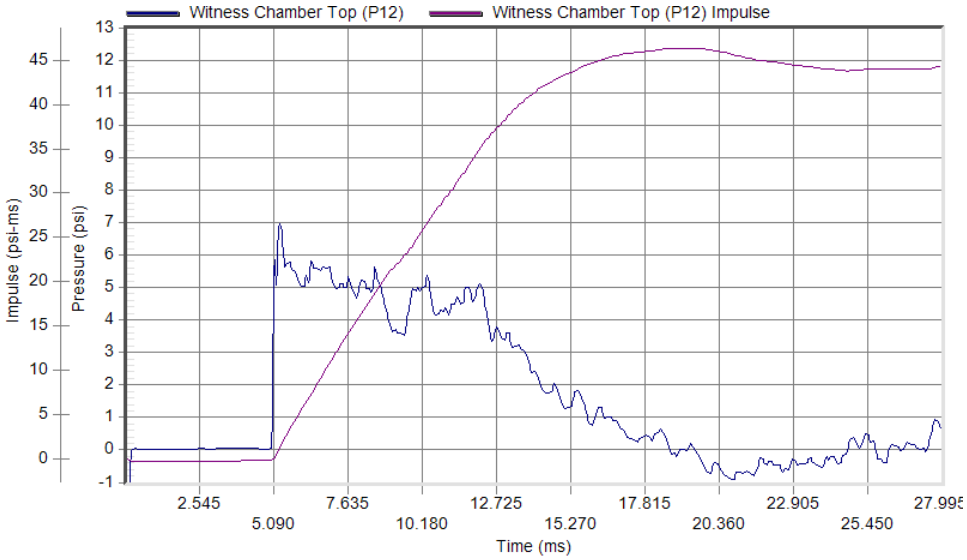
Test Date: 6/27/2011
Test Time: 8:49 am



Peak Pressure: 10.60 psi at 5.93 ms
Duration: 19.51 ms

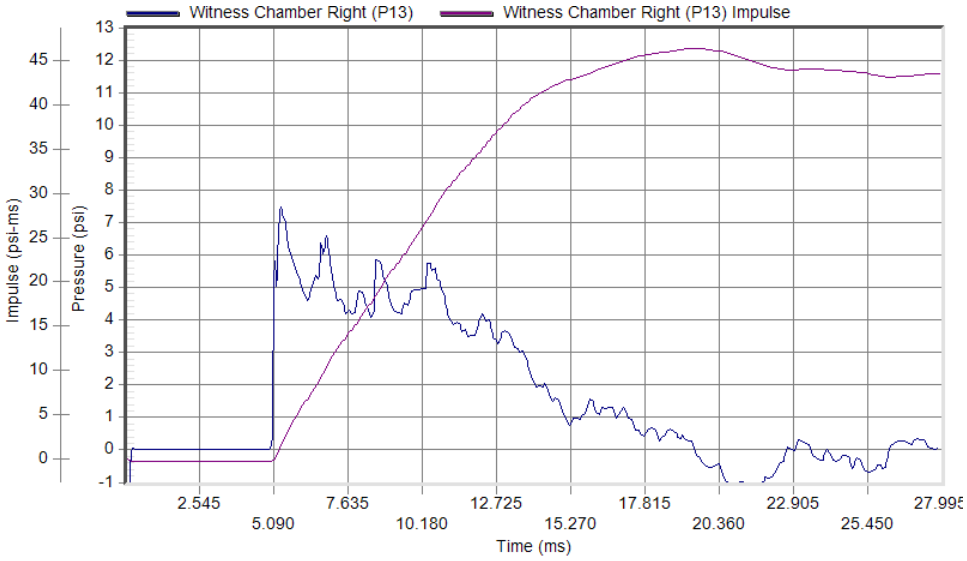
Test Date: 6/27/2011
Test Time: 8:49 am

Specimen #6



Peak Pressure: 7.04 psi at 5.30 ms
Duration: 13.37 ms

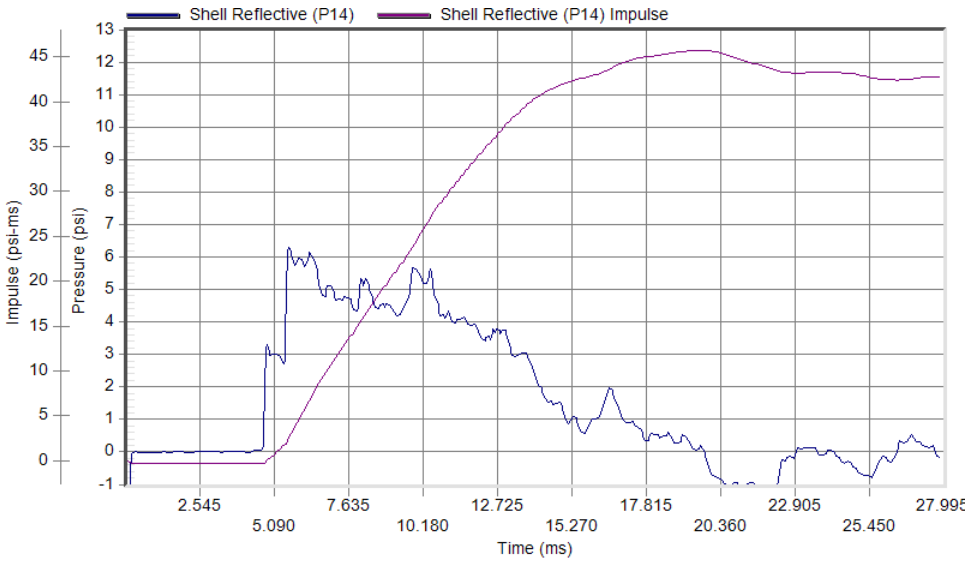
Test Date: 6/21/2011
Test Time: 1:58 pm



Peak Pressure: 7.49 psi at 5.33 ms
Duration: 14.19 ms

Test Date: 6/21/2011
Test Time: 1:58 pm

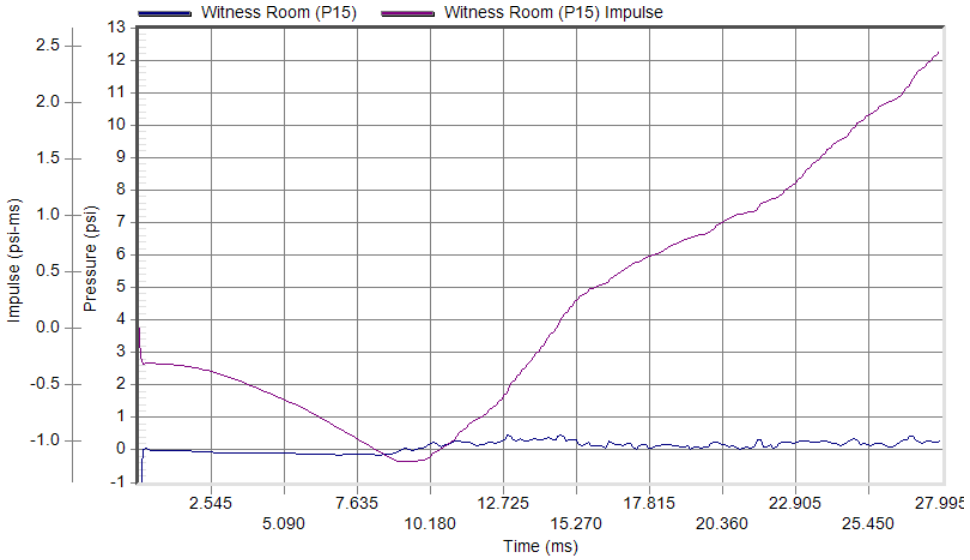
Specimen #6: (Continued)



Peak Pressure: 6.36 psi at 5.60 ms
Duration: 13.87 ms

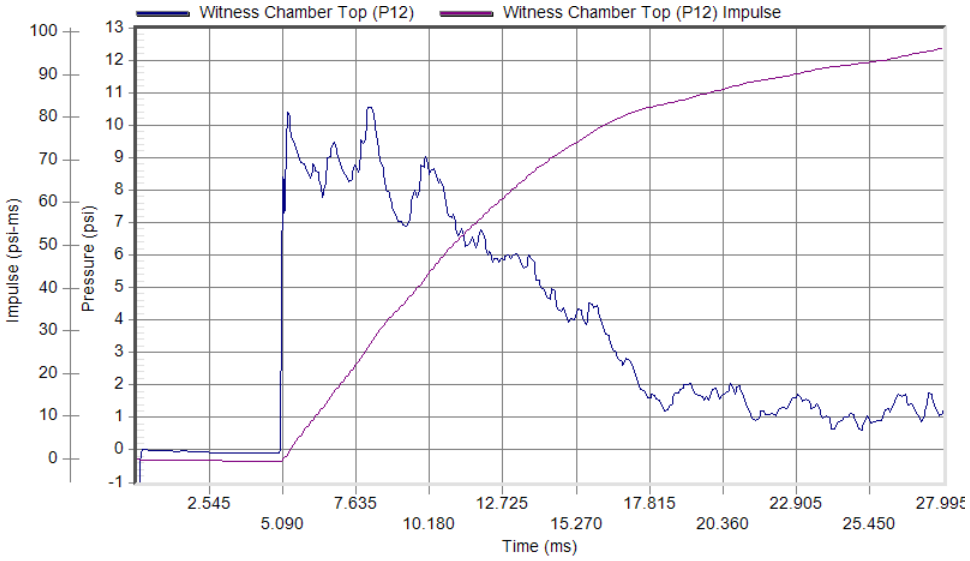
Test Date: 6/21/2011
Test Time: 1:58 pm

Specimen #7



Peak Pressure: 0.48 psi at 12.88 ms
Duration: 8.06 ms

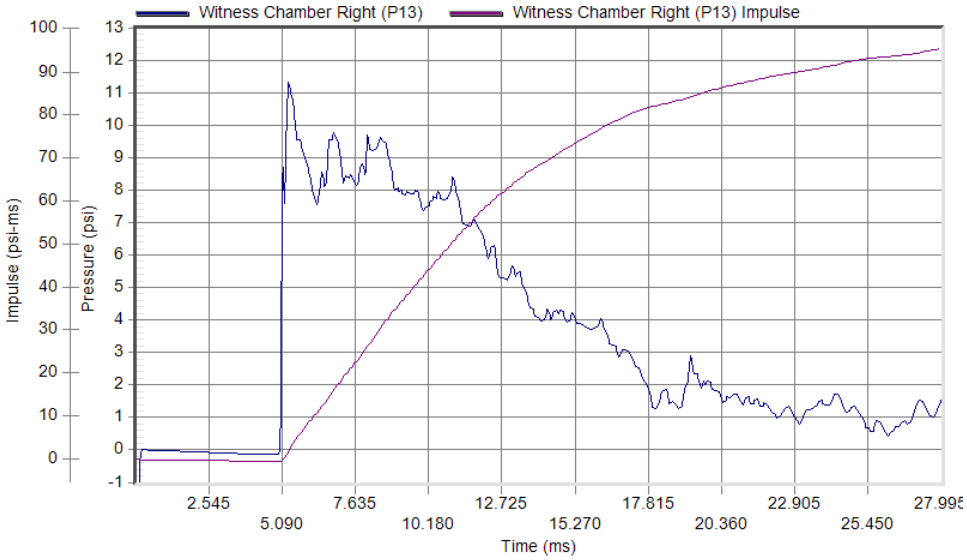
Test Date: 6/22/2011
Test Time: 10:09 am



Peak Pressure: 10.59 psi at 8.07 ms
Duration: 0.00 ms

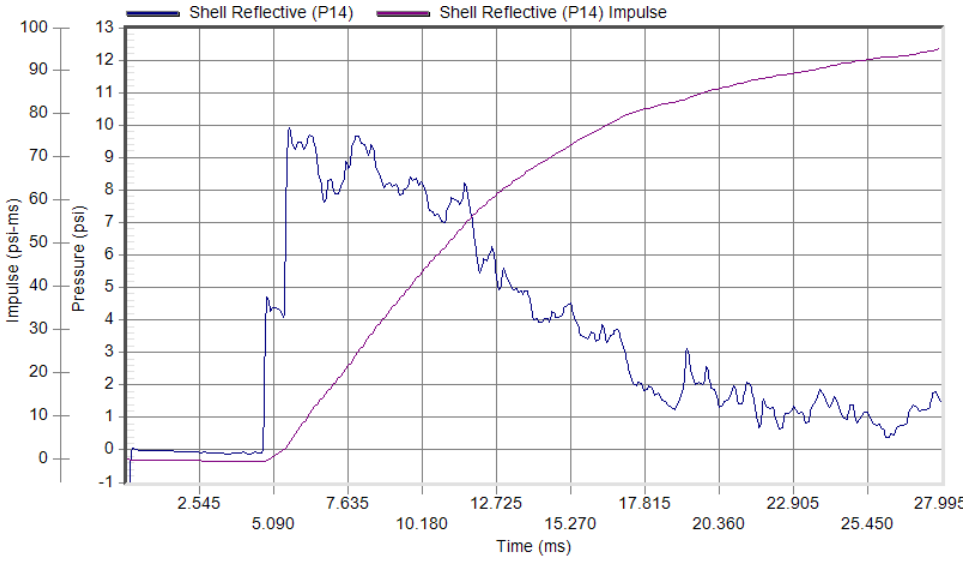
Test Date: 6/22/2011
Test Time: 10:09 am

Specimen #7: (Continued)



Peak Pressure: 11.36 psi at 5.34 ms
Duration: 0.00 ms

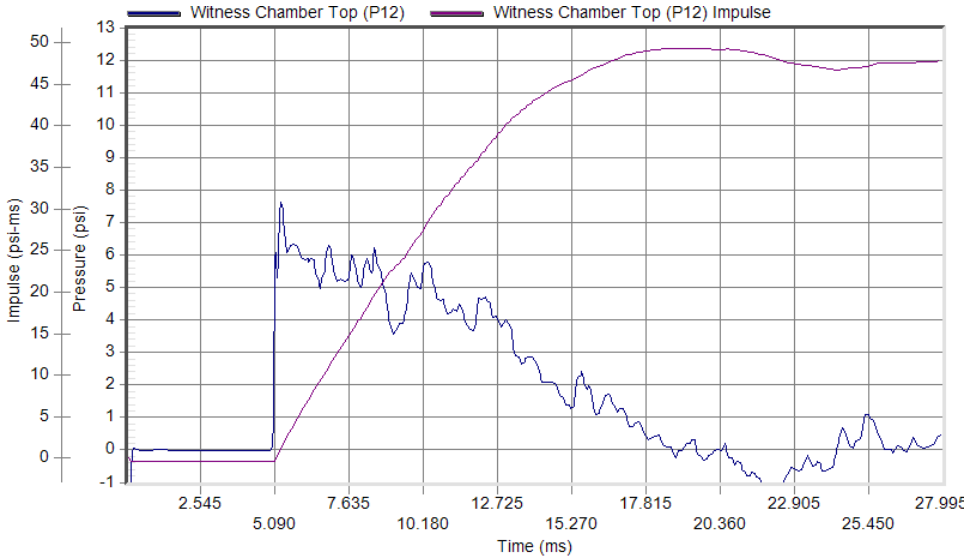
Test Date: 6/22/2011
Test Time: 10:09 am



Peak Pressure: 9.91 psi at 5.62 ms
Duration: 0.00 ms

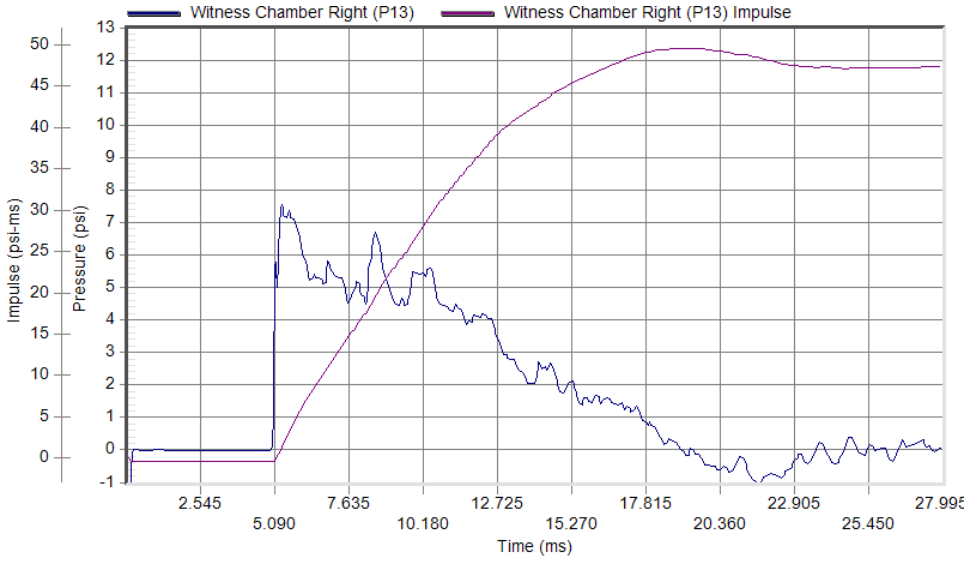
Test Date: 6/22/2011
Test Time: 10:09 am

Specimen #8



Peak Pressure: 7.71 psi at 5.31 ms
Duration: 13.26 ms

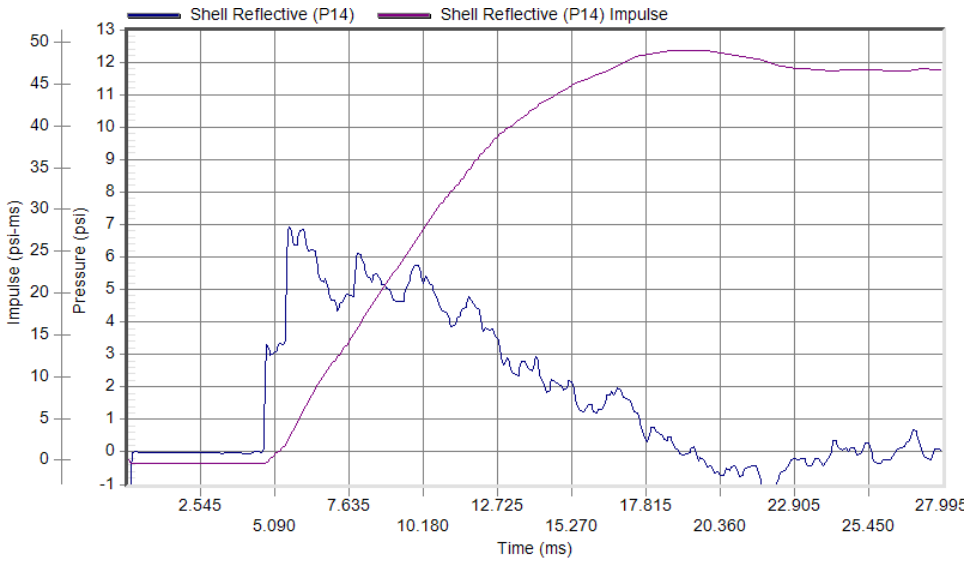
Test Date: 6/24/2011
Test Time: 8:45 am



Peak Pressure: 7.56 psi at 5.32 ms
Duration: 13.66 ms

Test Date: 6/24/2011
Test Time: 8:45 am

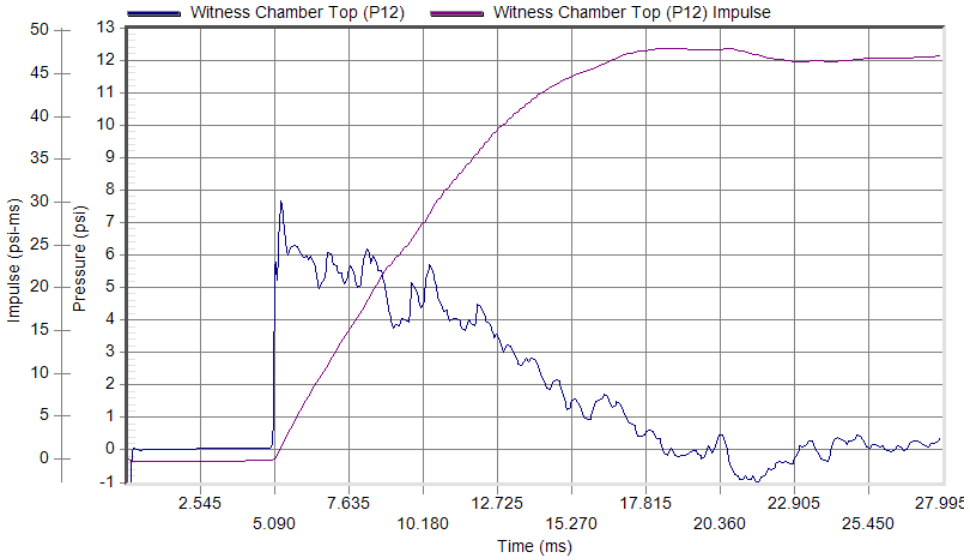
Specimen #8: (Continued)



Peak Pressure: 7.01 psi at 5.60 ms
Duration: 13.29 ms

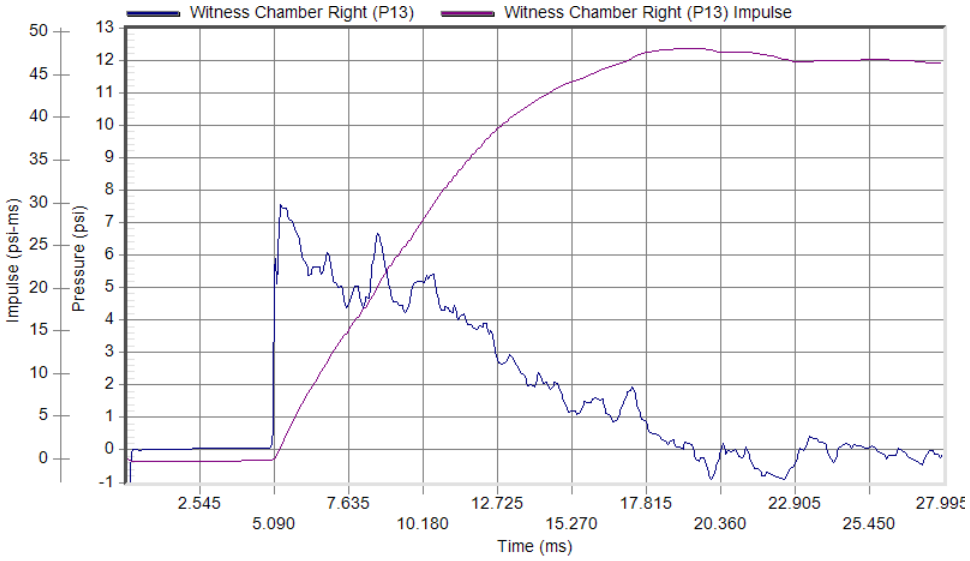
Test Date: 6/24/2011
Test Time: 8:45 am

Specimen #9



Peak Pressure: 7.66 psi at 5.31 ms
Duration: 13.07 ms

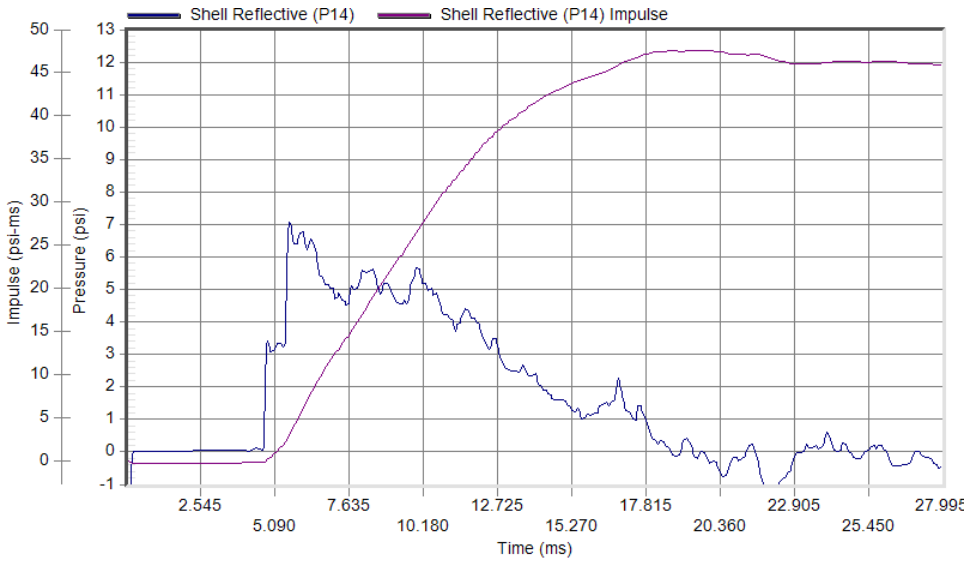
Test Date: 6/24/2011
Test Time: 10:14 am



Peak Pressure: 7.64 psi at 5.32 ms
Duration: 13.57 ms

Test Date: 6/24/2011
Test Time: 10:14 am

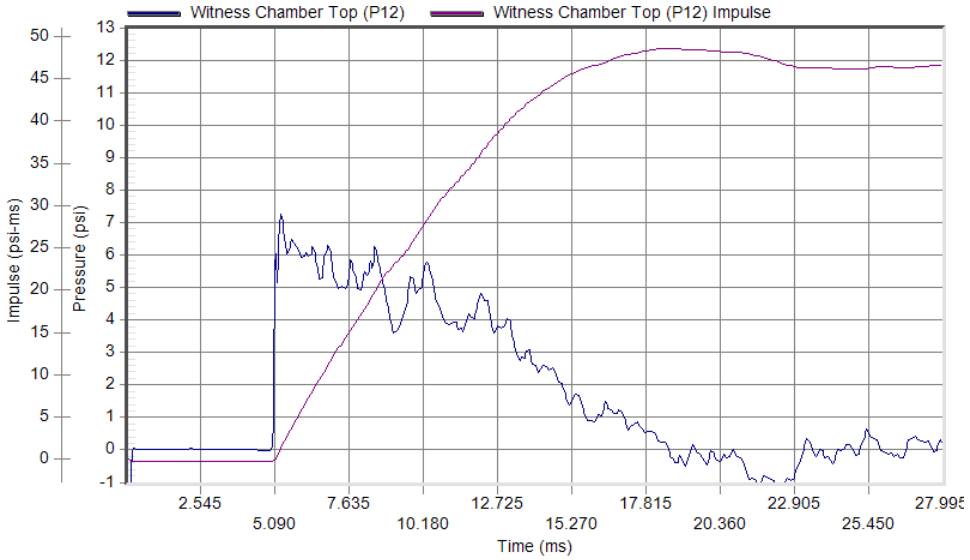
Specimen #9: (Continued)



Peak Pressure: 7.11 psi at 5.60 ms
Duration: 13.05 ms

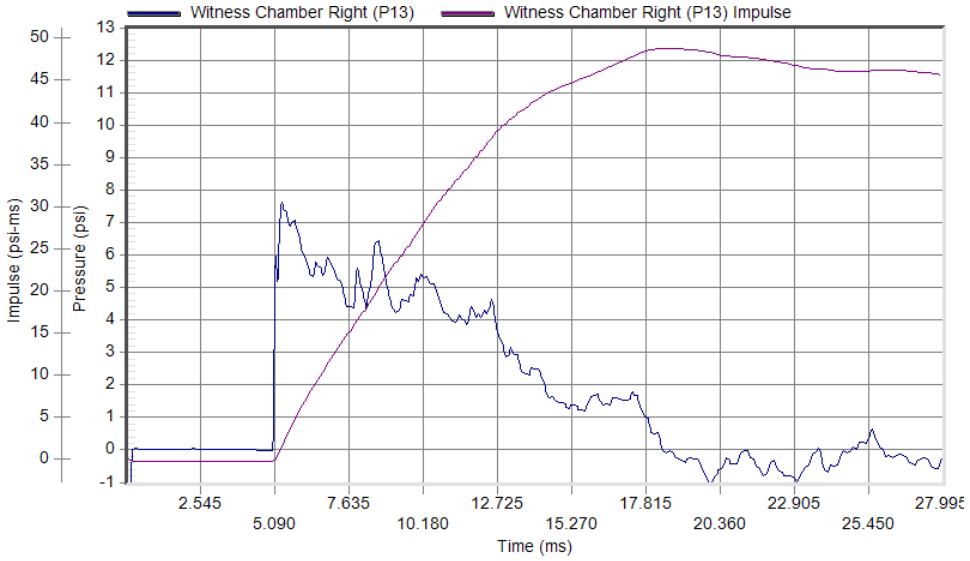
Test Date: 6/24/2011
Test Time: 10:14 am

Specimen #10



Peak Pressure: 7.28 psi at 5.31 ms
Duration: 13.28 ms

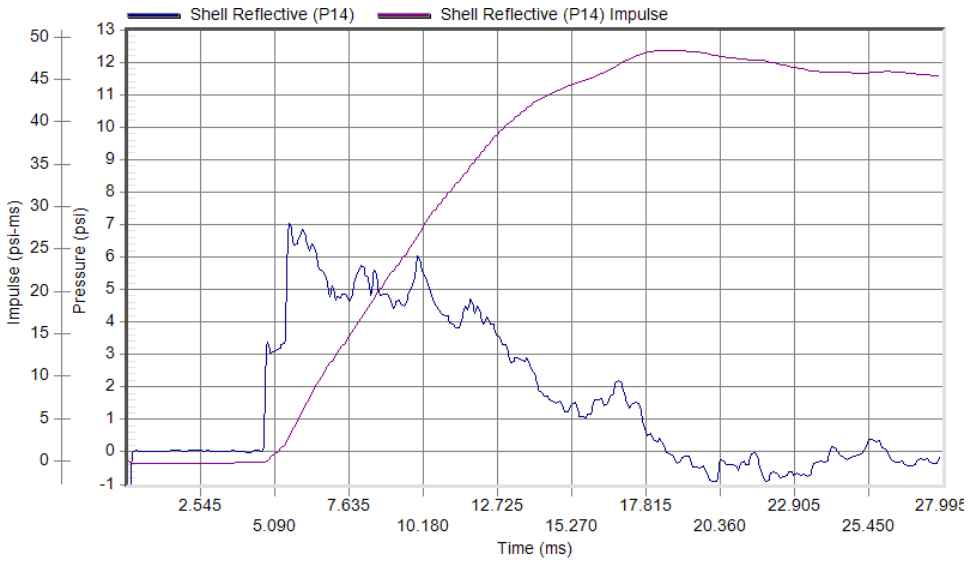
Test Date: 6/27/2011
Test Time: 11:24 am



Peak Pressure: 7.67 psi at 5.33 ms
Duration: 13.05 ms

Test Date: 6/27/2011
Test Time: 11:24 am

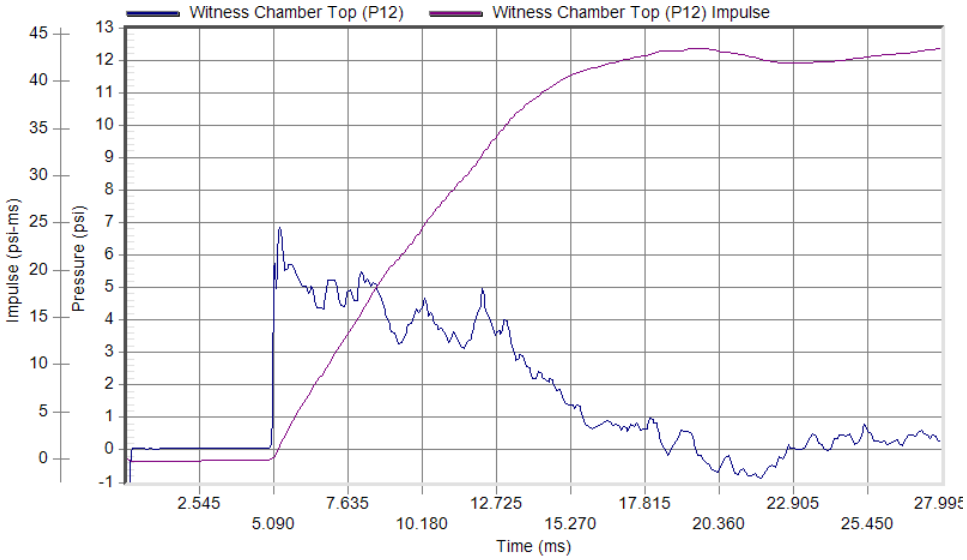
Specimen #10: (Continued)



Peak Pressure: 7.04 psi at 5.60 ms
Duration: 12.88 ms

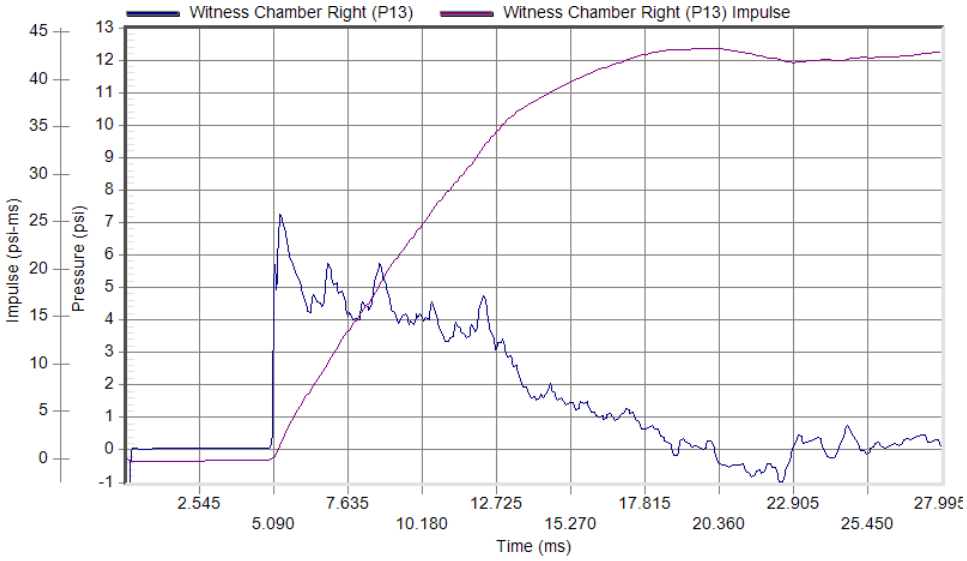
Test Date: 6/27/2011
Test Time: 11:24 am

Specimen #11



Peak Pressure: 6.89 psi at 5.30 ms
Duration: 13.17 ms

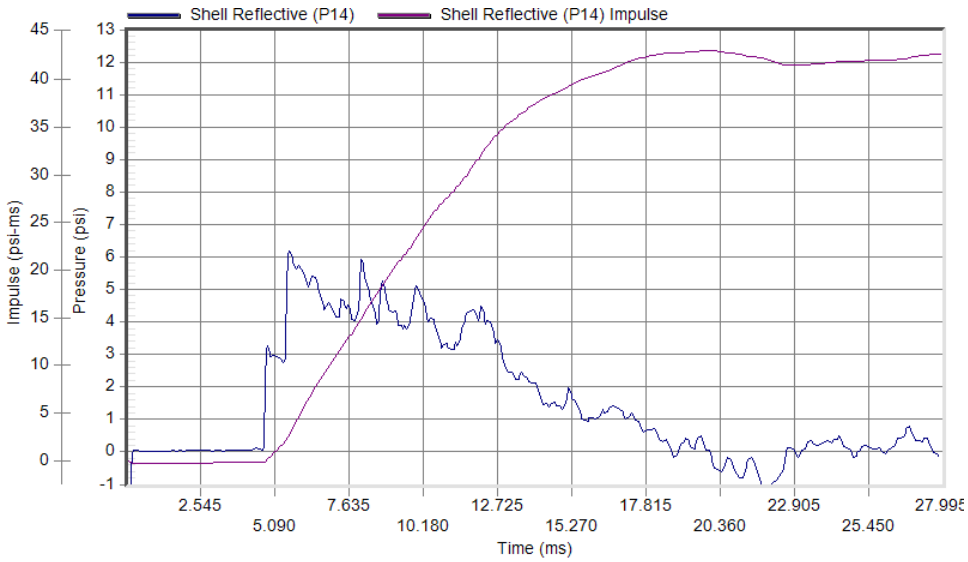
Test Date: 6/21/2011
Test Time: 3:17 pm



Peak Pressure: 7.31 psi at 5.33 ms
Duration: 13.42 ms

Test Date: 6/21/2011
Test Time: 3:17 pm

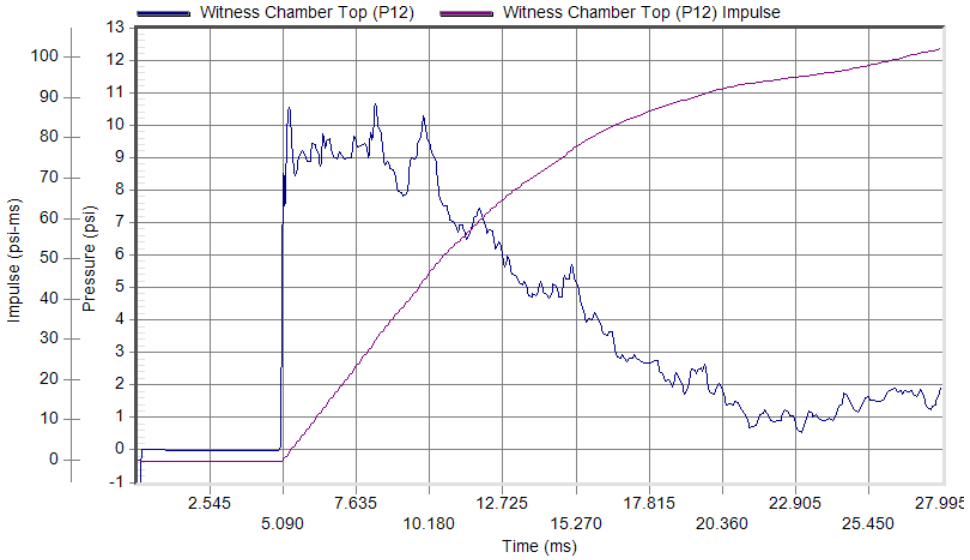
Specimen #11: (Continued)



Peak Pressure: 6.27 psi at 5.60 ms
Duration: 13.09 ms

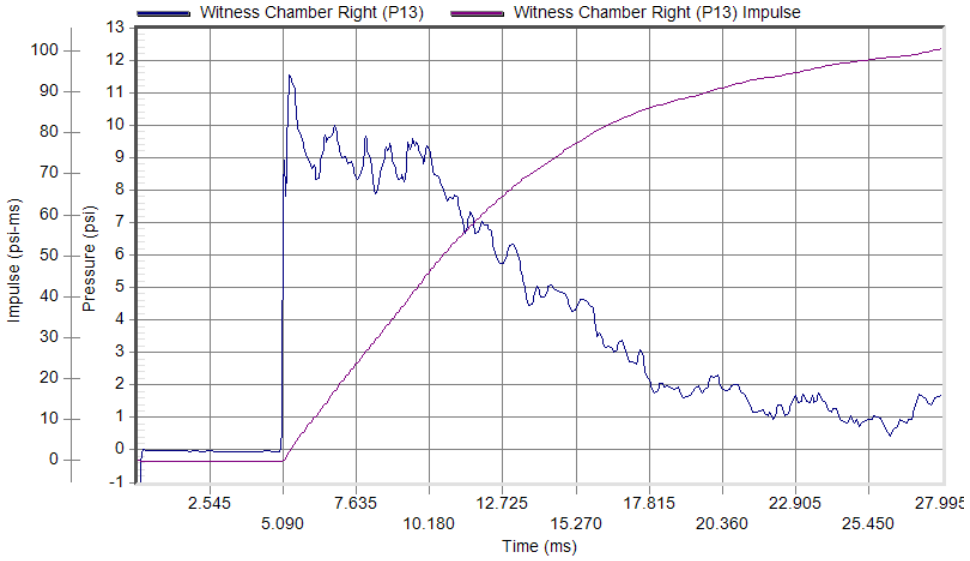
Test Date: 6/21/2011
Test Time: 3:17 pm

Specimen #12



Peak Pressure: 10.69 psi at 8.31 ms
Duration: 0.00 ms

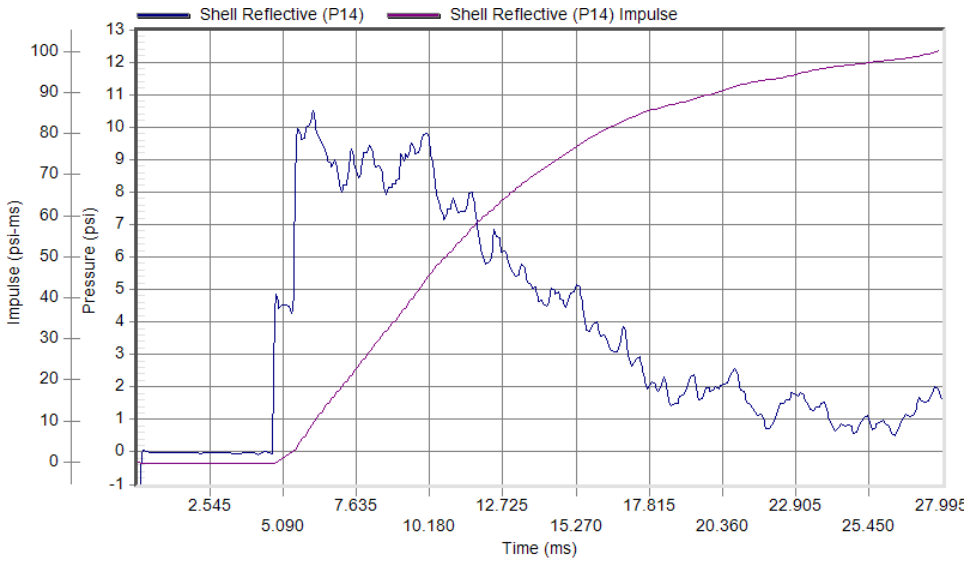
Test Date: 6/21/2011
Test Time: 4:38 pm



Peak Pressure: 11.63 psi at 5.34 ms
Duration: 0.00 ms

Test Date: 6/21/2011
Test Time: 4:38 pm

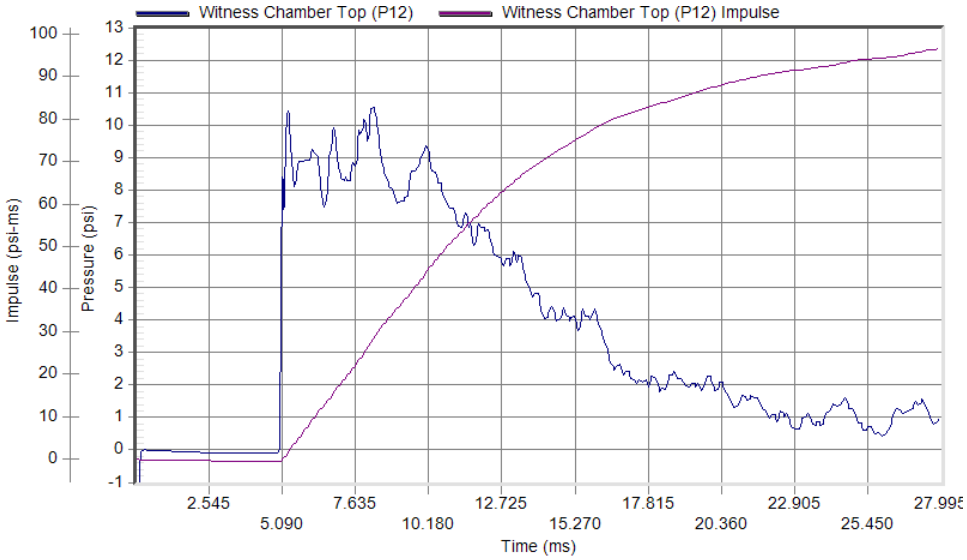
Specimen #12: (Continued)



Peak Pressure: 10.49 psi at 6.14 ms
Duration: 0.00 ms

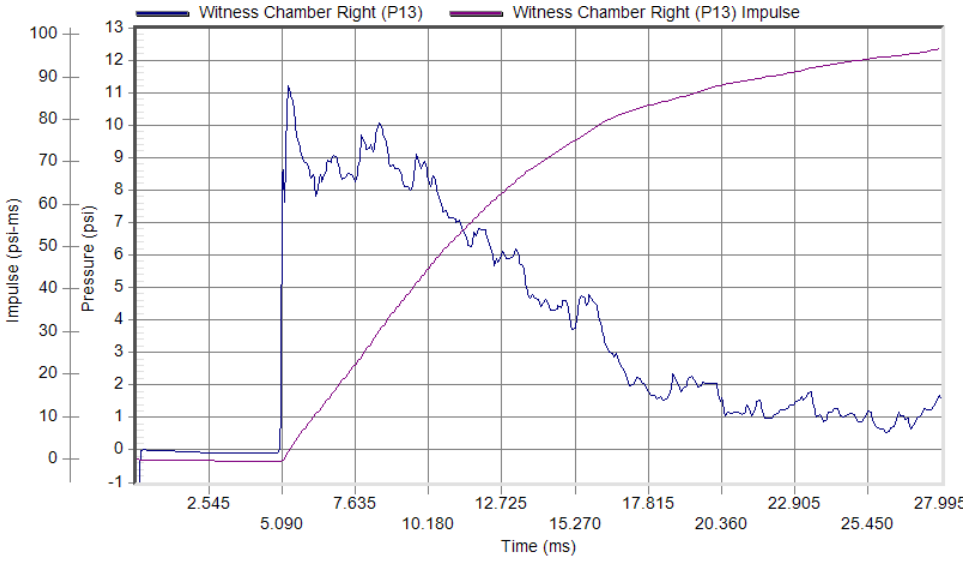
Test Date: 6/21/2011
Test Time: 4:38 pm

Specimen #13



Peak Pressure: 10.57 psi at 8.19 ms
Duration: 0.00 ms

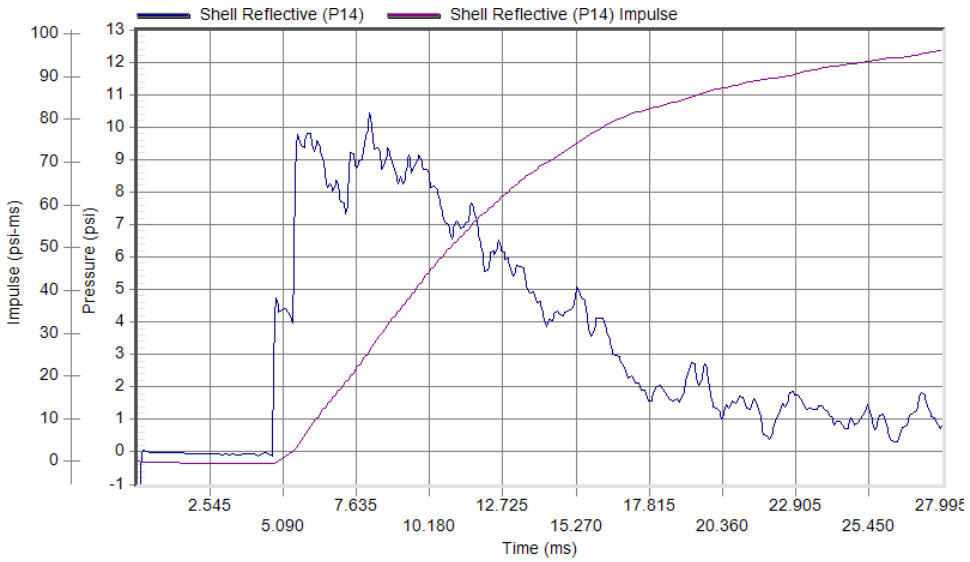
Test Date: 6/22/2011
Test Time: 4:04 pm



Peak Pressure: 11.24 psi at 5.33 ms
Duration: 0.00 ms

Test Date: 6/22/2011
Test Time: 4:04 pm

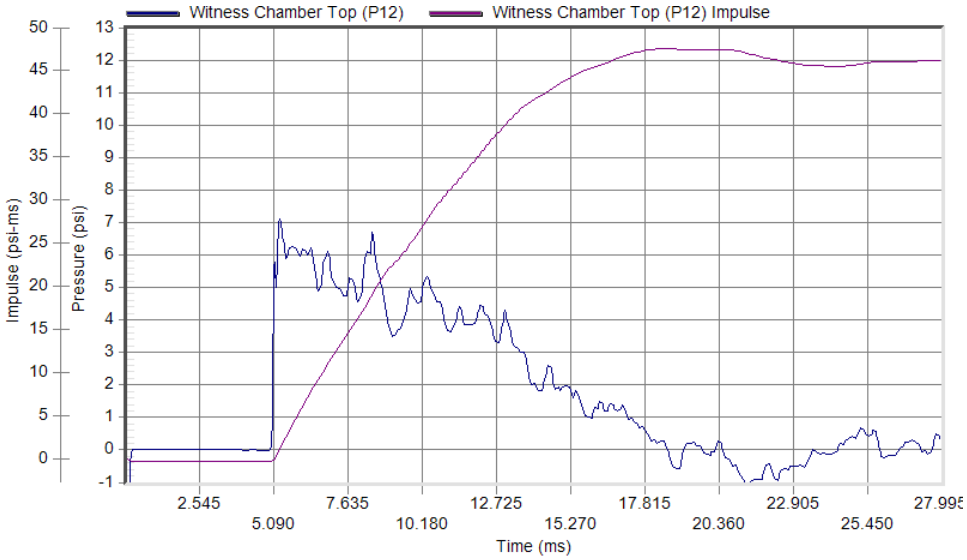
Specimen #13: (Continued)



Peak Pressure: 10.42 psi at 8.10 ms
Duration: 0.00 ms

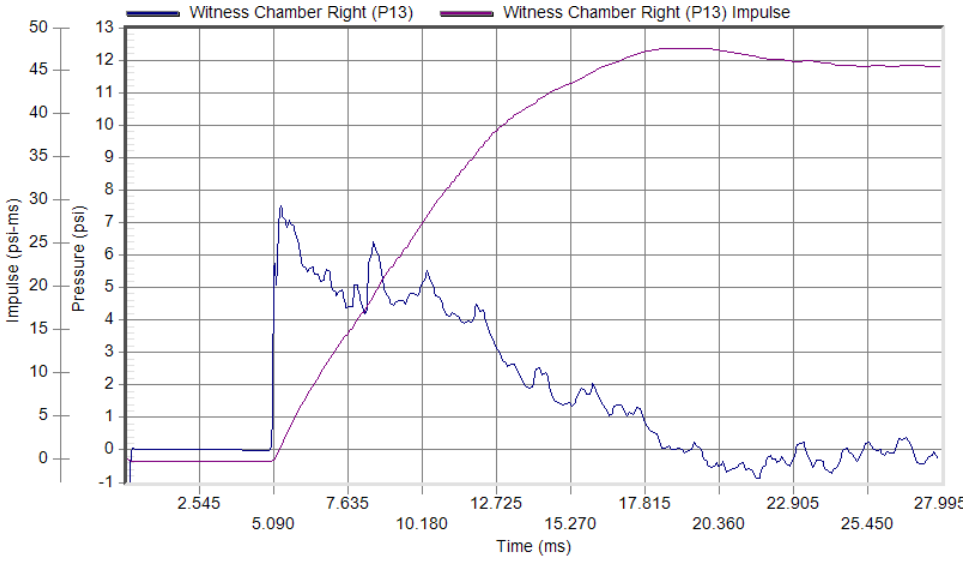
Test Date: 6/22/2011
Test Time: 4:04 pm

Specimen #14



Peak Pressure: 7.13 psi at 5.30 ms
Duration: 13.26 ms

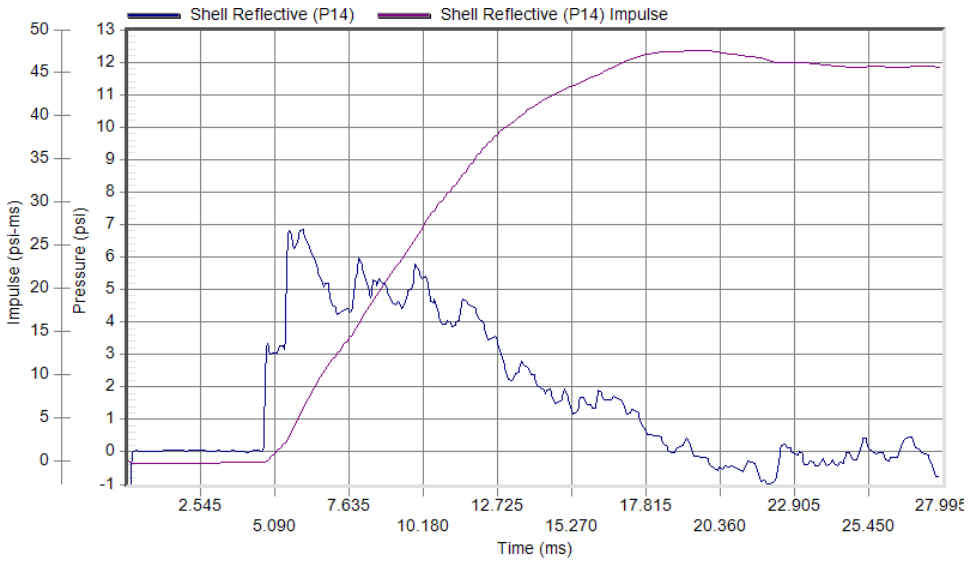
Test Date: 6/23/2011
Test Time: 4:12 pm



Peak Pressure: 7.50 psi at 5.32 ms
Duration: 13.08 ms

Test Date: 6/23/2011
Test Time: 4:12 pm

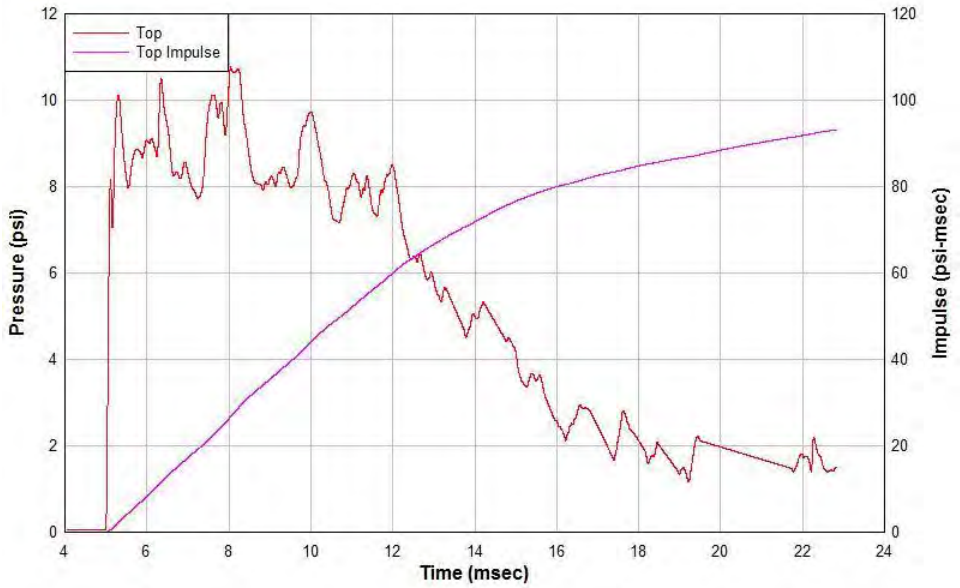
Specimen #14: (Continued)

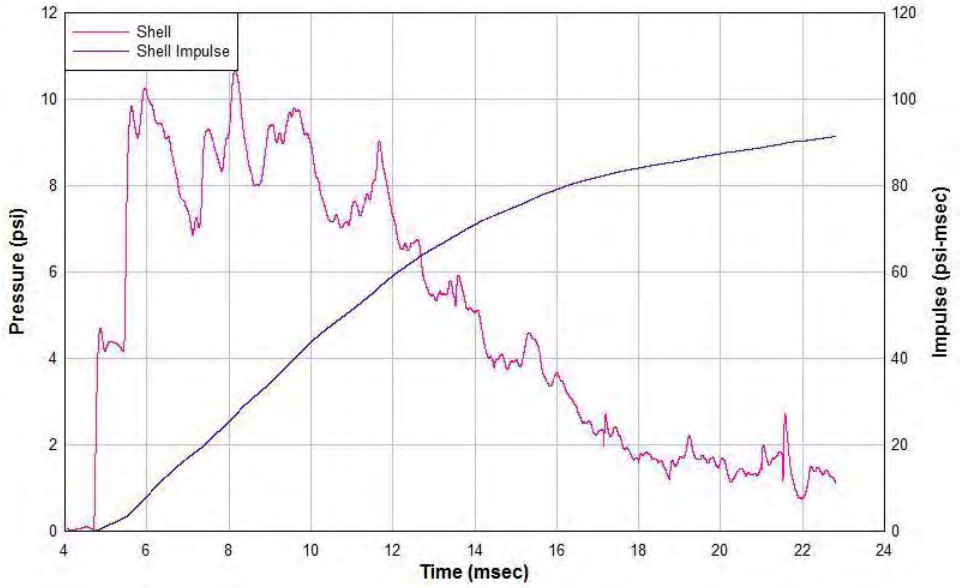


Peak Pressure: 6.89 psi at 6.00 ms
Duration: 12.59 ms

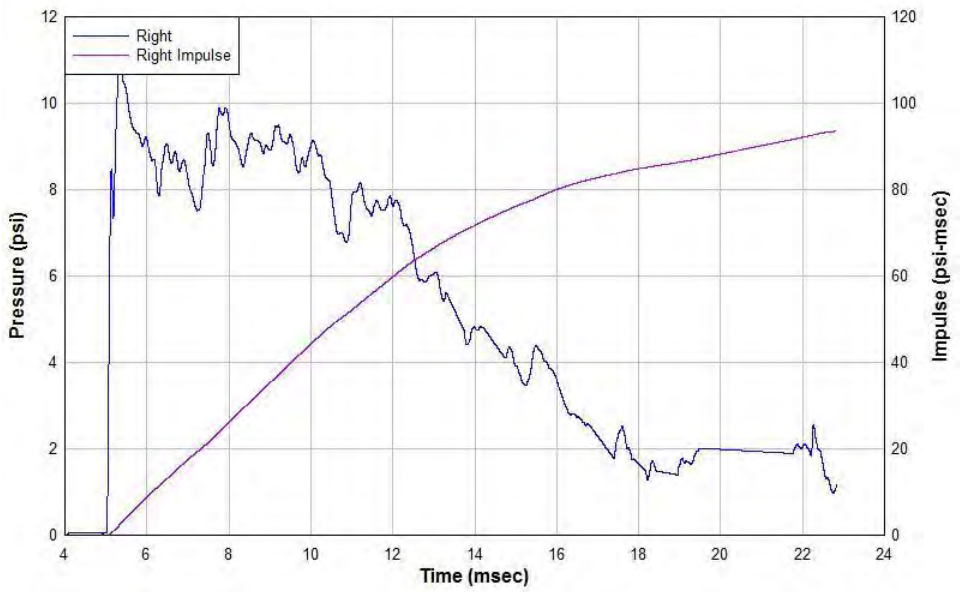
Test Date: 6/23/2011
Test Time: 4:12 pm

Specimen #15

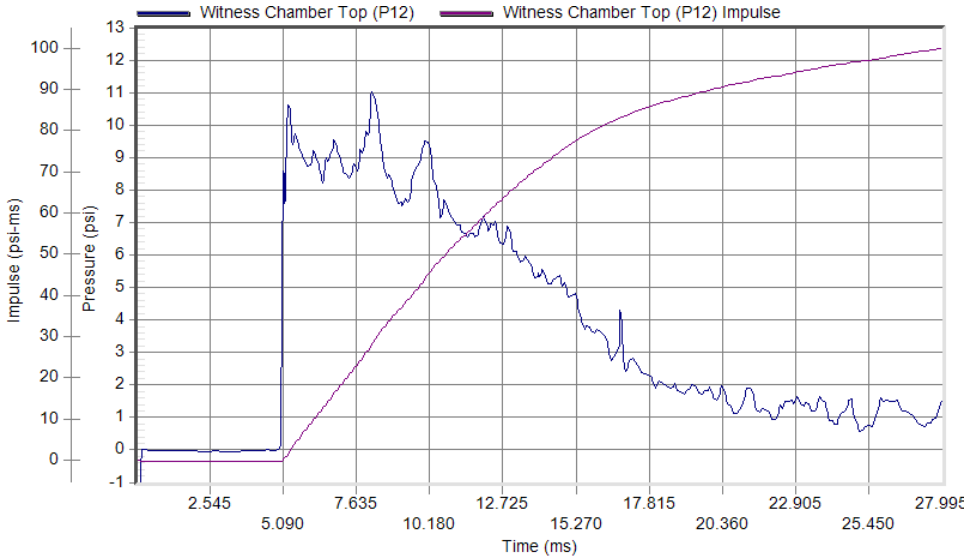

Top
Top Impulse
Pressure (psi)
Impulse (psi-msec)
Time (msec)
0
2
4
6
8
10
12
0
20
40
60
80
100
120
4
6
8
10
12
14
16
18
20
22
24


Shell
Shell Impulse
Pressure (psi)
Impulse (psi-msec)
Time (msec)
0
2
4
6
8
10
12
0
20
40
60
80
100
120
4
6
8
10
12
14
16
18
20
22
24

Specimen #15: (Continued)

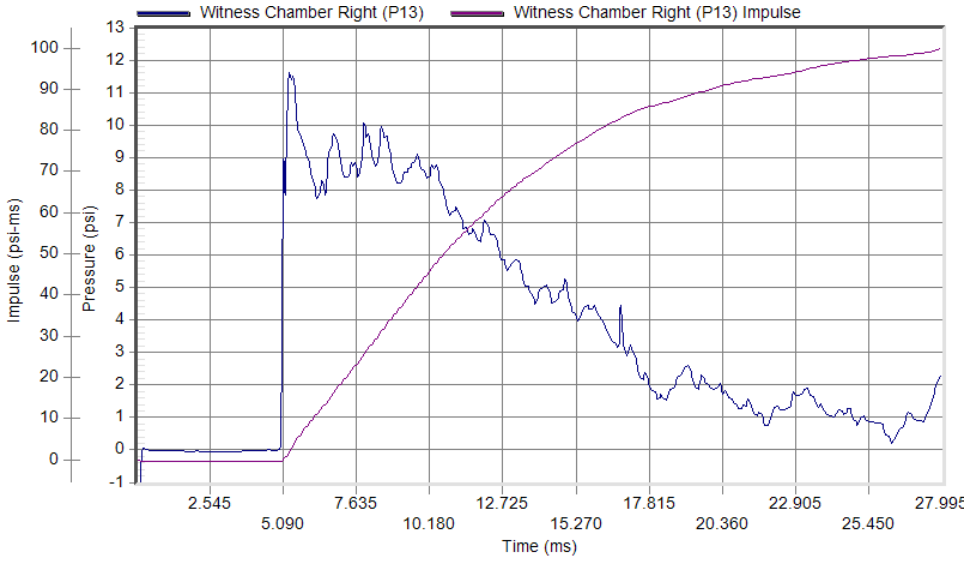


Specimen #16



Peak Pressure: 11.09 psi at 8.18 ms
Duration: 0.00 ms

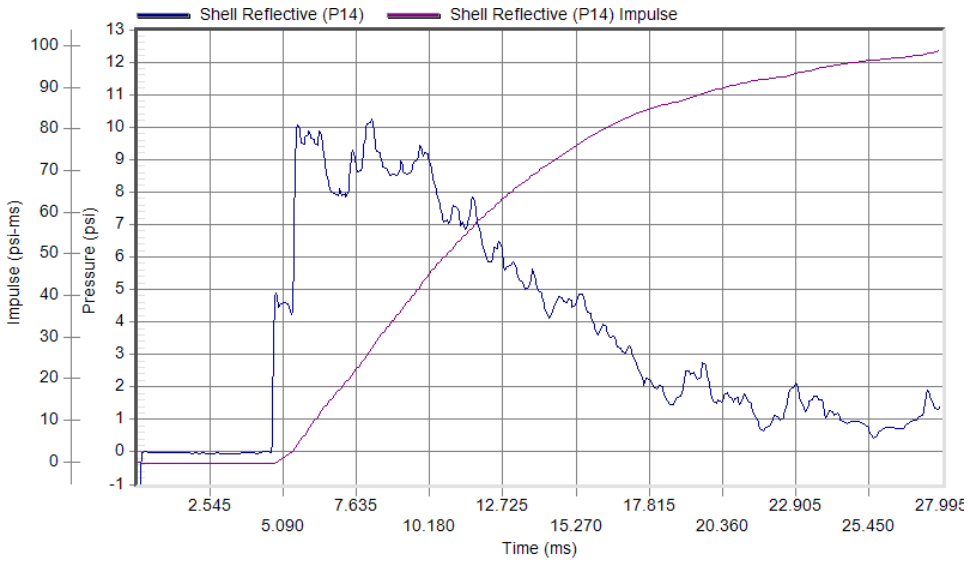
Test Date: 6/22/2011
Test Time: 9:27 am



Peak Pressure: 11.68 psi at 5.32 ms
Duration: 20.99 ms

Test Date: 6/22/2011
Test Time: 9:27 am

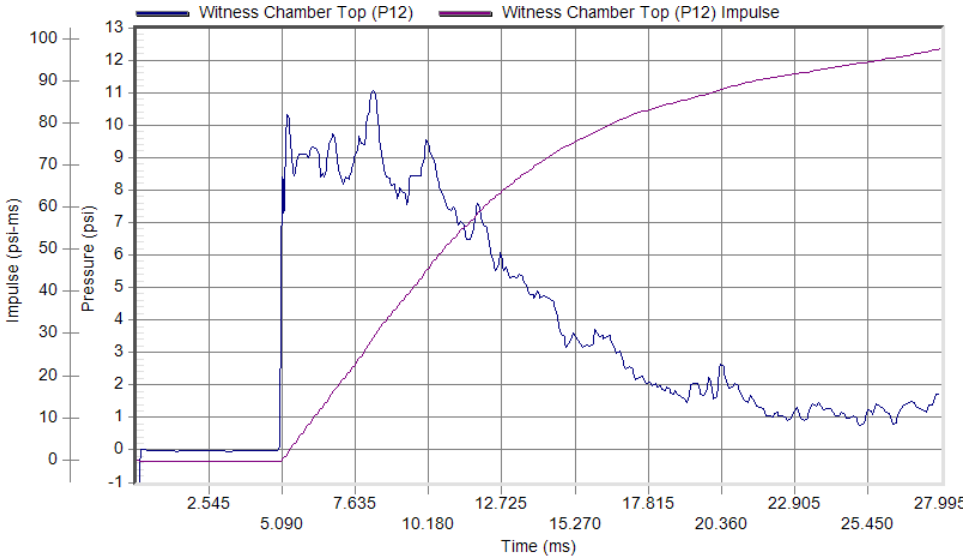
Specimen #16: (Continued)



Peak Pressure: 10.26 psi at 8.18 ms
Duration: 0.00 ms

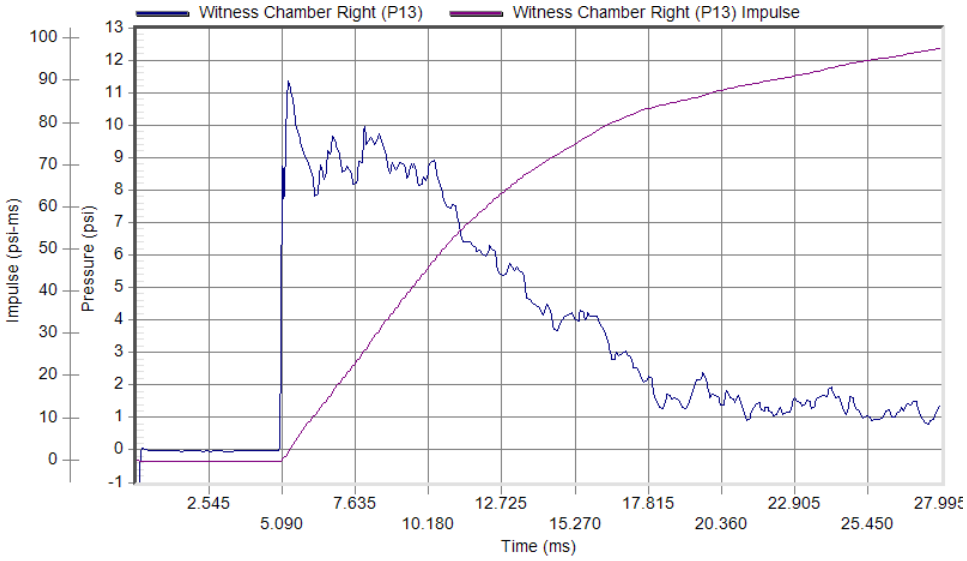
Test Date: 6/22/2011
Test Time: 9:27 am

Specimen #17



Peak Pressure: 11.13 psi at 8.29 ms
Duration: 0.00 ms

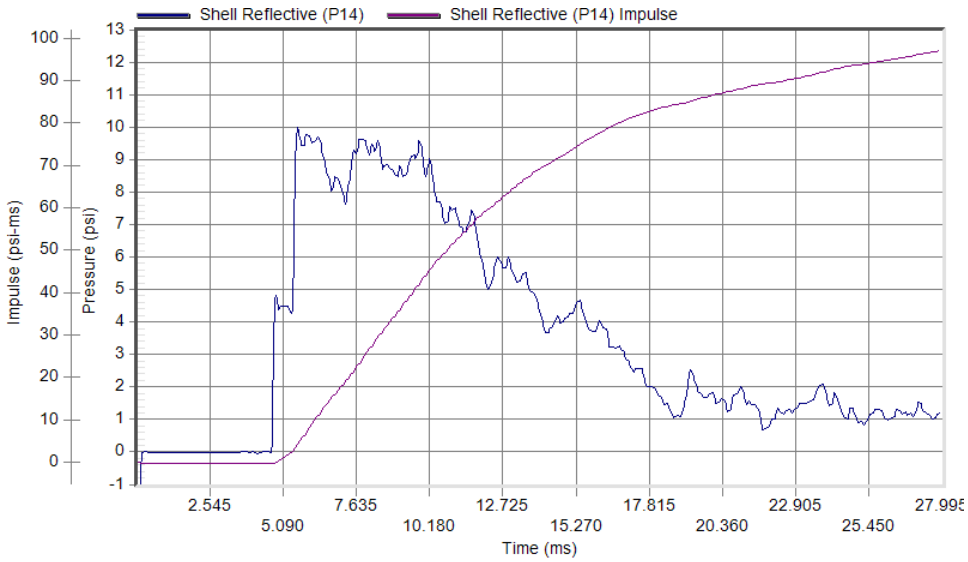
Test Date: 6/23/2011
Test Time: 10:14 am



Peak Pressure: 11.39 psi at 5.33 ms
Duration: 0.00 ms

Test Date: 6/23/2011
Test Time: 10:14 am

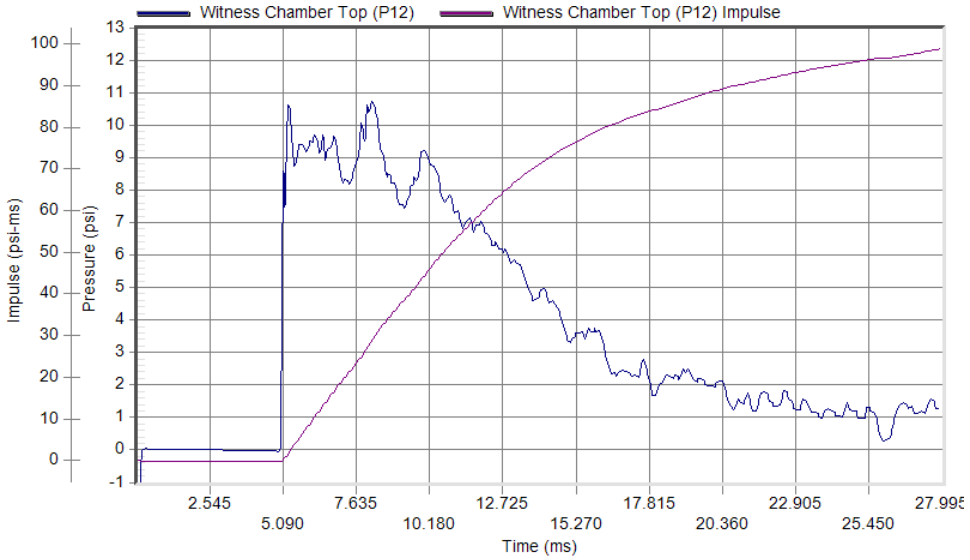
Specimen #17: (Continued)



Peak Pressure: 9.99 psi at 5.61 ms
Duration: 0.00 ms

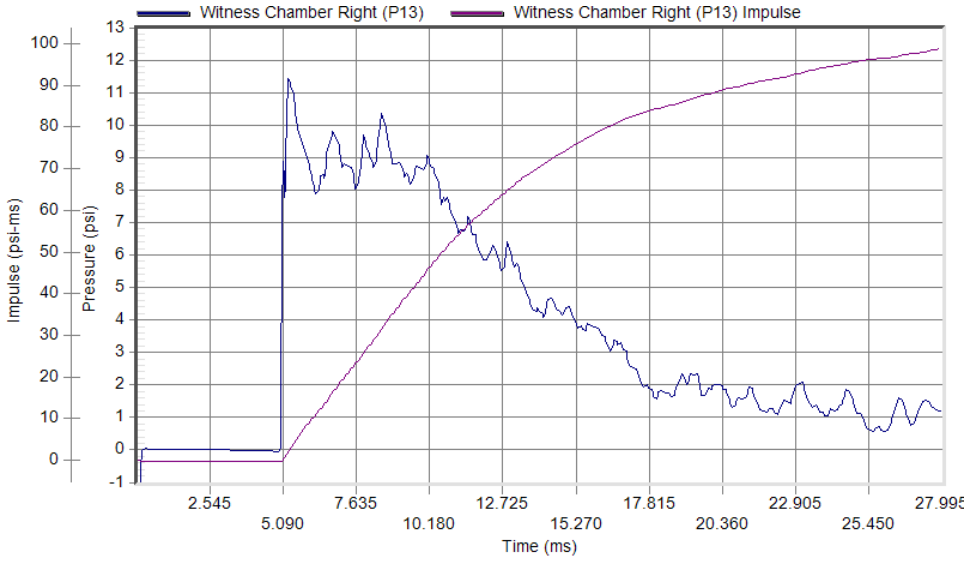
Test Date: 6/23/2011
Test Time: 10:14 am

Specimen #18



Peak Pressure: 10.79 psi at 8.23 ms
Duration: 0.00 ms

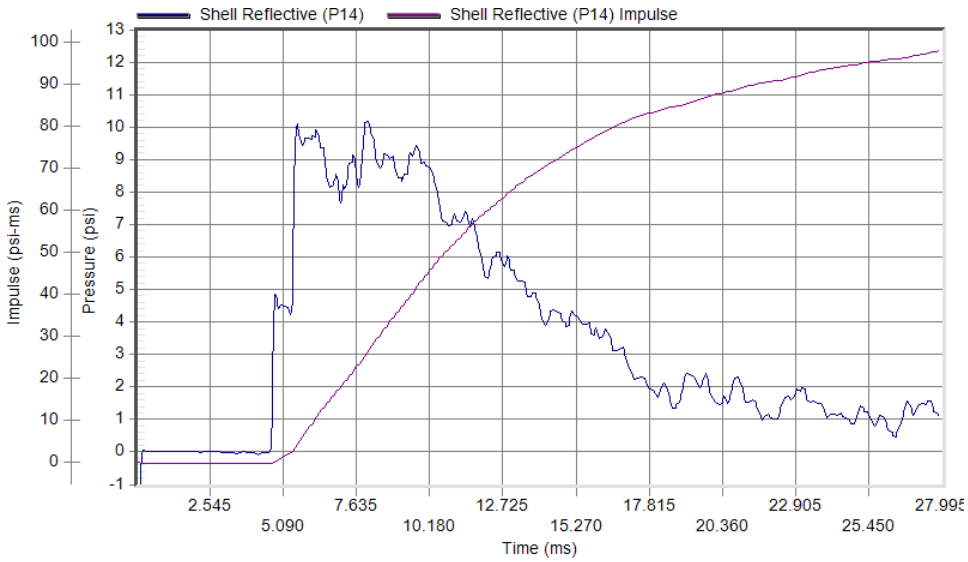
Test Date: 6/23/2011
Test Time: 11:03 am



Peak Pressure: 11.50 psi at 5.30 ms
Duration: 0.00 ms

Test Date: 6/23/2011
Test Time: 11:03 am

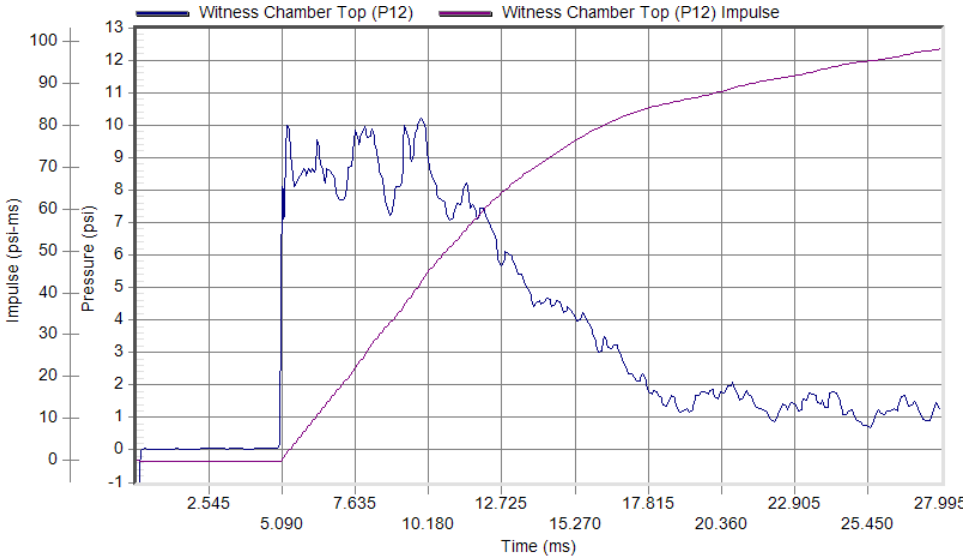
Specimen #18: (Continued)



Peak Pressure: 10.22 psi at 7.99 ms
Duration: 0.00 ms

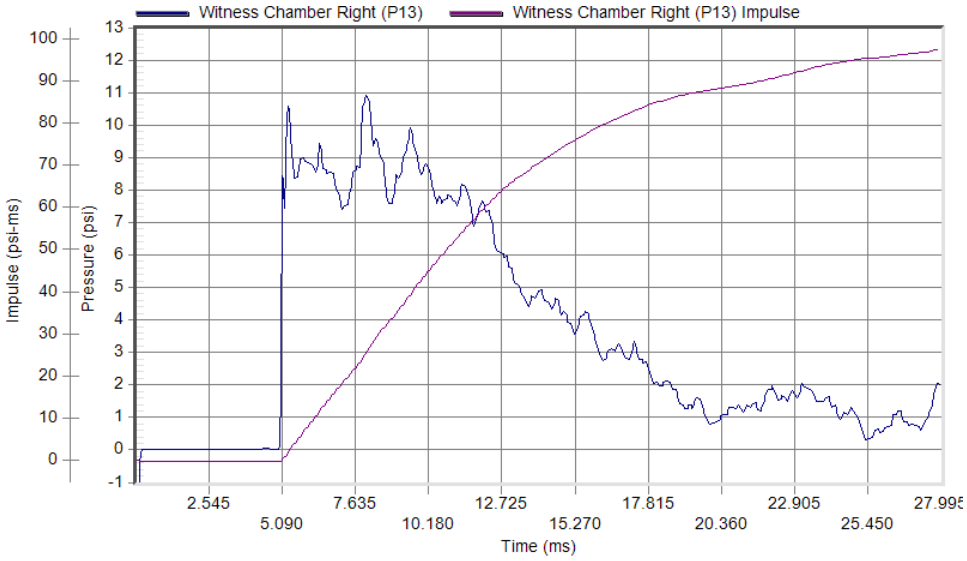
Test Date: 6/23/2011
Test Time: 11:03 am

Specimen #19



Peak Pressure: 10.30 psi at 9.97 ms
Duration: 0.00 ms

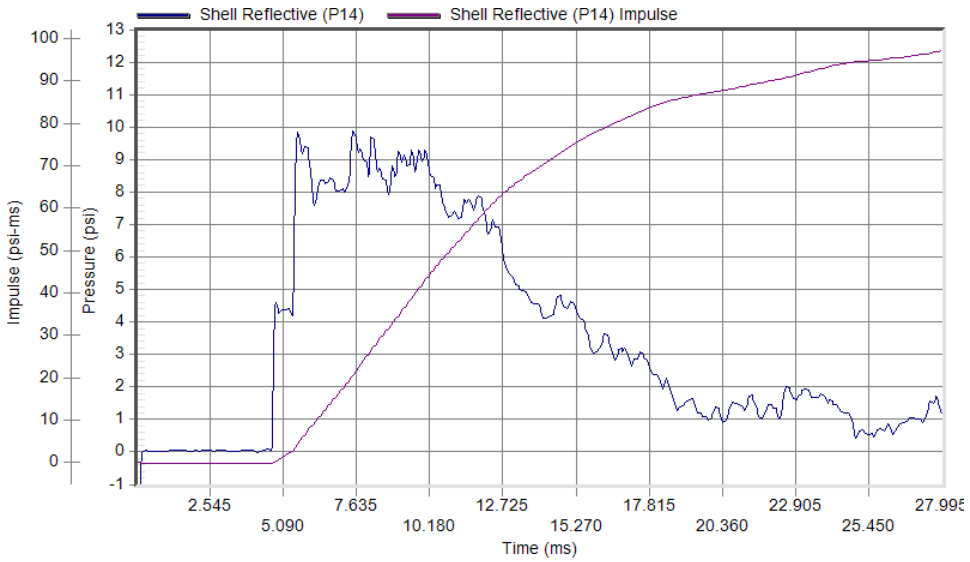
Test Date: 6/28/2011
Test Time: 8:52 am



Peak Pressure: 10.97 psi at 8.04 ms
Duration: 0.00 ms

Test Date: 6/28/2011
Test Time: 8:52 am

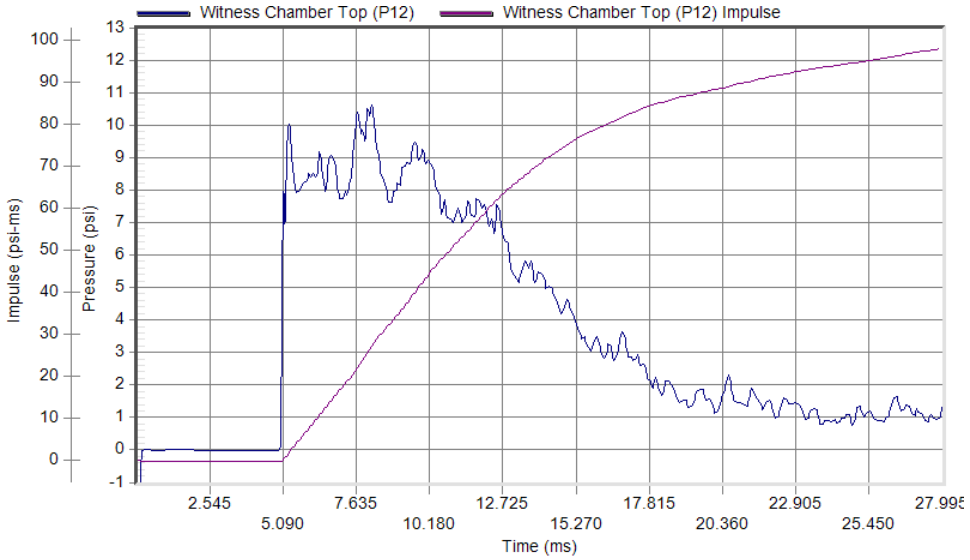
Specimen #19: (Continued)



Peak Pressure: 9.96 psi at 7.57 ms
Duration: 0.00 ms

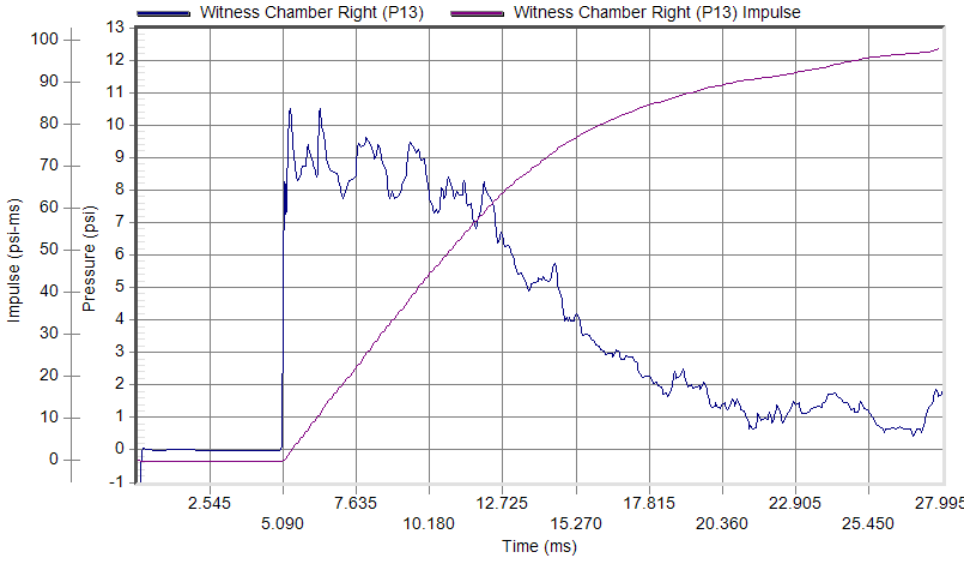
Test Date: 6/28/2011
Test Time: 8:52 am

Specimen #20



Peak Pressure: 10.61 psi at 8.17 ms
Duration: 0.00 ms

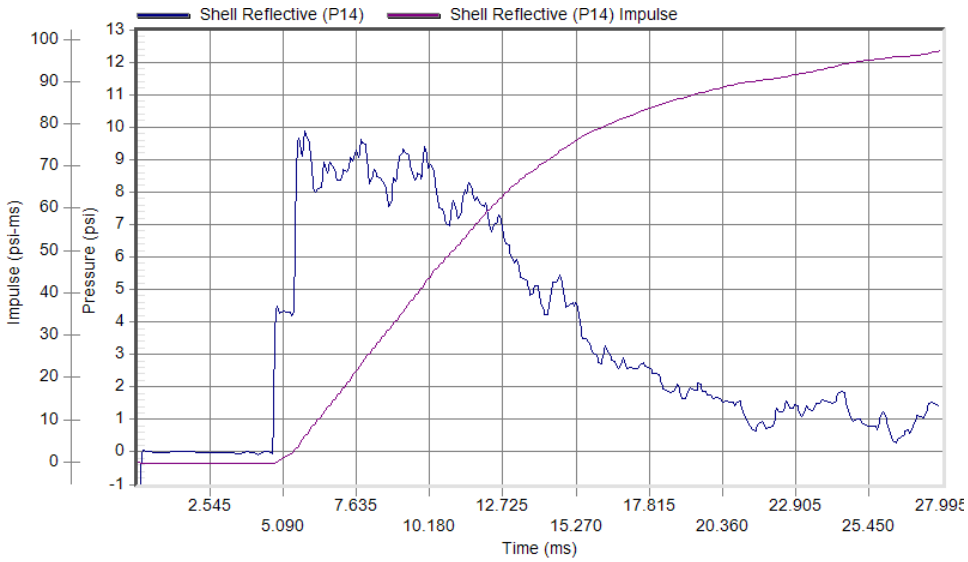
Test Date: 6/28/2011
Test Time: 9:34 am



Peak Pressure: 10.52 psi at 5.35 ms
Duration: 0.00 ms

Test Date: 6/28/2011
Test Time: 9:34 am

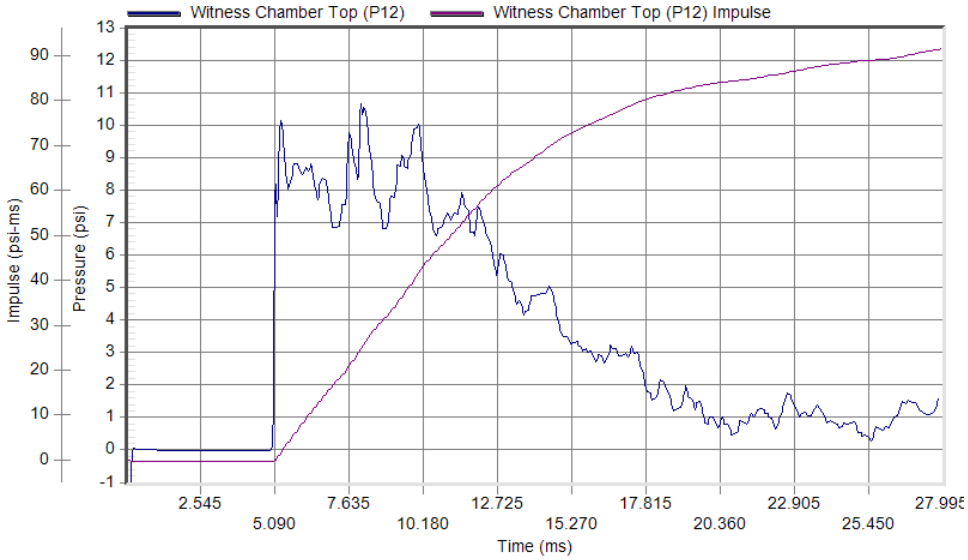
Specimen #20: (Continued)



Peak Pressure: 9.87 psi at 5.87 ms
Duration: 0.00 ms

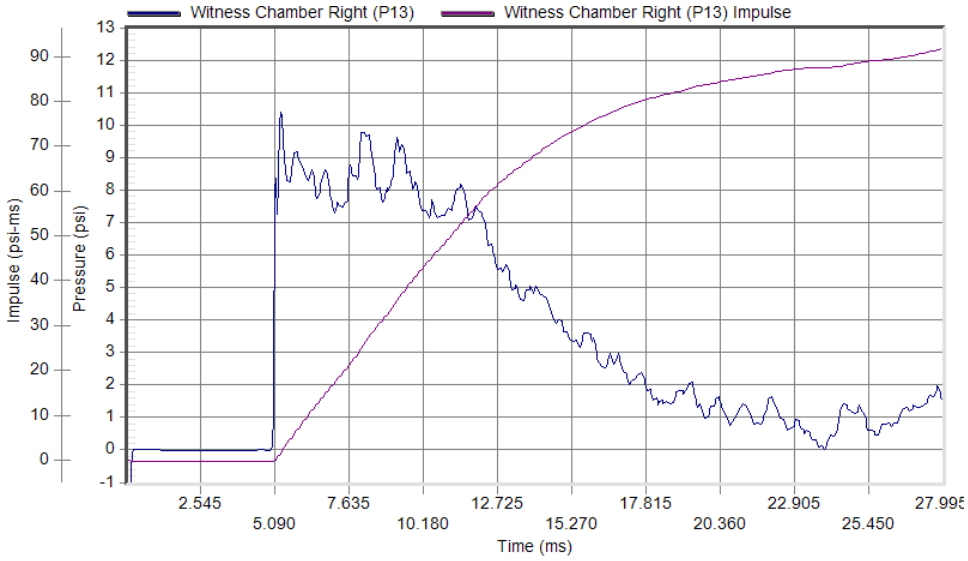
Test Date: 6/28/2011
Test Time: 9:34 am

Specimen #21



Peak Pressure: 10.69 psi at 8.04 ms
Duration: 0.00 ms

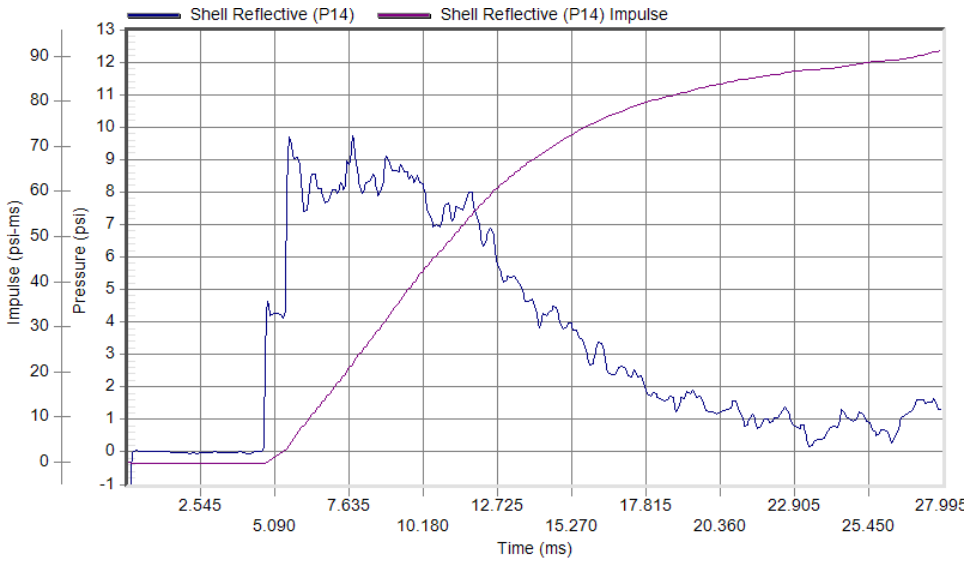
Test Date: 6/28/2011
Test Time: 2:21 pm



Peak Pressure: 10.40 psi at 5.30 ms
Duration: 18.44 ms

Test Date: 6/28/2011
Test Time: 2:21 pm

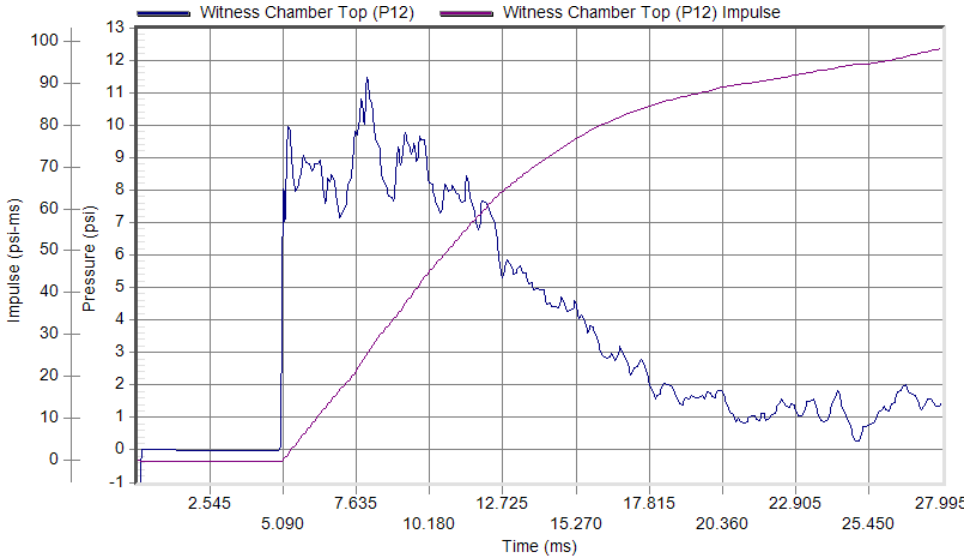
Specimen #21: (Continued)



Peak Pressure: 9.78 psi at 7.76 ms
Duration: 0.00 ms

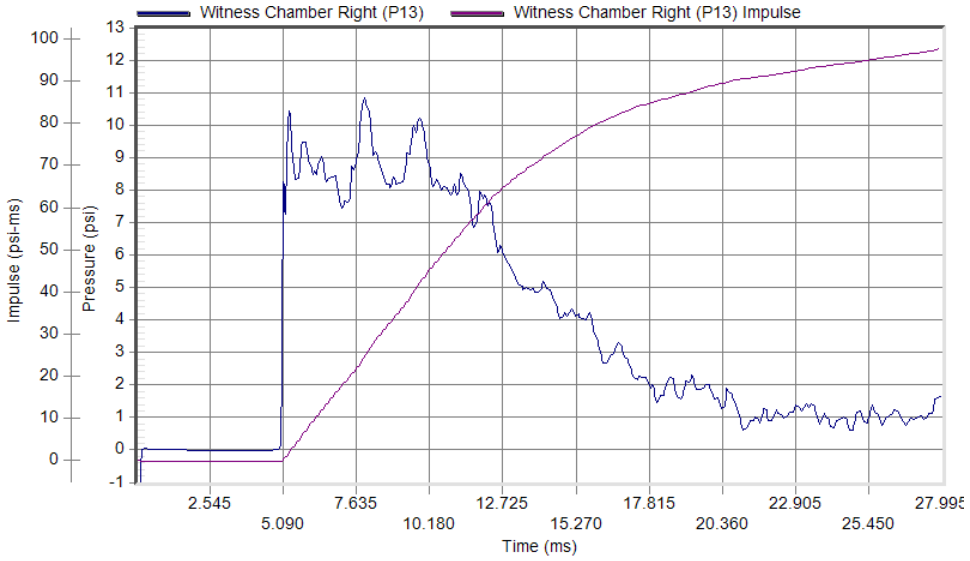
Test Date: 6/28/2011
Test Time: 2:21 pm

Specimen #22



Peak Pressure: 11.54 psi at 8.01 ms
Duration: 0.00 ms

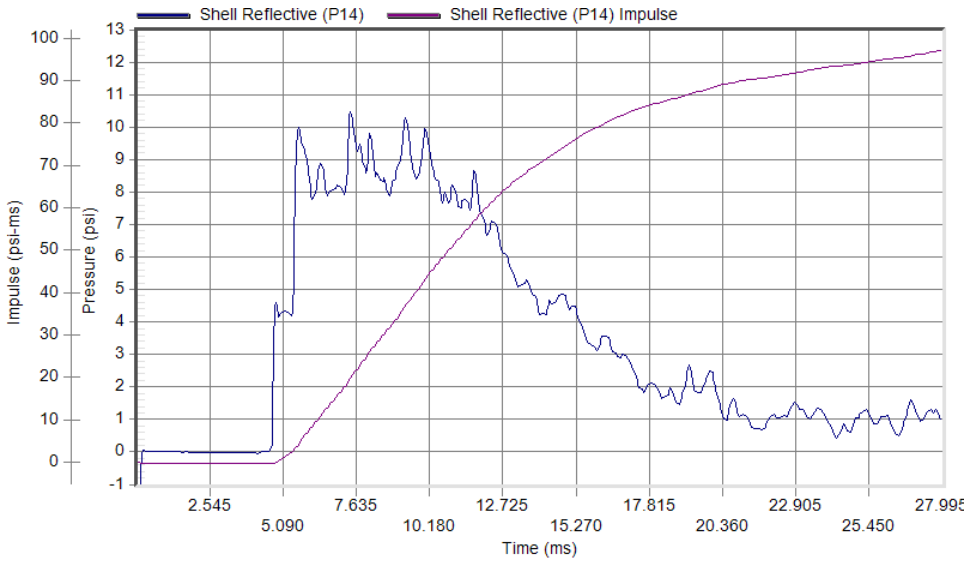
Test Date: 6/28/2011
Test Time: 3:25 pm



Peak Pressure: 10.82 psi at 7.92 ms
Duration: 0.00 ms

Test Date: 6/28/2011
Test Time: 3:25 pm

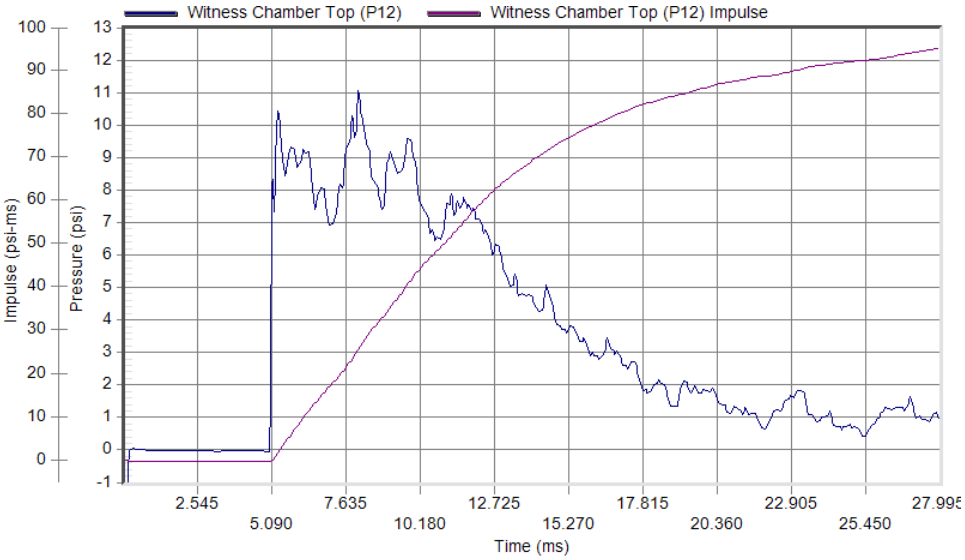
Specimen #22: (Continued)



Peak Pressure: 10.53 psi at 7.44 ms
Duration: 0.00 ms

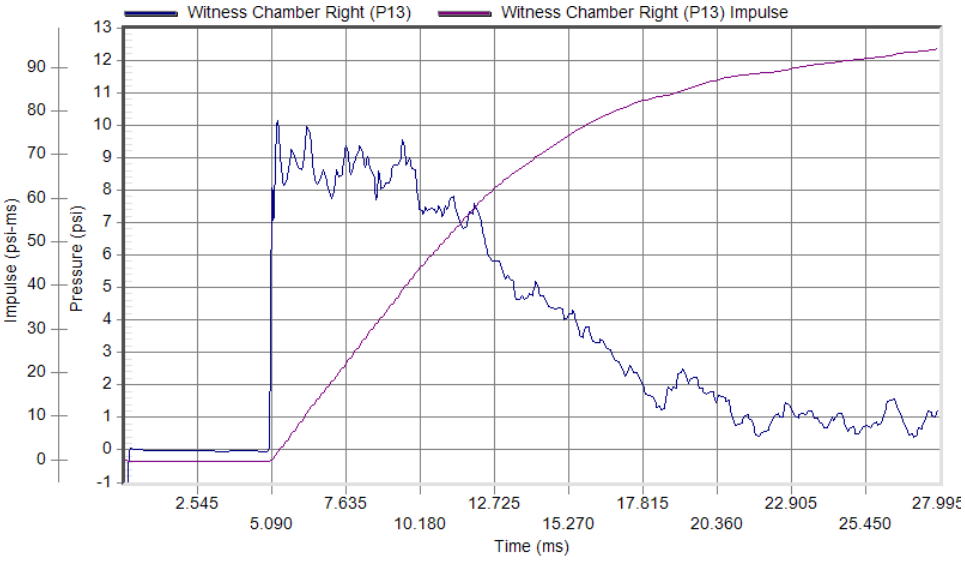
Test Date: 6/28/2011
Test Time: 3:25 pm

Specimen #23



Peak Pressure: 11.13 psi at 8.06 ms
Duration: 0.00 ms

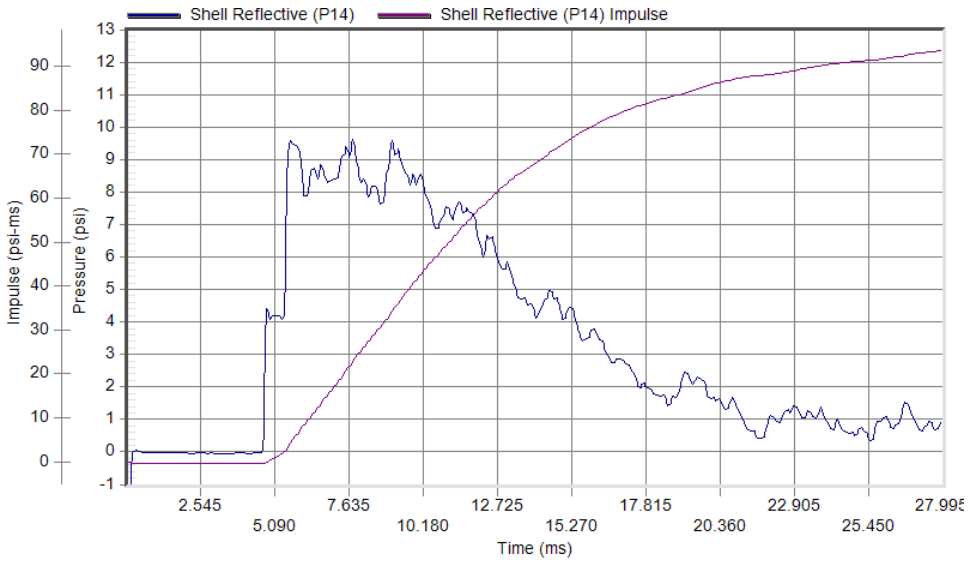
Test Date: 6/28/2011
Test Time: 4:25 pm



Peak Pressure: 10.12 psi at 5.29 ms
Duration: 0.00 ms

Test Date: 6/28/2011
Test Time: 4:25 pm

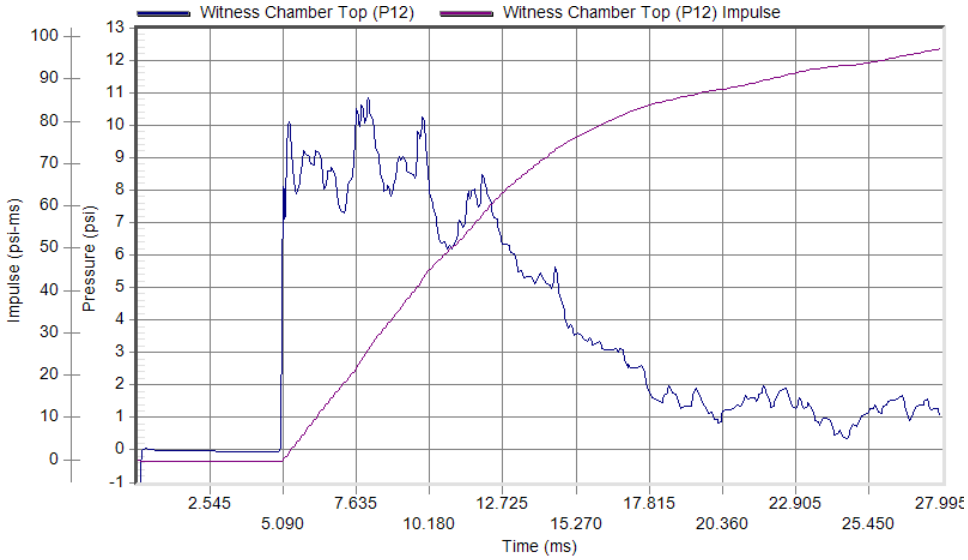
Specimen #23: (Continued)



Peak Pressure: 9.70 psi at 7.76 ms
Duration: 0.00 ms

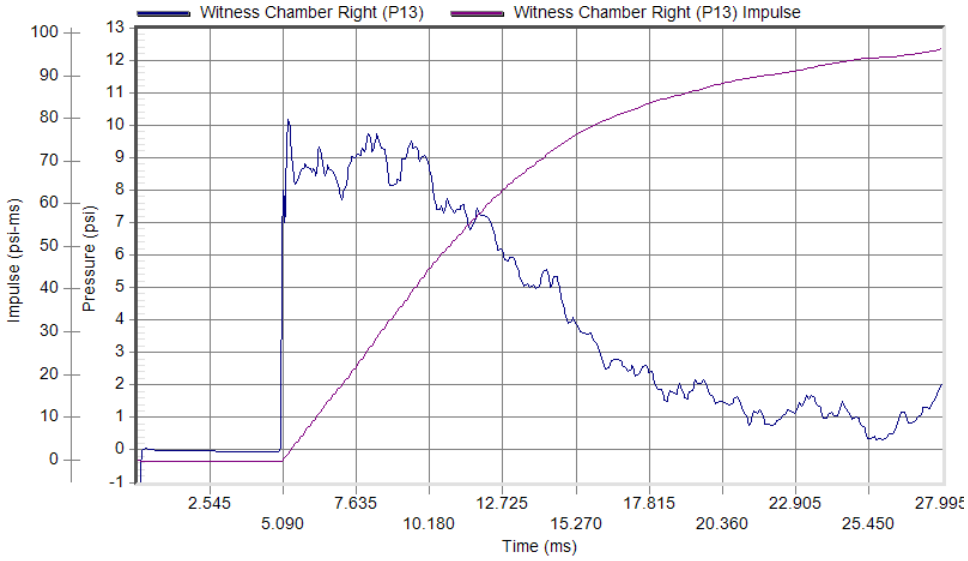
Test Date: 6/28/2011
Test Time: 4:25 pm

Specimen #24



Peak Pressure: 10.90 psi at 8.05 ms
Duration: 0.00 ms

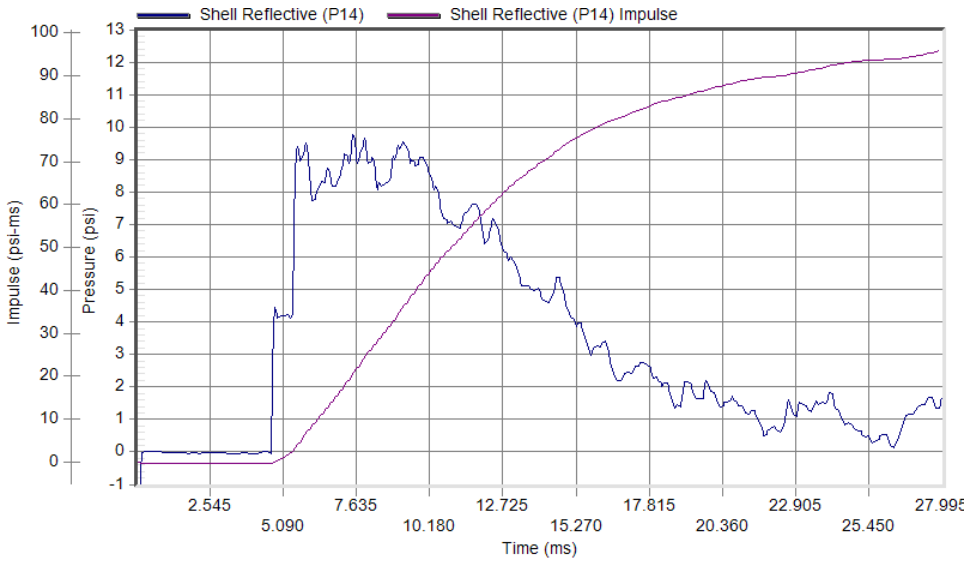
Test Date: 6/28/2011
Test Time: 10:17 am



Peak Pressure: 10.23 psi at 5.29 ms
Duration: 0.00 ms

Test Date: 6/28/2011
Test Time: 10:17 am

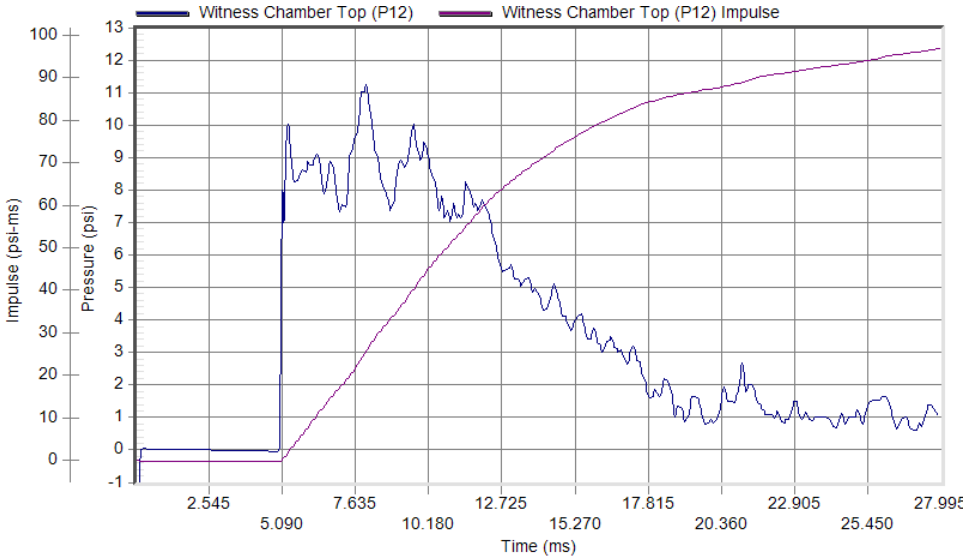
Specimen #24: (Continued)



Peak Pressure: 9.84 psi at 7.54 ms
Duration: 20.72 ms

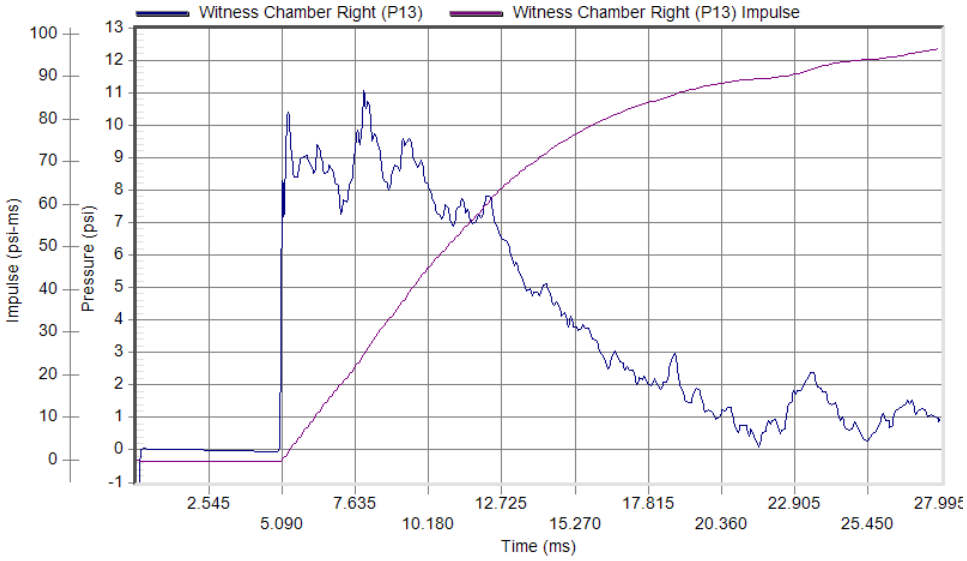
Test Date: 6/28/2011
Test Time: 10:17 am

Specimen #25



Peak Pressure: 11.27 psi at 8.02 ms
Duration: 0.00 ms

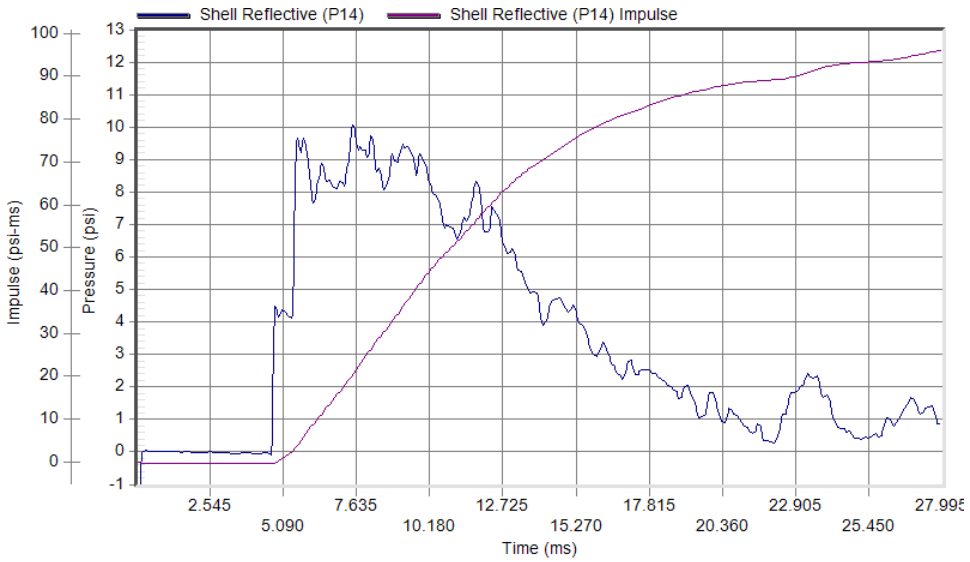
Test Date: 6/28/2011
Test Time: 11:01 am



Peak Pressure: 11.04 psi at 7.95 ms
Duration: 13.71 ms

Test Date: 6/28/2011
Test Time: 11:01 am

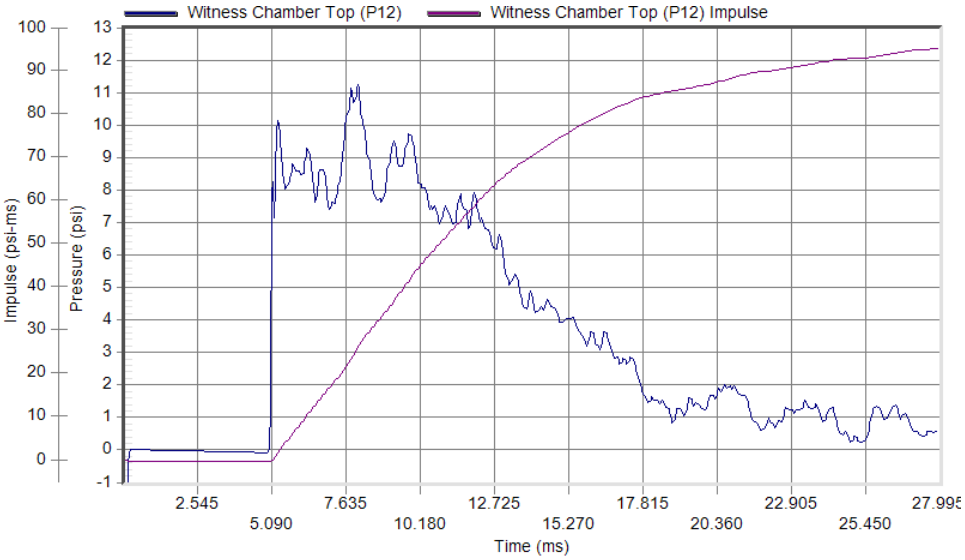
Specimen #25: (Continued)



Peak Pressure: 10.14 psi at 7.53 ms
Duration: 0.00 ms

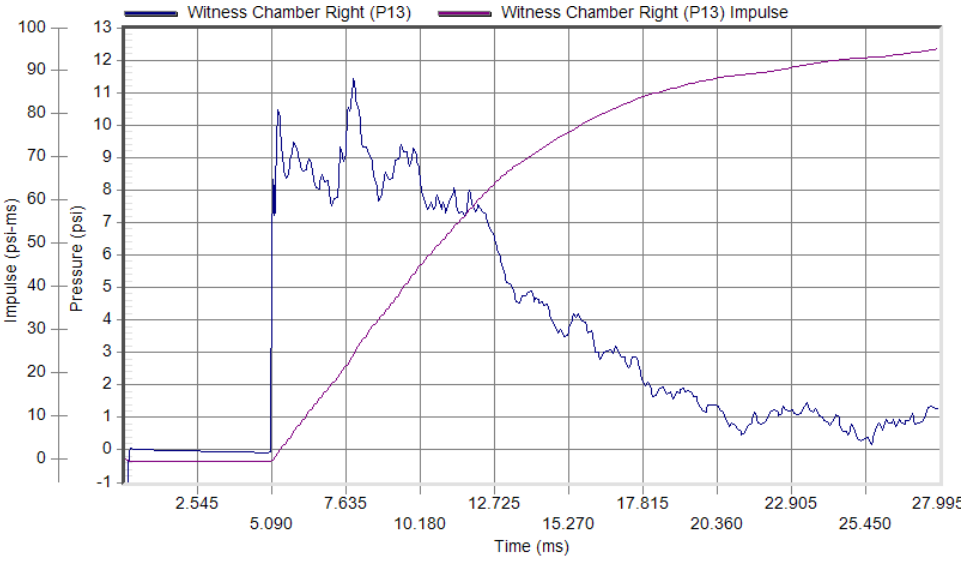
Test Date: 6/28/2011
Test Time: 11:01 am

Specimen #26



Peak Pressure: 11.27 psi at 8.04 ms
Duration: 16.92 ms

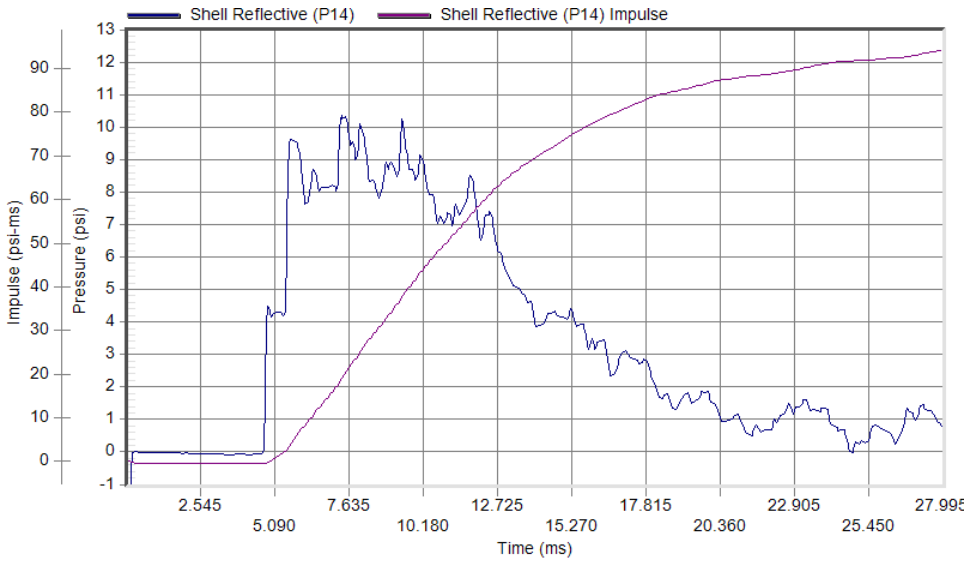
Test Date: 6/28/2011
Test Time: 1:29 pm



Peak Pressure: 11.41 psi at 7.90 ms
Duration: 20.52 ms

Test Date: 6/28/2011
Test Time: 1:29 pm

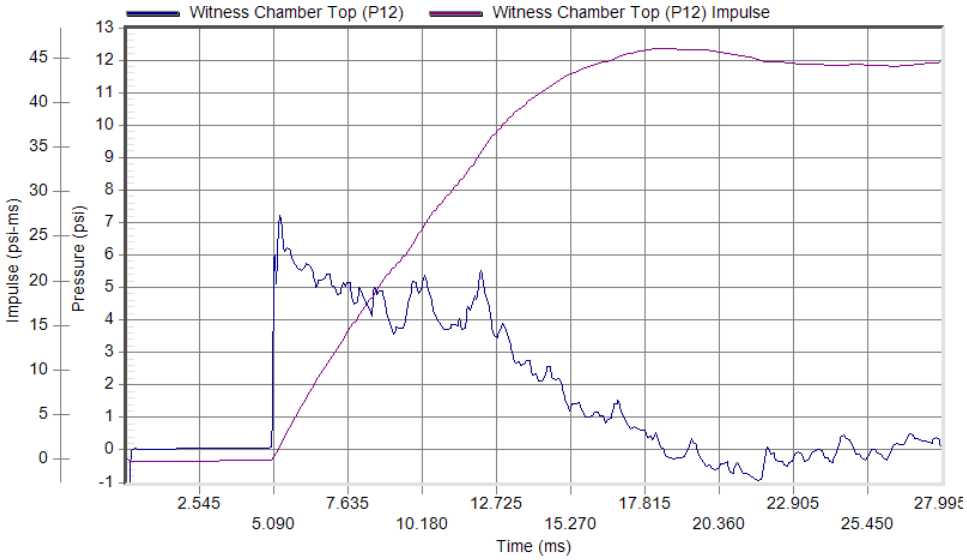
Specimen #26: (Continued)



Peak Pressure: 10.34 psi at 7.36 ms
Duration: 17.42 ms

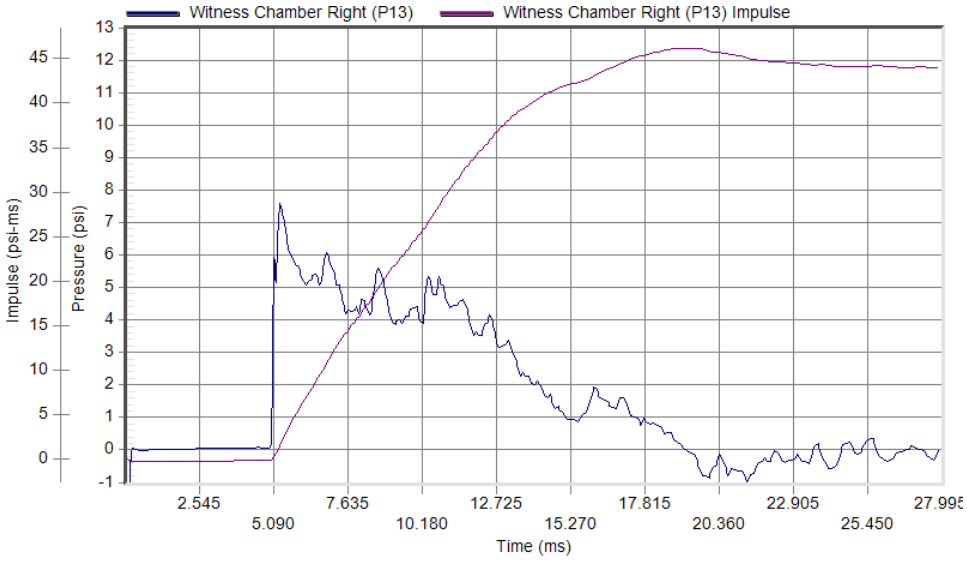
Test Date: 6/28/2011
Test Time: 1:29 pm

Specimen #27



Peak Pressure: 7.21 psi at 5.30 ms
Duration: 13.13 ms

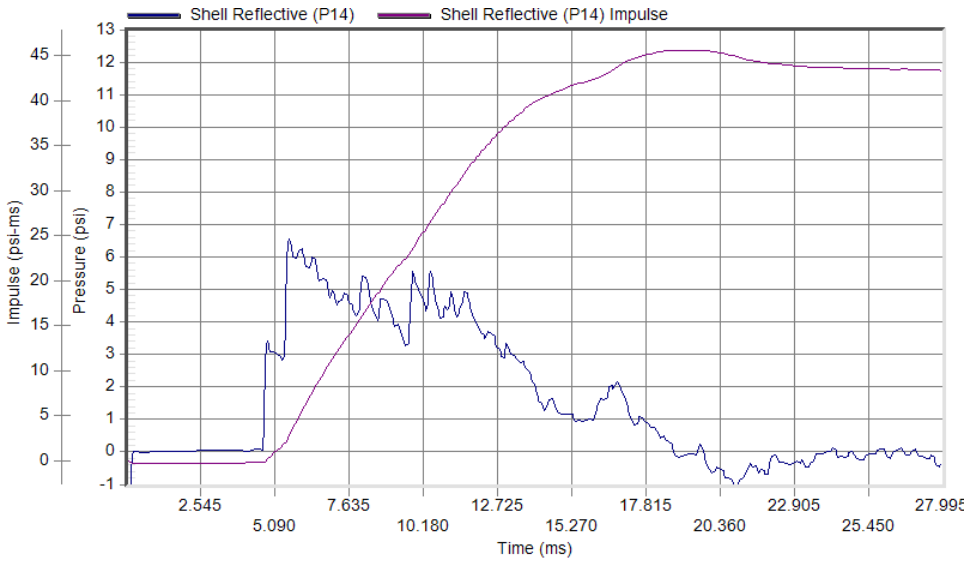
Test Date: 6/21/2011
Test Time: 11:54 am



Peak Pressure: 7.58 psi at 5.31 ms
Duration: 13.84 ms

Test Date: 6/21/2011
Test Time: 11:54 am

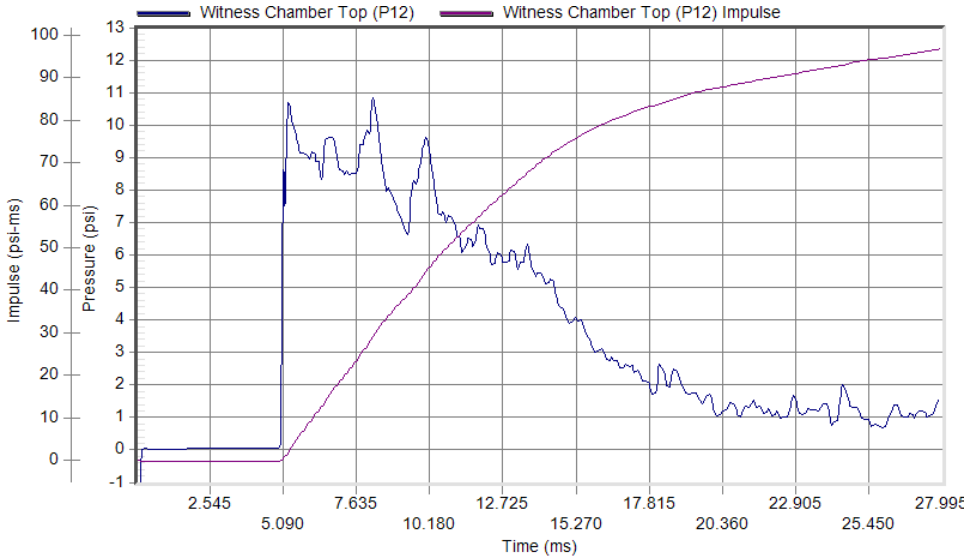
Specimen #27: (Continued)



Peak Pressure: 6.56 psi at 5.59 ms
Duration: 13.19 ms

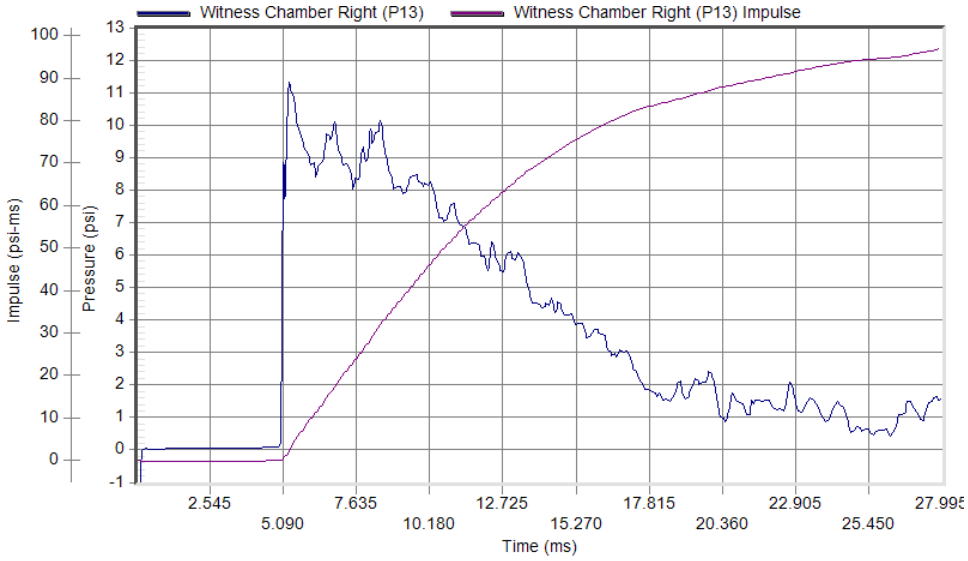
Test Date: 6/21/2011
Test Time: 11:54 am

Specimen #28



Peak Pressure: 10.82 psi at 8.21 ms
Duration: 0.00 ms

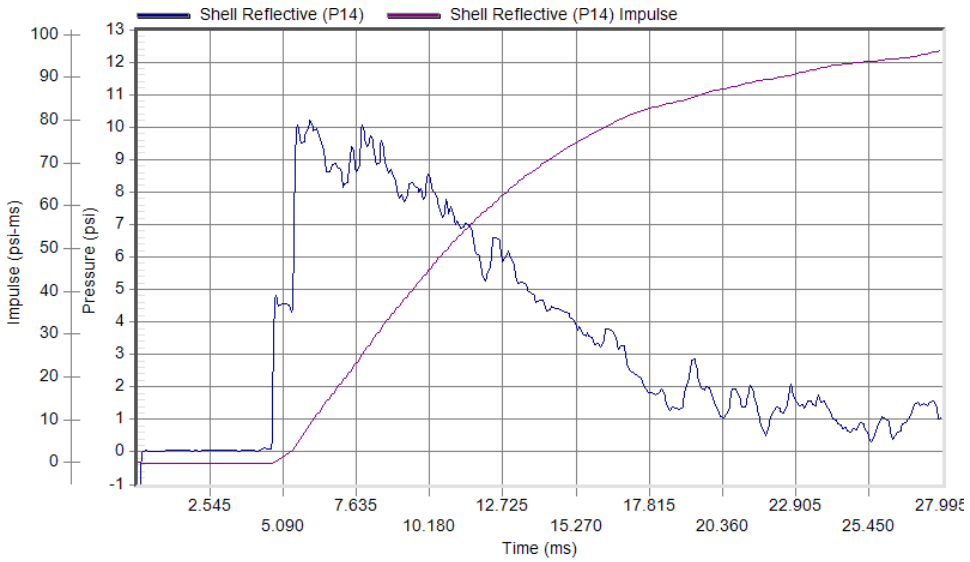
Test Date: 6/22/2011
Test Time: 2:28 pm



Peak Pressure: 11.35 psi at 5.31 ms
Duration: 0.00 ms

Test Date: 6/22/2011
Test Time: 2:28 pm

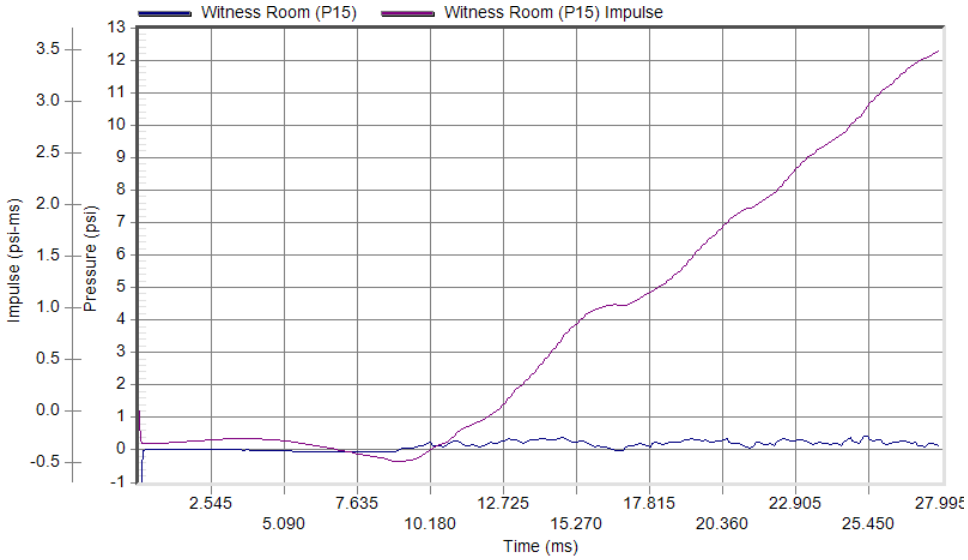
Specimen #28: (Continued)



Peak Pressure: 10.23 psi at 6.06 ms
Duration: 0.00 ms

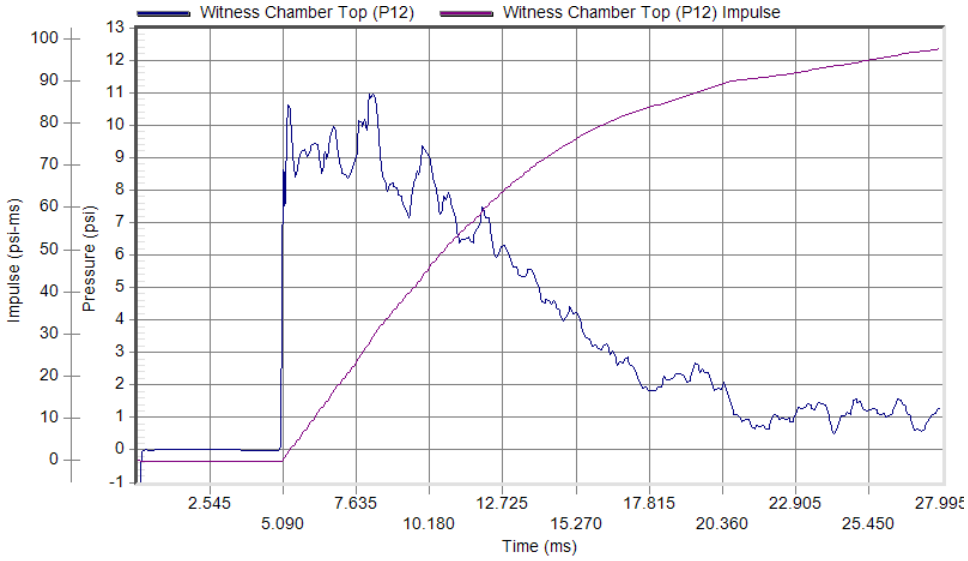
Test Date: 6/22/2011
Test Time: 2:28 pm

Specimen #29



Peak Pressure: 0.43 psi at 25.30 ms
Duration: 0.00 ms

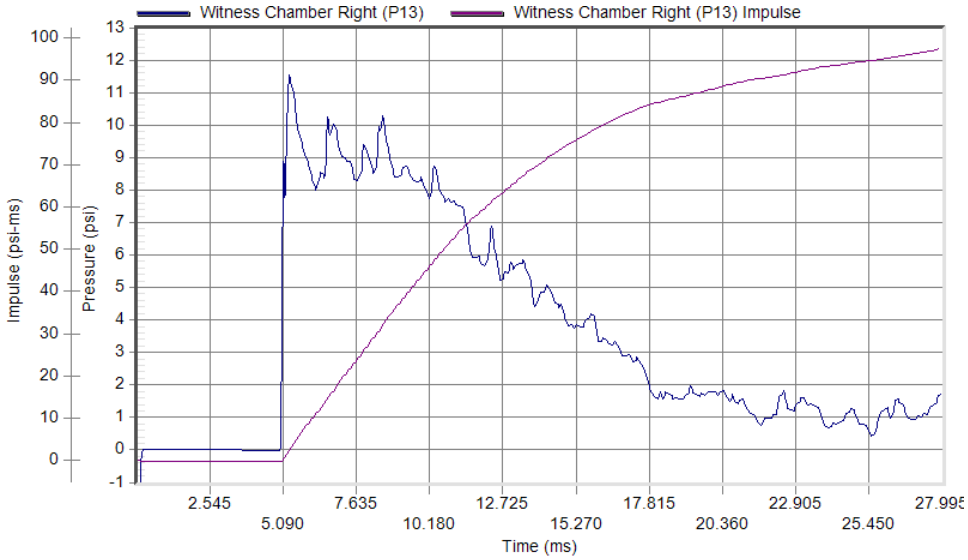
Test Date: 6/23/2011
Test Time: 9:14 am



Peak Pressure: 10.98 psi at 8.10 ms
Duration: 0.00 ms

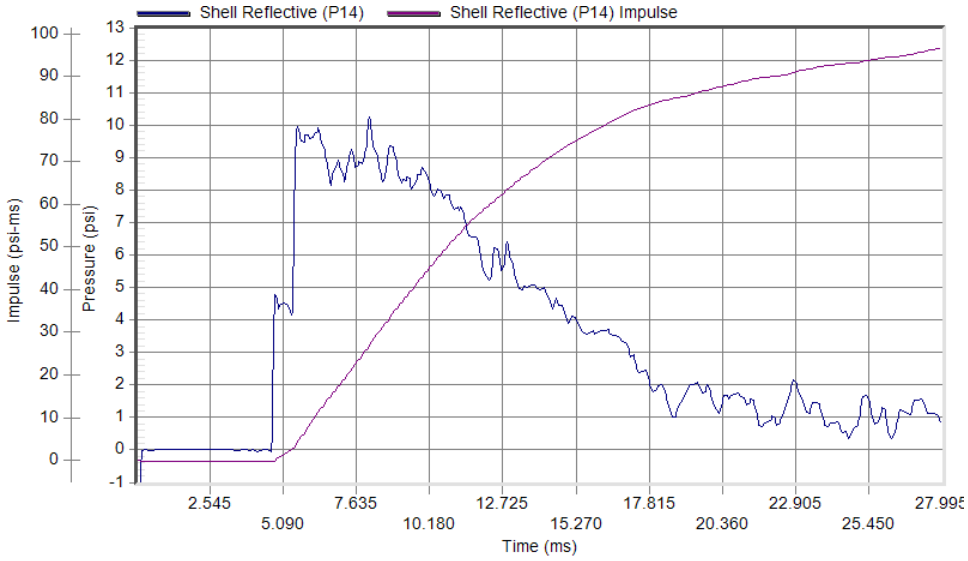
Test Date: 6/23/2011
Test Time: 9:14 am

Specimen #29: (Continued)



Peak Pressure: 11.54 psi at 5.32 ms
Duration: 0.00 ms

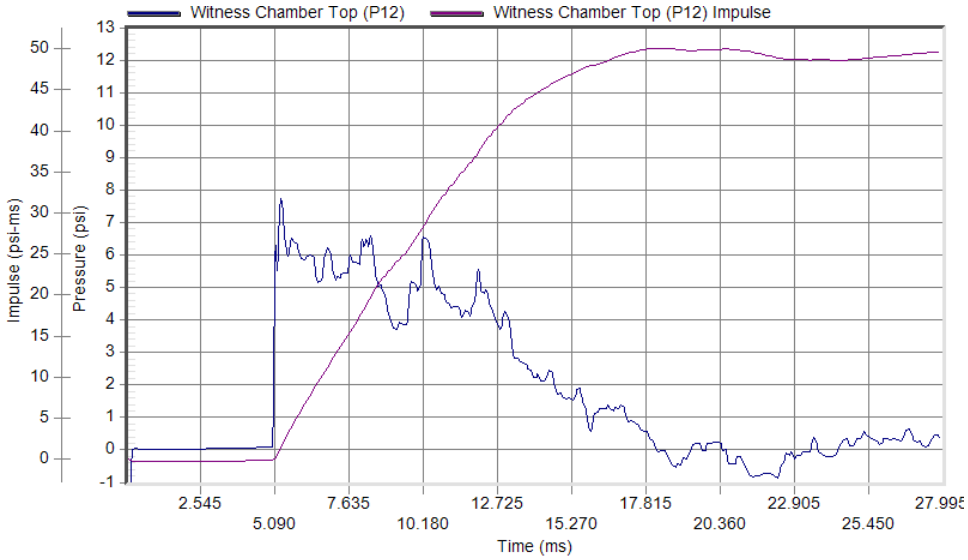
Test Date: 6/23/2011
Test Time: 9:14 am



Peak Pressure: 10.25 psi at 8.09 ms
Duration: 0.00 ms

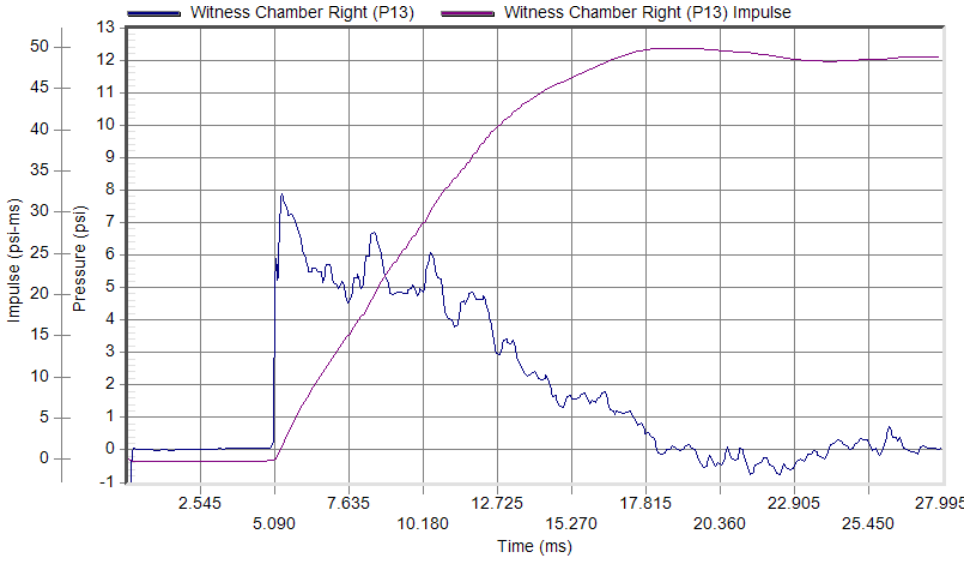
Test Date: 6/23/2011
Test Time: 9:14 am

Specimen #30



Peak Pressure: 7.72 psi at 5.30 ms
Duration: 12.86 ms

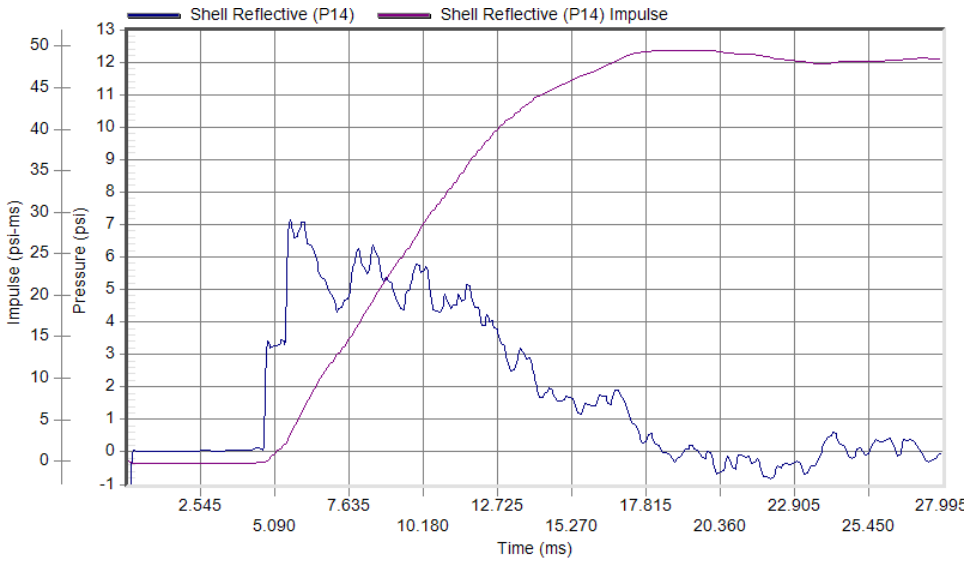
Test Date: 6/23/2011
Test Time: 2:07 pm



Peak Pressure: 7.87 psi at 5.33 ms
Duration: 12.84 ms

Test Date: 6/23/2011
Test Time: 2:07 pm

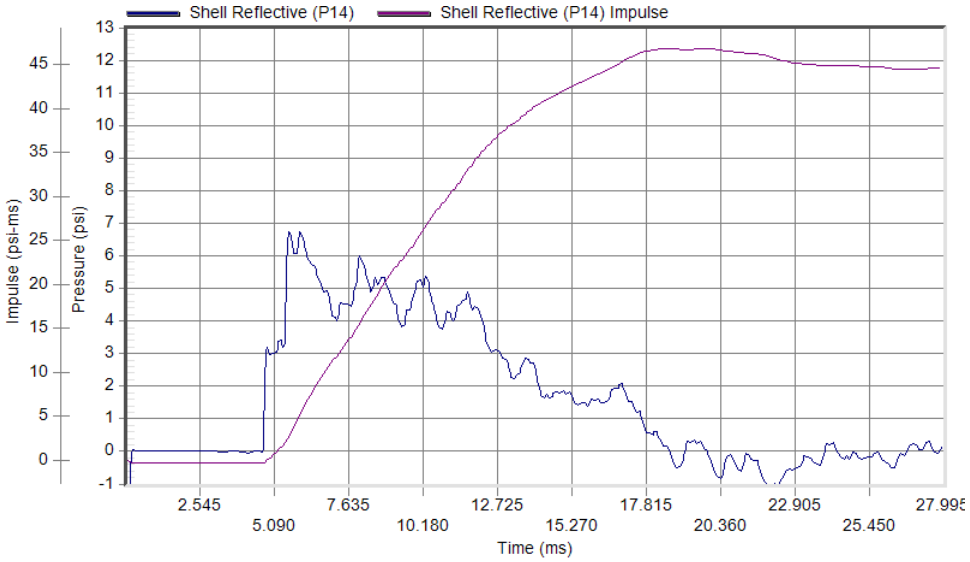
Specimen #30: (Continued)



Peak Pressure: 7.15 psi at 5.62 ms
Duration: 12.71 ms

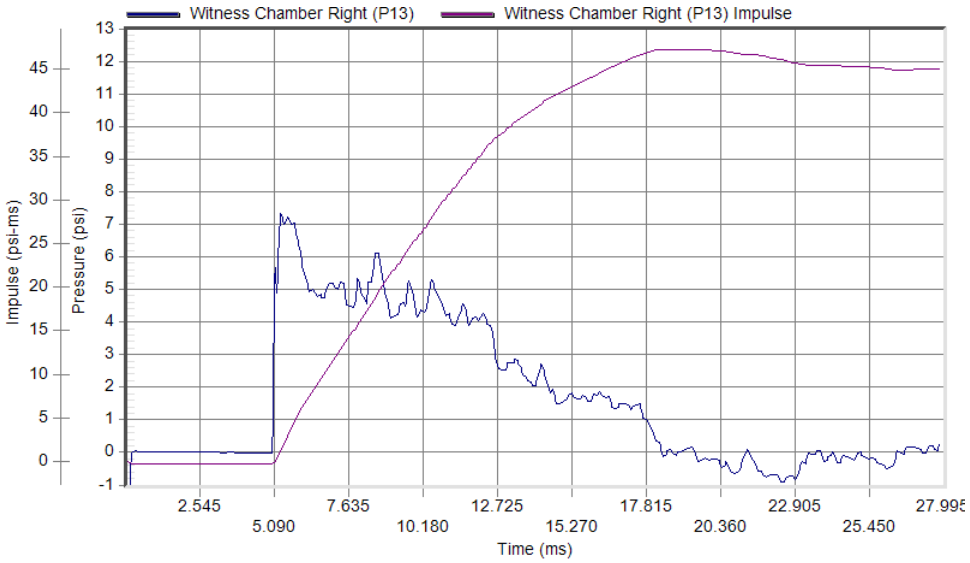
Test Date: 6/23/2011
Test Time: 2:07 pm

Specimen #31



Peak Pressure: 6.79 psi at 5.60 ms
Duration: 13.02 ms

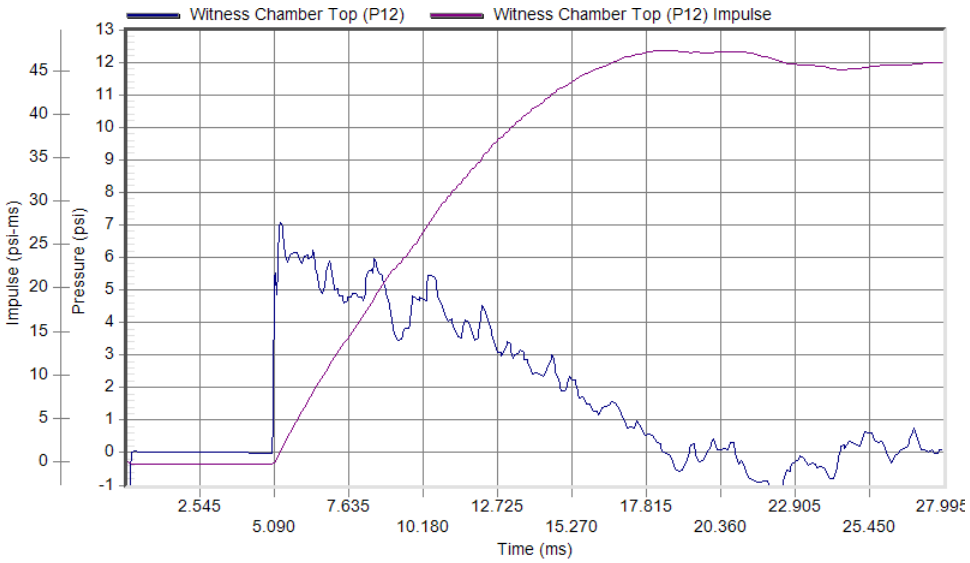
Test Date: 6/27/2011
Test Time: 1:30 pm



Peak Pressure: 7.39 psi at 5.33 ms
Duration: 13.01 ms

Test Date: 6/27/2011
Test Time: 1:30 pm

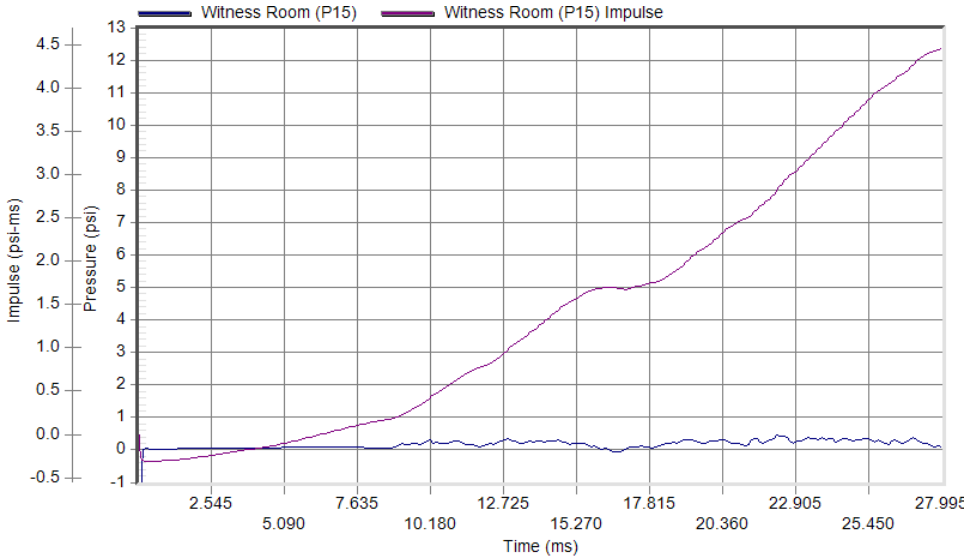
Specimen #31: (Continued)



Peak Pressure: 7.12 psi at 5.31 ms
Duration: 13.05 ms

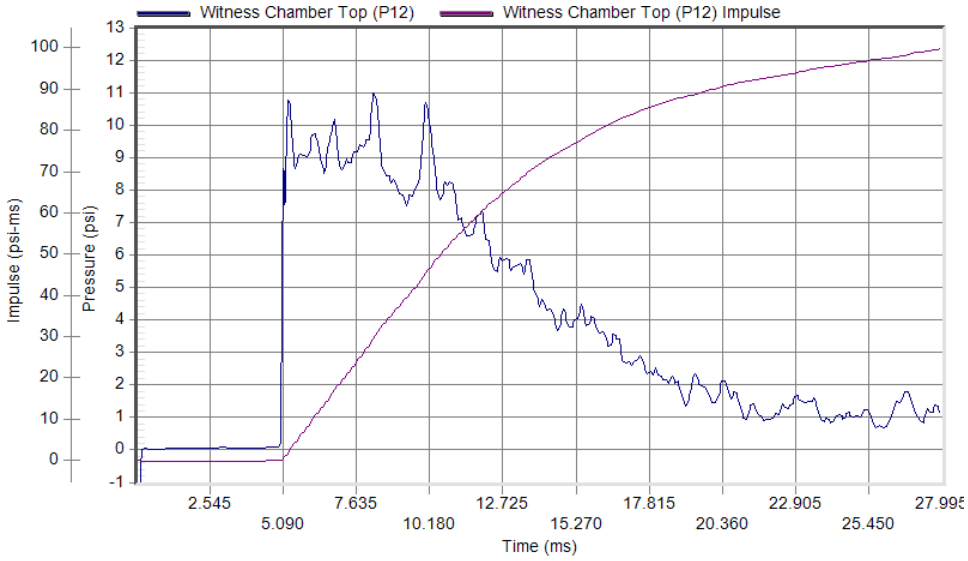
Test Date: 6/27/2011
Test Time: 1:30 pm

Specimen #32



Peak Pressure: 0.47 psi at 22.27 ms
Duration: 0.00 ms

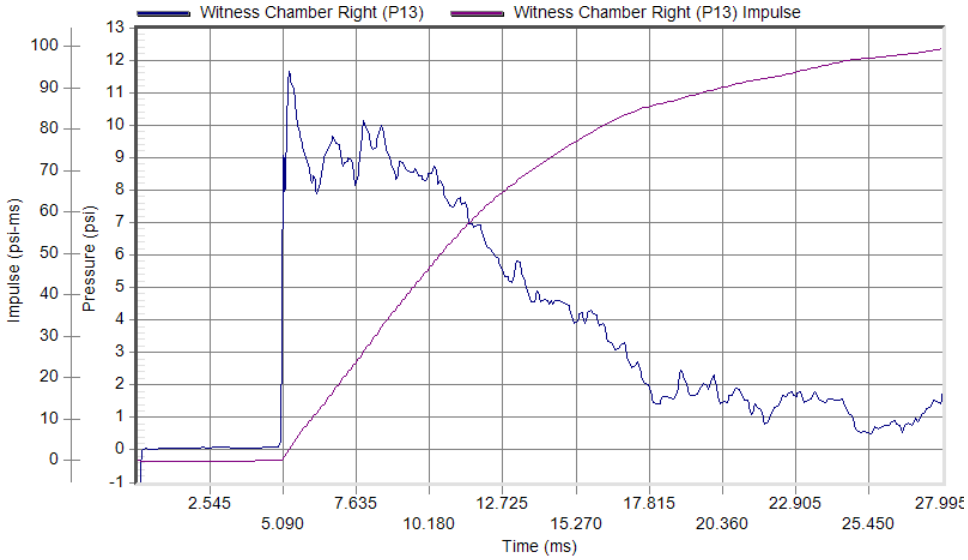
Test Date: 6/22/2011
Test Time: 3:18 pm



Peak Pressure: 11.04 psi at 8.26 ms
Duration: 0.00 ms

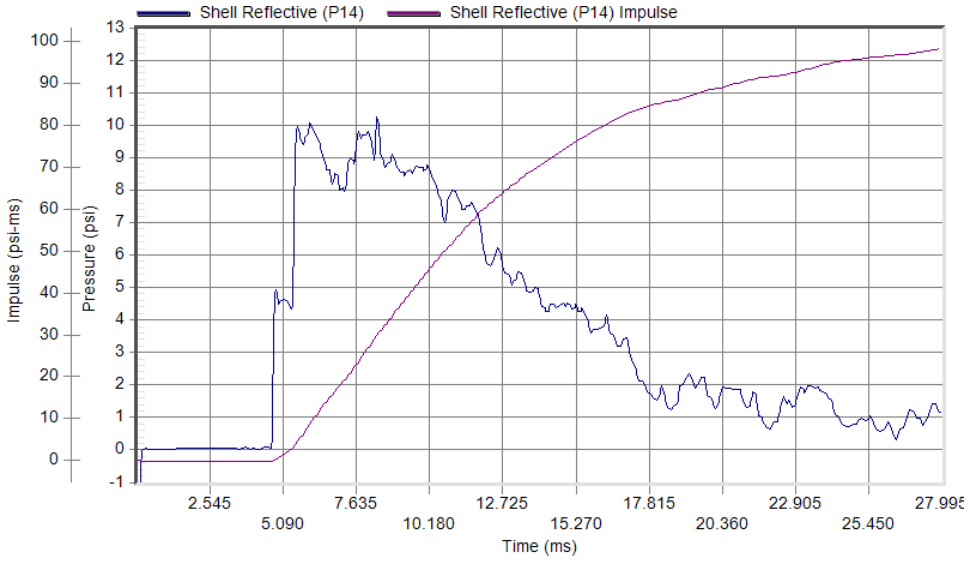
Test Date: 6/22/2011
Test Time: 3:18 pm

Specimen #32: (Continued)



Peak Pressure: 11.64 psi at 5.31 ms
Duration: 0.00 ms

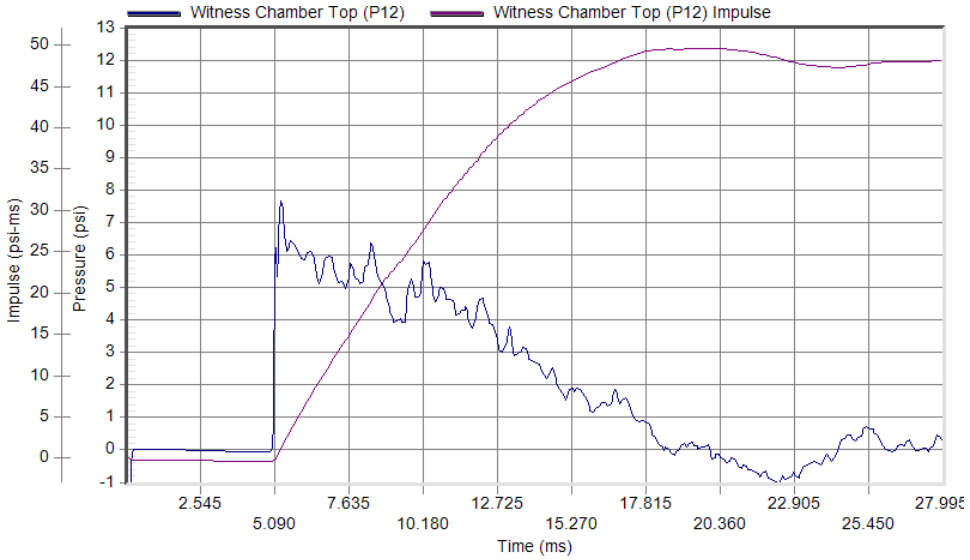
Test Date: 6/22/2011
Test Time: 3:18 pm



Peak Pressure: 10.27 psi at 8.37 ms
Duration: 0.00 ms

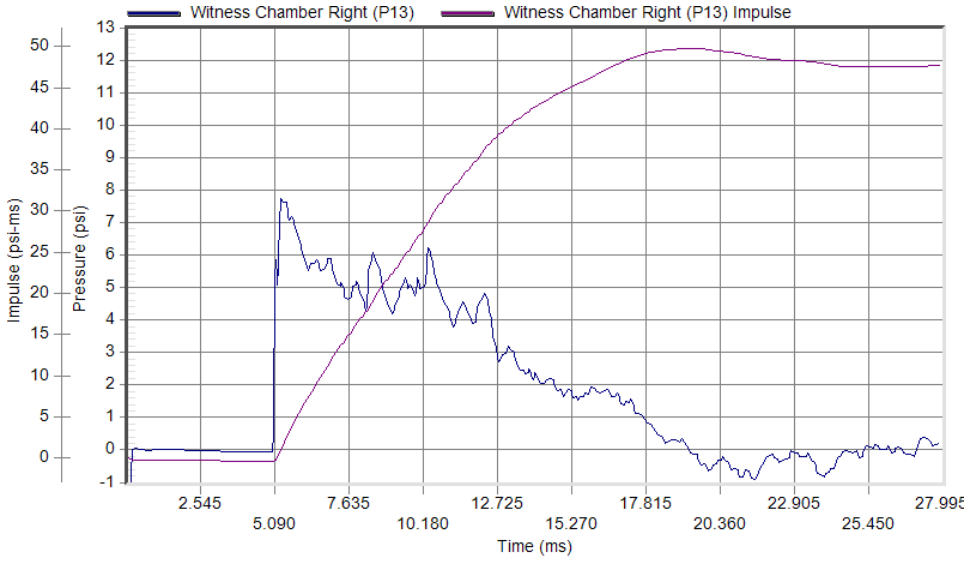
Test Date: 6/22/2011
Test Time: 3:18 pm

Specimen #33



Peak Pressure: 7.70 psi at 5.31 ms
Duration: 13.07 ms

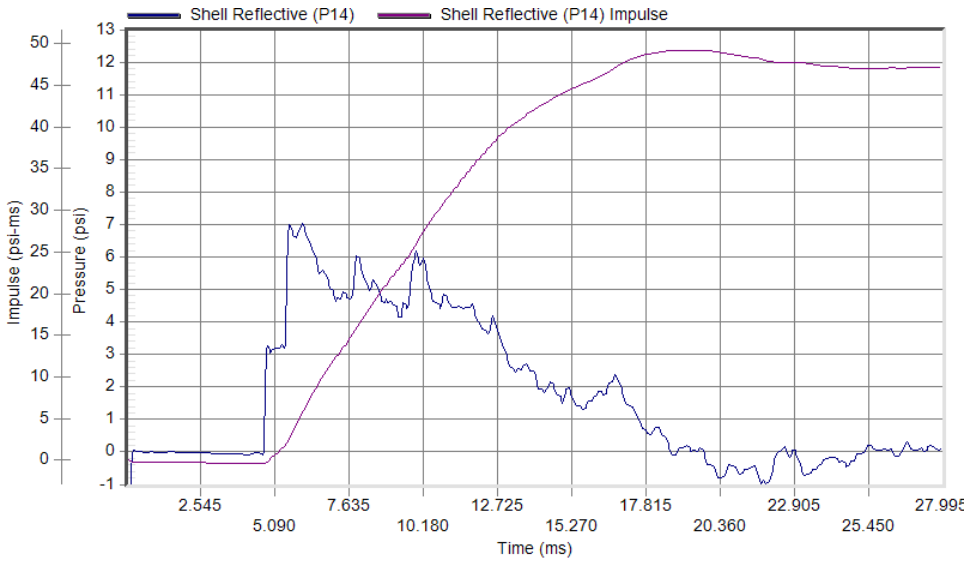
Test Date: 6/23/2011
Test Time: 11:54 am



Peak Pressure: 7.82 psi at 5.33 ms
Duration: 13.97 ms

Test Date: 6/23/2011
Test Time: 11:54 am

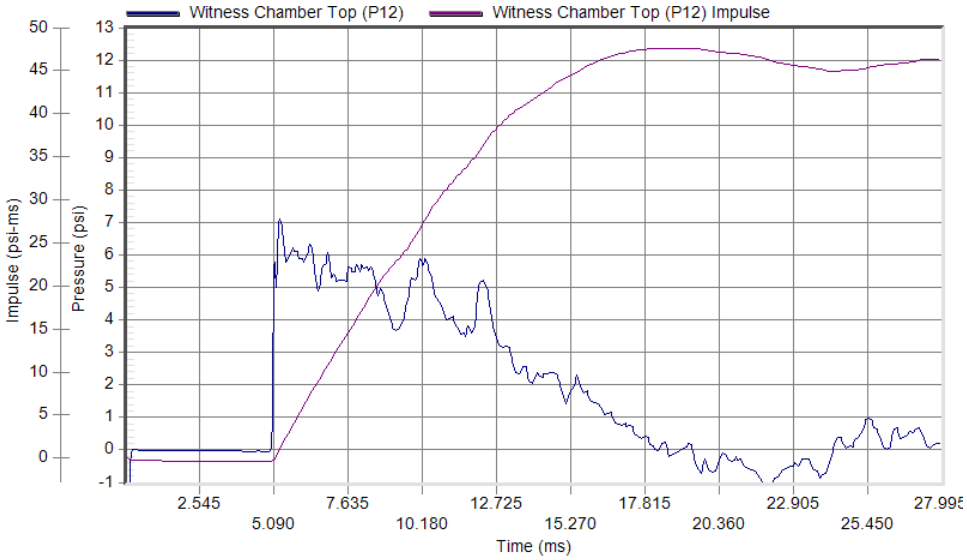
Specimen #33: (Continued)



Peak Pressure: 7.06 psi at 6.04 ms
Duration: 12.60 ms

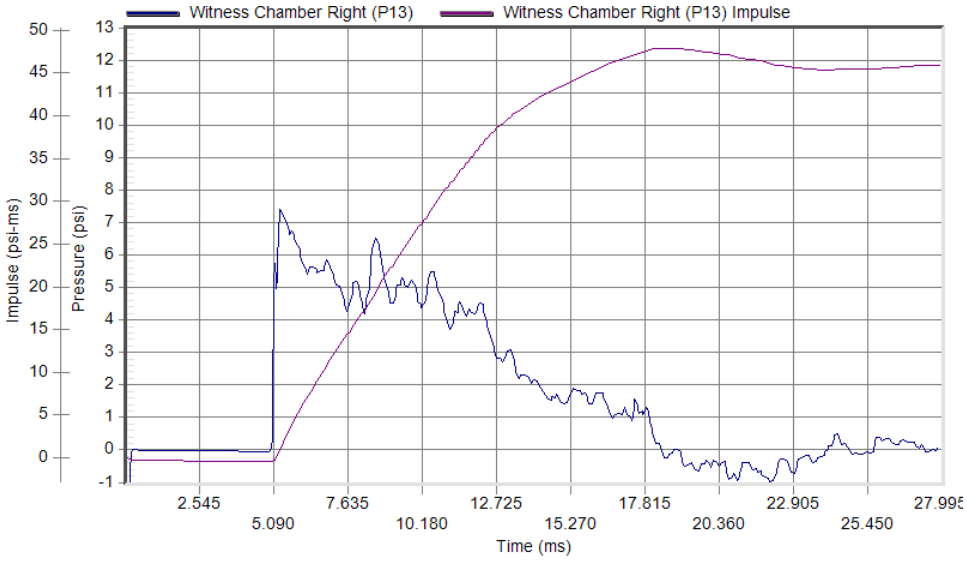
Test Date: 6/23/2011
Test Time: 11:54 am

Specimen #34



Peak Pressure: 7.16 psi at 5.30 ms
Duration: 12.83 ms

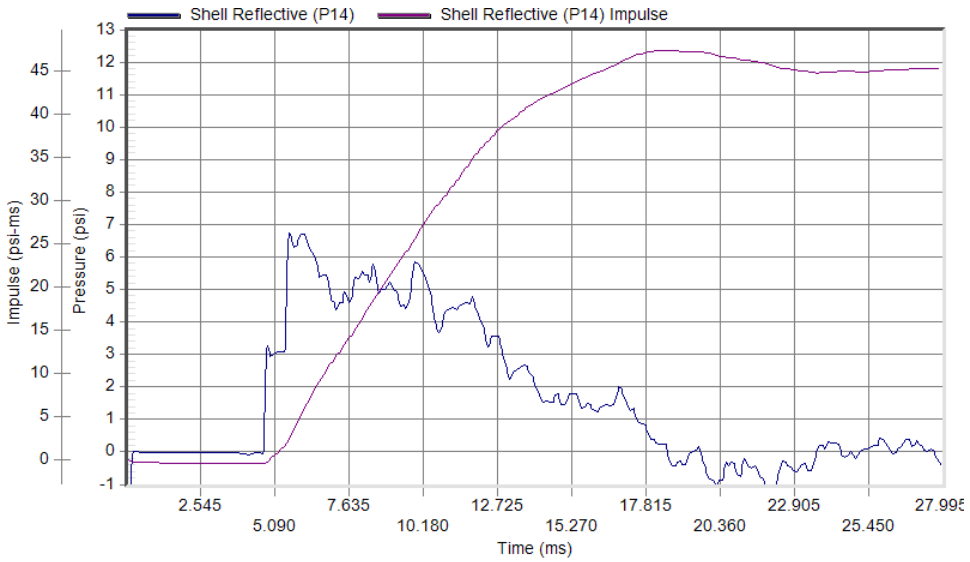
Test Date: 6/23/2011
Test Time: 2:43 pm



Peak Pressure: 7.48 psi at 5.33 ms
Duration: 13.03 ms

Test Date: 6/23/2011
Test Time: 2:43 pm

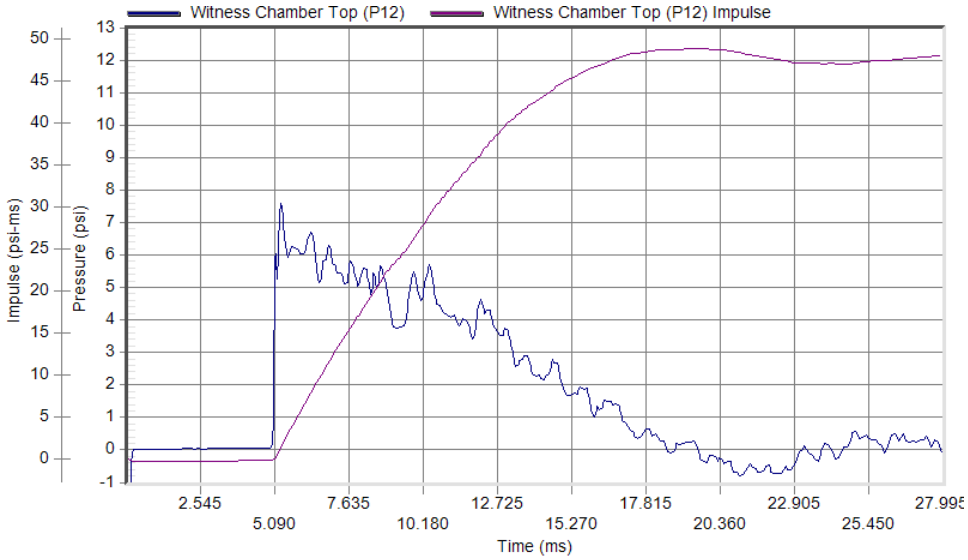
Specimen #34: (Continued)



Peak Pressure: 6.78 psi at 5.61 ms
Duration: 12.94 ms

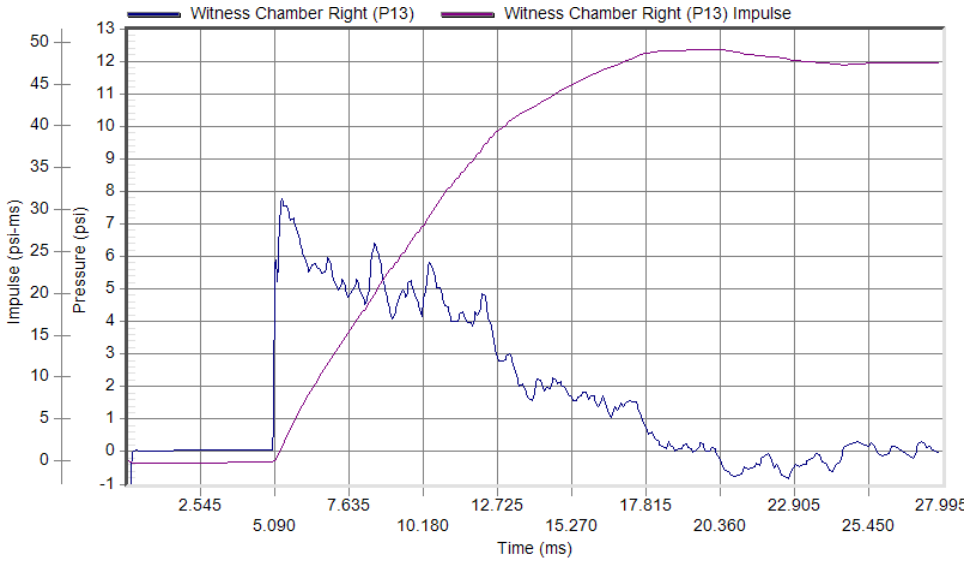
Test Date: 6/23/2011
Test Time: 2:43 pm

Specimen #35



Peak Pressure: 7.67 psi at 5.30 ms
Duration: 13.21 ms

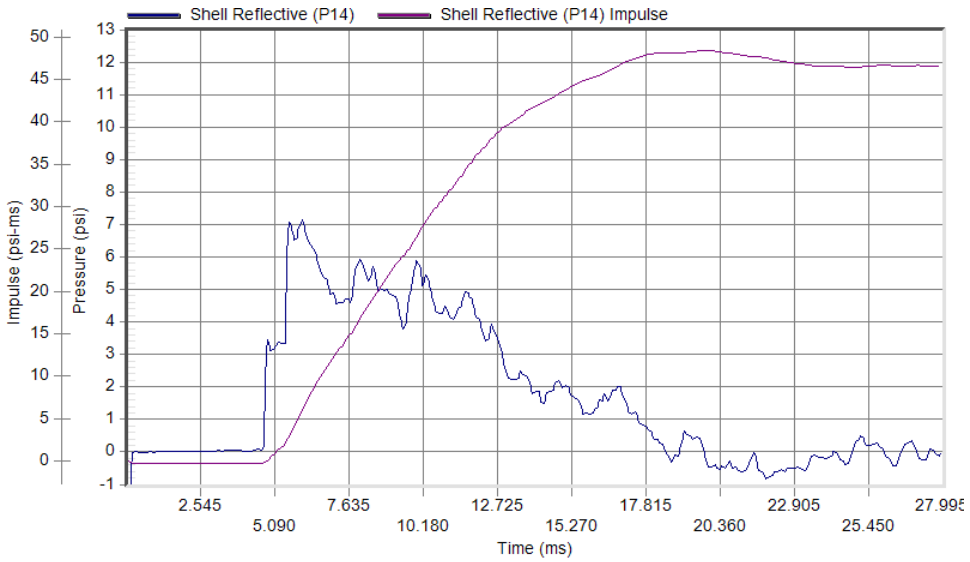
Test Date: 6/23/2011
Test Time: 3:19 pm



Peak Pressure: 7.76 psi at 5.33 ms
Duration: 13.15 ms

Test Date: 6/23/2011
Test Time: 3:19 pm

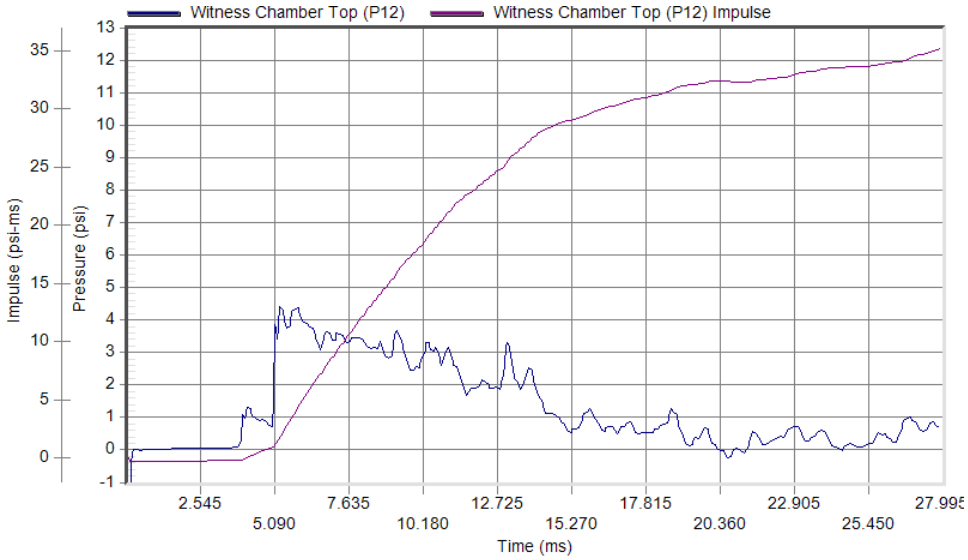
Specimen #35: (Continued)



Peak Pressure: 7.13 psi at 6.03 ms
Duration: 12.44 ms

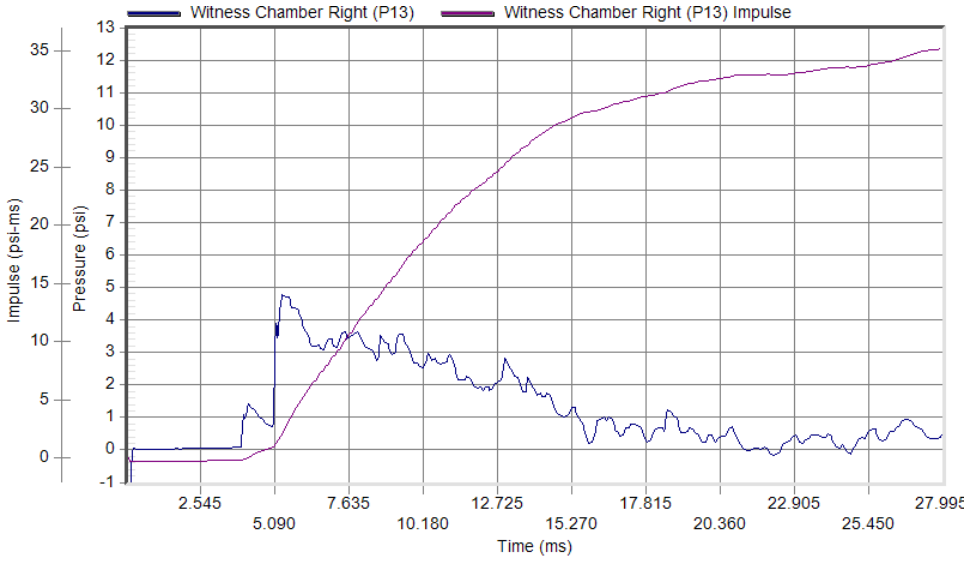
Test Date: 6/23/2011
Test Time: 3:19 pm

Specimen #36



Peak Pressure: 4.50 psi at 5.30 ms
Duration: 14.98 ms

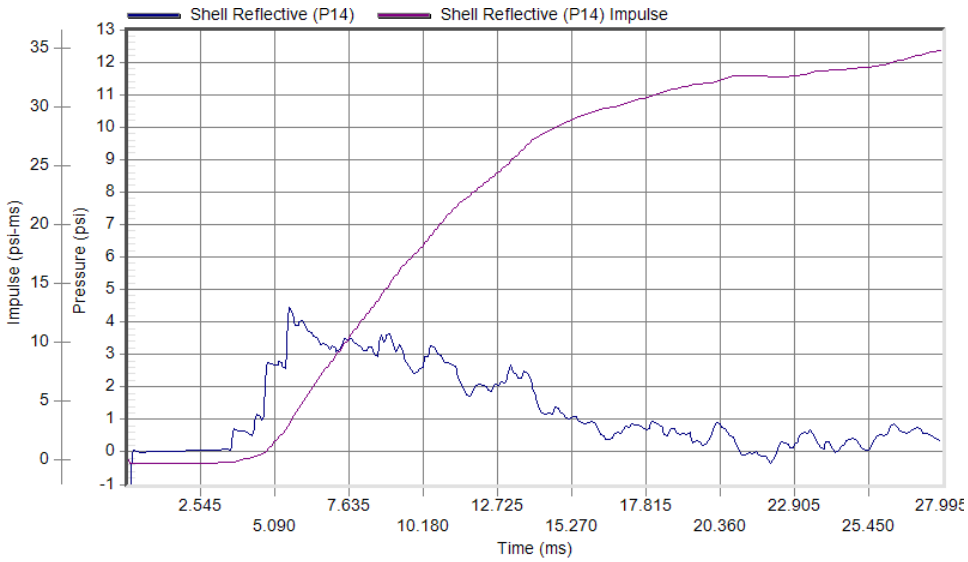
Test Date: 6/27/2011
Test Time: 10:43 am



Peak Pressure: 4.85 psi at 5.36 ms
Duration: 15.81 ms

Test Date: 6/27/2011
Test Time: 10:43 am

Specimen #36: (Continued)



Peak Pressure: 4.46 psi at 5.61 ms
Duration: 15.42 ms

Test Date: 6/27/2011
Test Time: 10:43 am

Appendix C

Photographs

Photo No. 1
Pre-test Specimen #1, Interior

Photo No. 2
Post-test Specimen #1, Interior

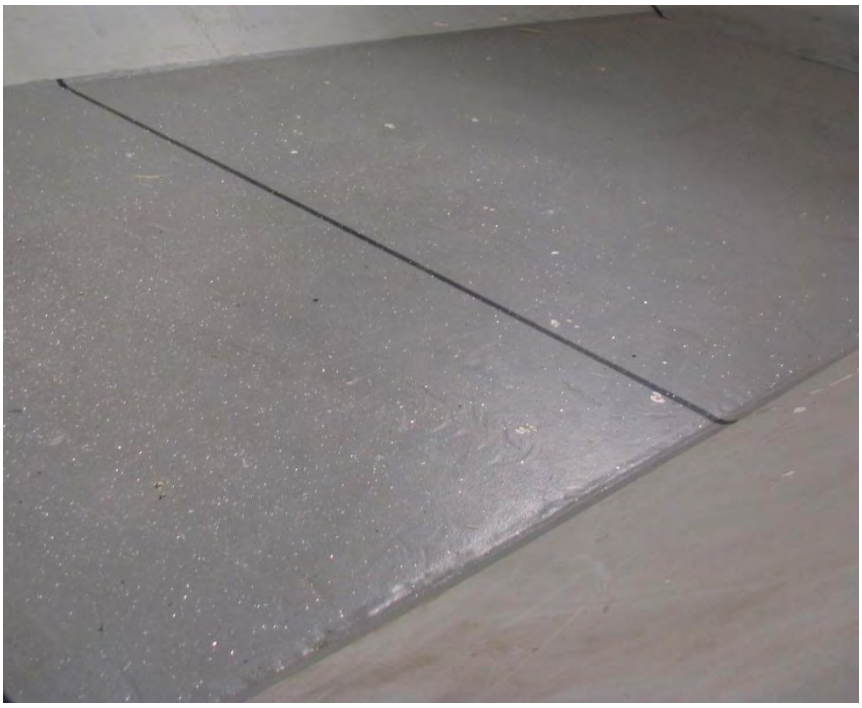


Photo No. 3
Post-test Specimen #1, Witness Chamber

Photo No. 4
Pre-test Specimen #2, Interior

Photo No. 5
Post-test Specimen #2, Interior

Photo No. 6
Post-test Specimen #2, Witness Chamber

Photo No. 7
Pre-test Specimen #3, Interior

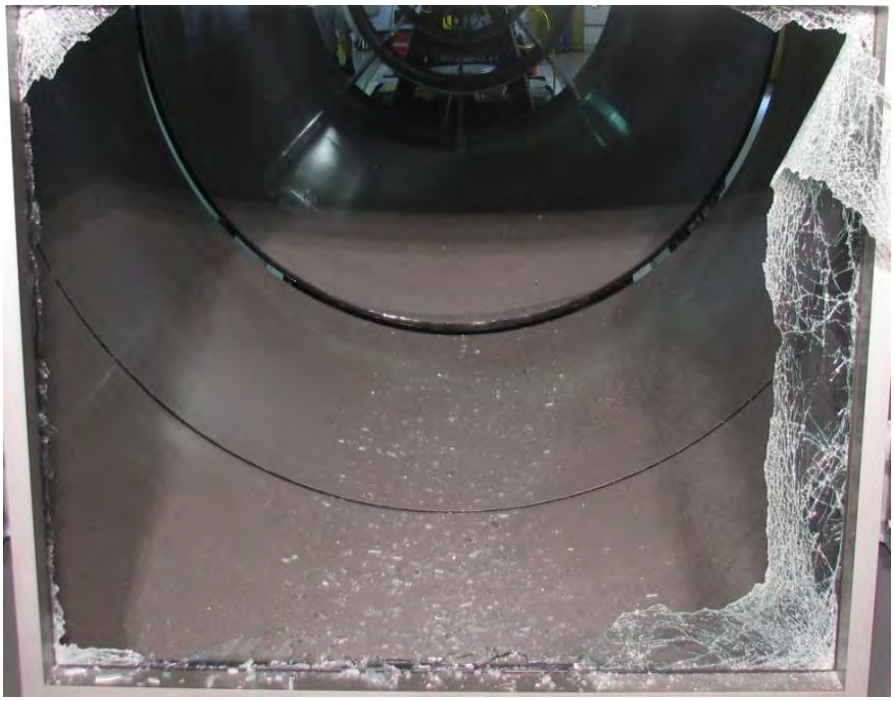


Photo No. 8
Post-test Specimen #3, Interior

Photo No. 9
Post-test Specimen #3, Witness Chamber

Photo No. 10
Pre-test Specimen #4, Interior

Photo No. 11
Post-test Specimen #4, Interior

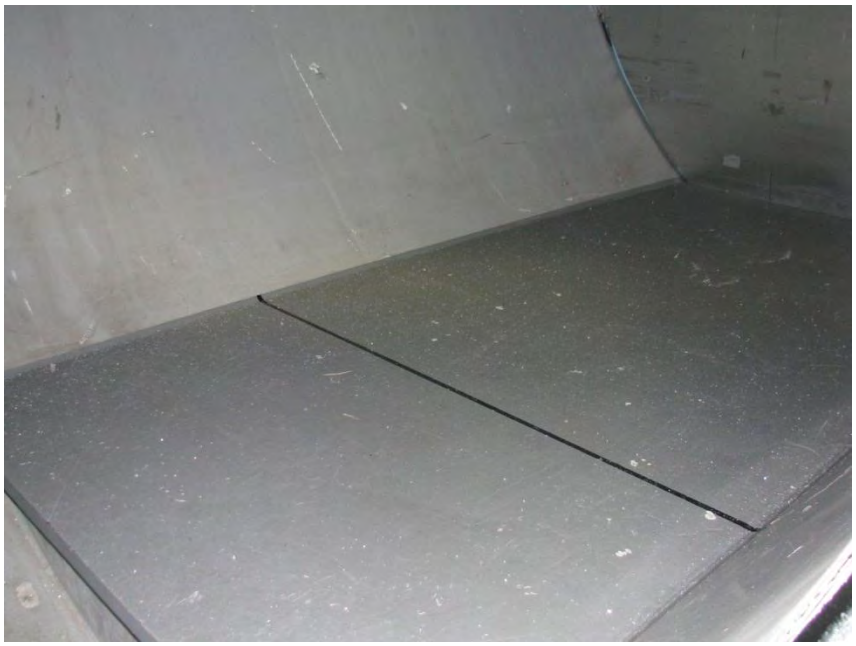


Photo No. 12
Post-test Specimen #4, Witness Chamber

Photo No. 13
Pre-test Specimen #5, Interior

Photo No. 14
Post-test Specimen #5, Interior

Photo No. 15
Post-test Specimen #5, Witness Chamber

Photo No. 16
Pre-test Specimen #6, Interior

Photo No. 17
Post-test Specimen #6, Interior

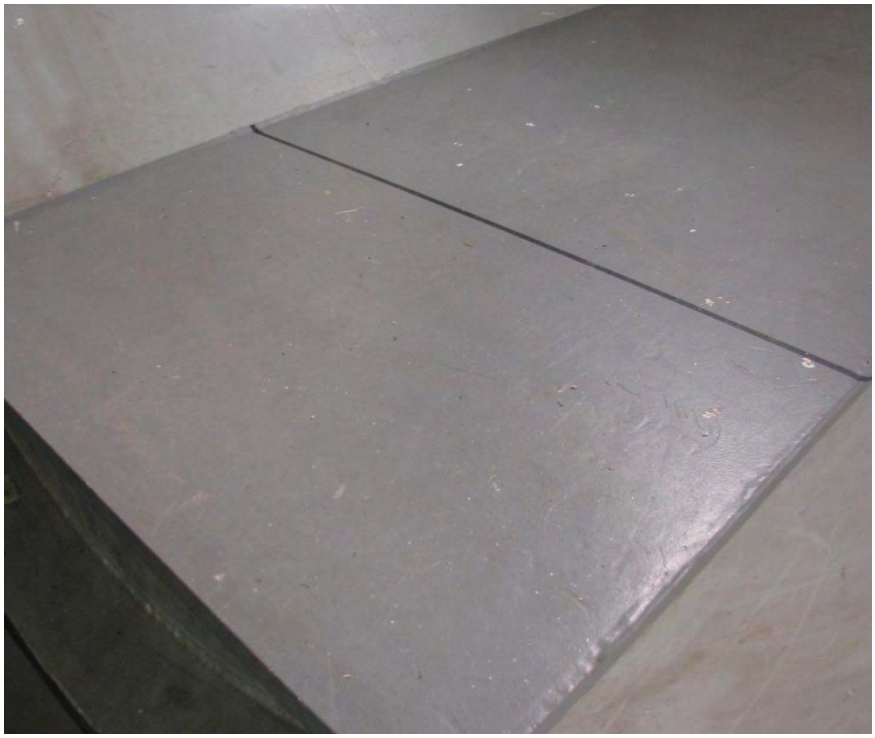


Photo No. 18
Post-test Specimen #6, Witness Chamber

Photo No. 19
Pre-test Specimen #7, Interior

Photo No. 20
Post-test Specimen #7, Interior

Photo No. 21
Post-test Specimen #7, Witness Chamber

Photo No. 22
Pre-test Specimen #8, Interior

Photo No. 23
Post-test Specimen #8, Interior

Photo No. 24
Post-test Specimen #8, Witness Chamber

Photo No. 25
Pre-test Specimen #9, Interior

Photo No. 26
Post-test Specimen #9, Interior

Photo No. 27
Post-test Specimen #9, Witness Chamber

Photo No. 28
Pre-test Specimen #10, Interior

Photo No. 29
Post-test Specimen #10, Interior

Photo No. 30
Post-test Specimen #10, Witness Chamber

Photo No. 31
Pre-test Specimen #11, Interior

Photo No. 32
Post-test Specimen #11, Interior

Photo No. 33
Post-test Specimen #11, Witness Chamber

Photo No. 34
Pre-test Specimen #12, Interior

Photo No. 35
Post-test Specimen #12, Interior

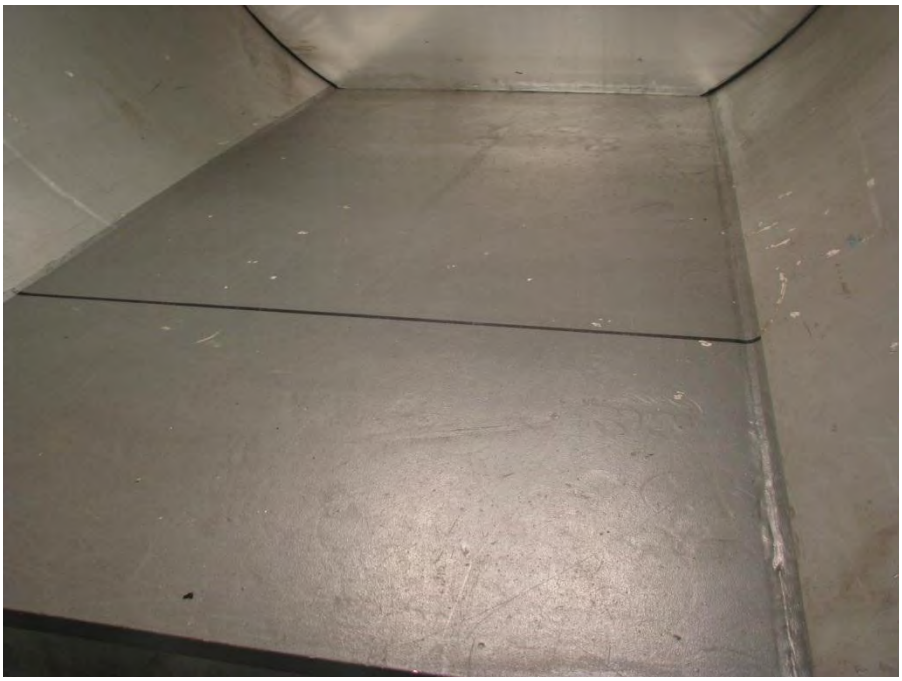


Photo No. 36
Post-test Specimen #12, Witness Chamber

Photo No. 37
Pre-test Specimen #13, Interior

Photo No. 38
Post-test Specimen #13, Interior

Photo No. 39
Post-test Specimen #13, Witness Chamber

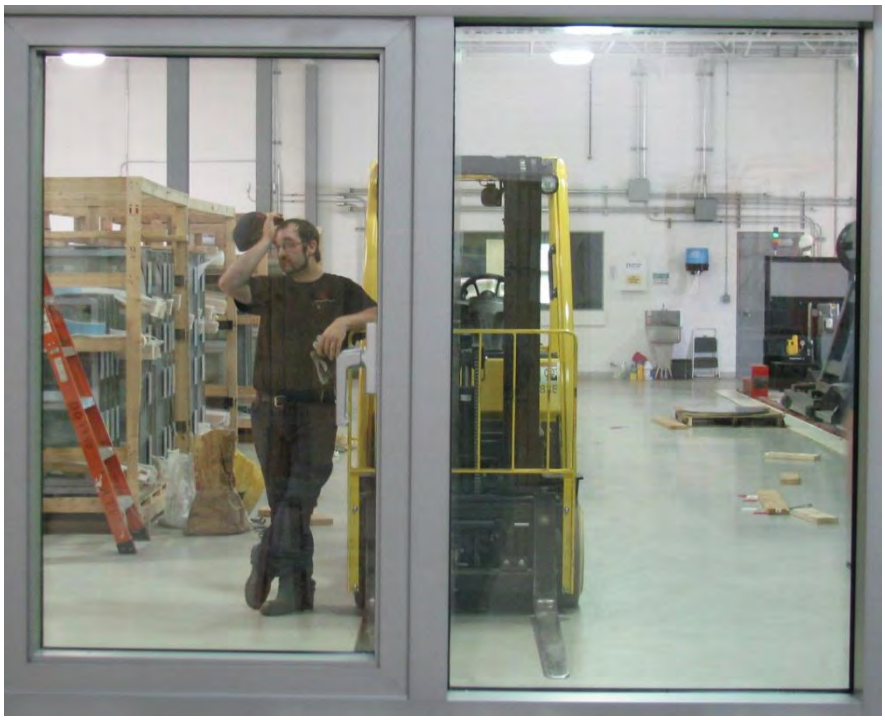


Photo No. 40
Pre-test Specimen #14, Interior

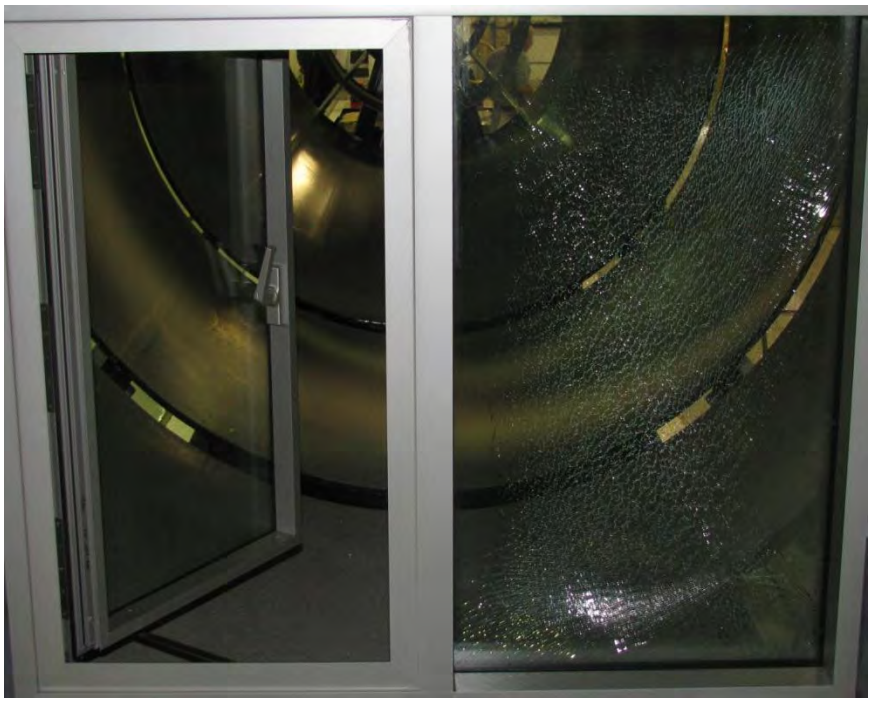


Photo No. 41
Post-test Specimen #14, Interior

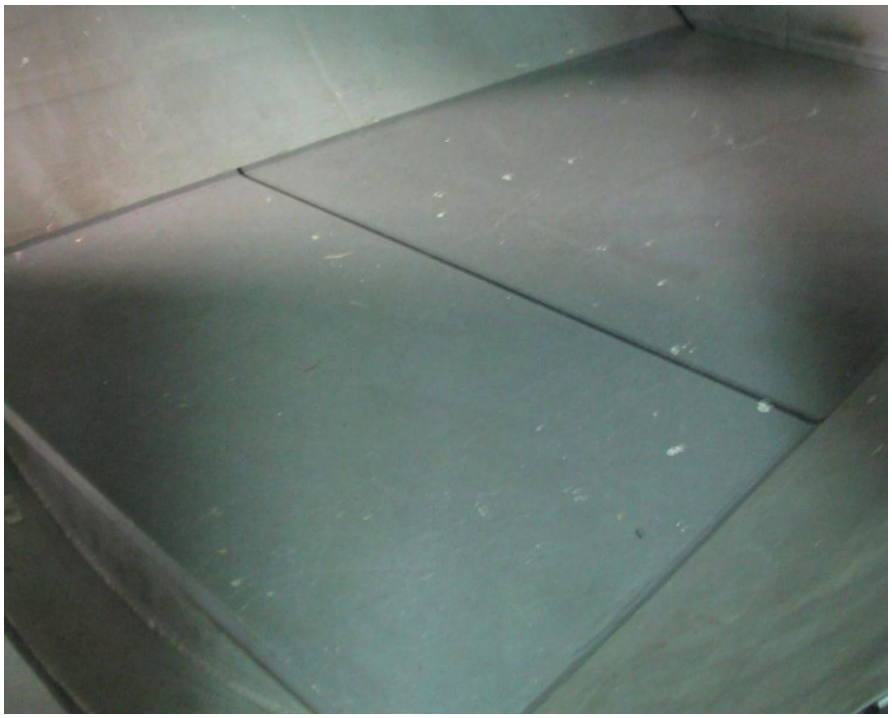


Photo No. 42
Post-test Specimen #14, Witness Chamber

Photo No. 43
Pre-test Specimen #15, Interior

Photo No. 44
Post-test Specimen #15, Interior

Photo No. 45
Post-test Specimen #15, Witness Chamber

Photo No. 46
Pre-test Specimen #16, Interior

Photo No. 47
Post-test Specimen #16, Interior

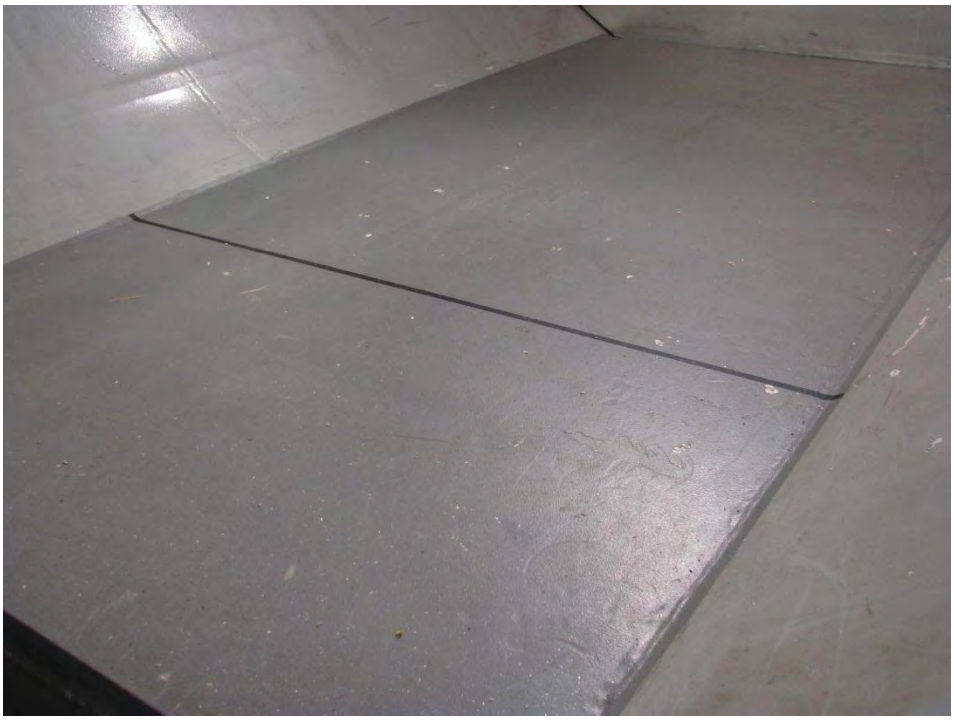


Photo No. 48
Post-test Specimen #16, Witness Chamber

Photo No. 49
Pre-test Specimen #17, Interior

Photo No. 50
Post-test Specimen #17, Interior

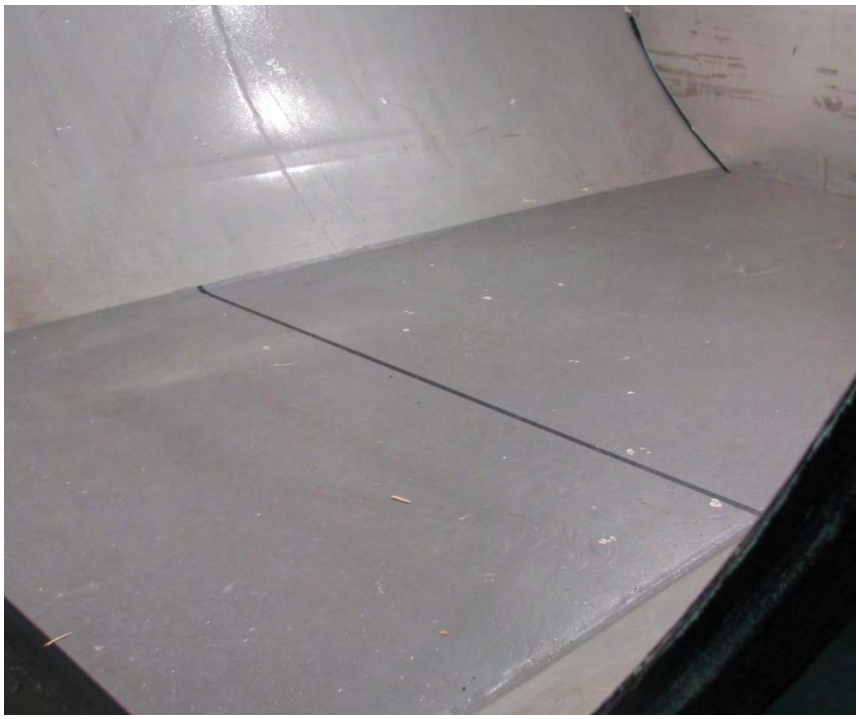


Photo No. 51
Post-test Specimen #17, Witness Chamber

Photo No. 52
Pre-test Specimen #18, Interior

Photo No. 53
Post-test Specimen #18, Interior

Photo No. 54
Post-test Specimen #18, Witness Chamber

Photo No. 55
Pre-test Specimen #19, Interior

Photo No. 56
Post-test Specimen #19, Interior

Photo No. 57
Post-test Specimen #19, Witness Chamber

Photo No. 58
Pre-test Specimen #20, Interior

Photo No. 59
Post-test Specimen #20, Interior

Photo No. 60
Post-test Specimen #20, Witness Chamber

Photo No. 61
Pre-test Specimen #21, Interior

Photo No. 62
Post-test Specimen #21, Interior

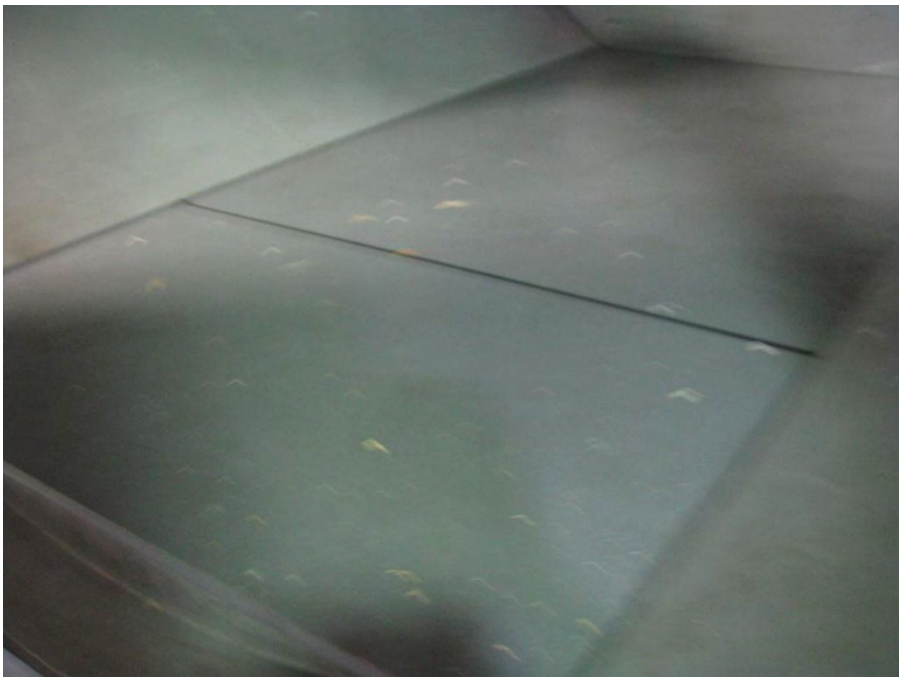


Photo No. 63
Post-test Specimen #21, Witness Chamber

Photo No. 64
Pre-test Specimen #22, Interior

Photo No. 65
Post-test Specimen #22, Interior

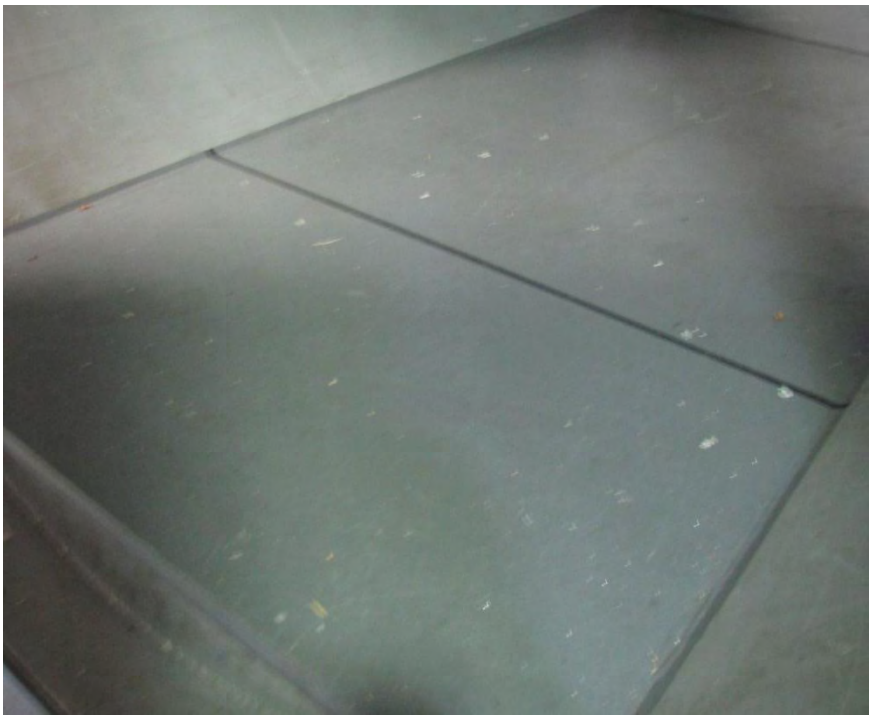


Photo No. 66
Post-test Specimen #22, Witness Chamber

Photo No. 67
Pre-test Specimen #23, Interior

Photo No. 68
Post-test Specimen #23, Interior

Photo No. 69
Post-test Specimen #23, Witness Chamber

Photo No. 70
Pre-test Specimen #24, Interior

Photo No. 71
Post-test Specimen #24, Interior

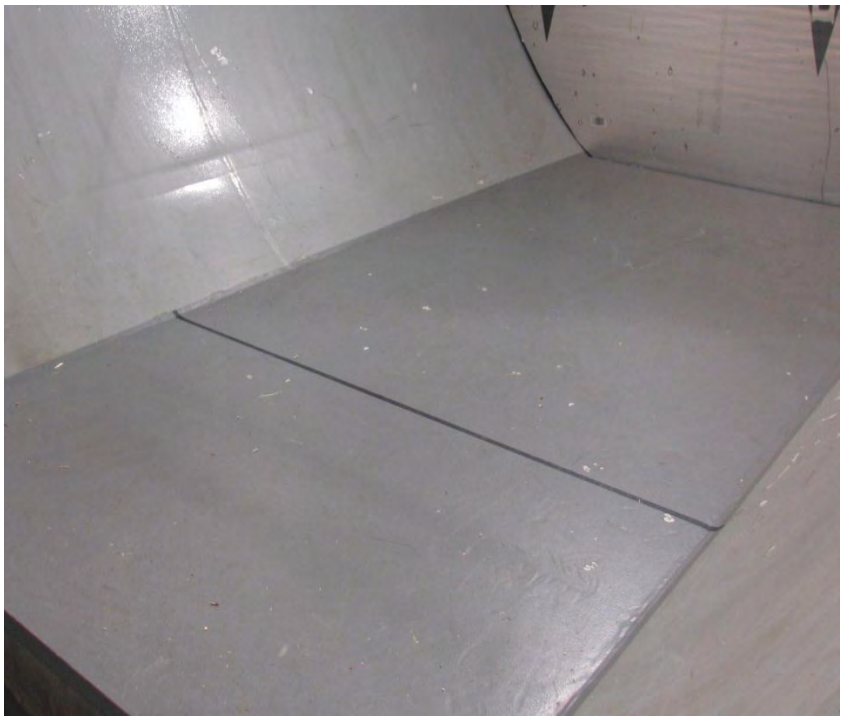


Photo No. 72
Post-test Specimen #24, Witness Chamber

Photo No. 73
Pre-test Specimen #25, Interior

Photo No. 74
Post-test Specimen #25, Interior

Photo No. 75
Post-test Specimen #25, Witness Chamber

Photo No. 76
Pre-test Specimen #26, Interior

Photo No. 77
Post-test Specimen #26, Interior

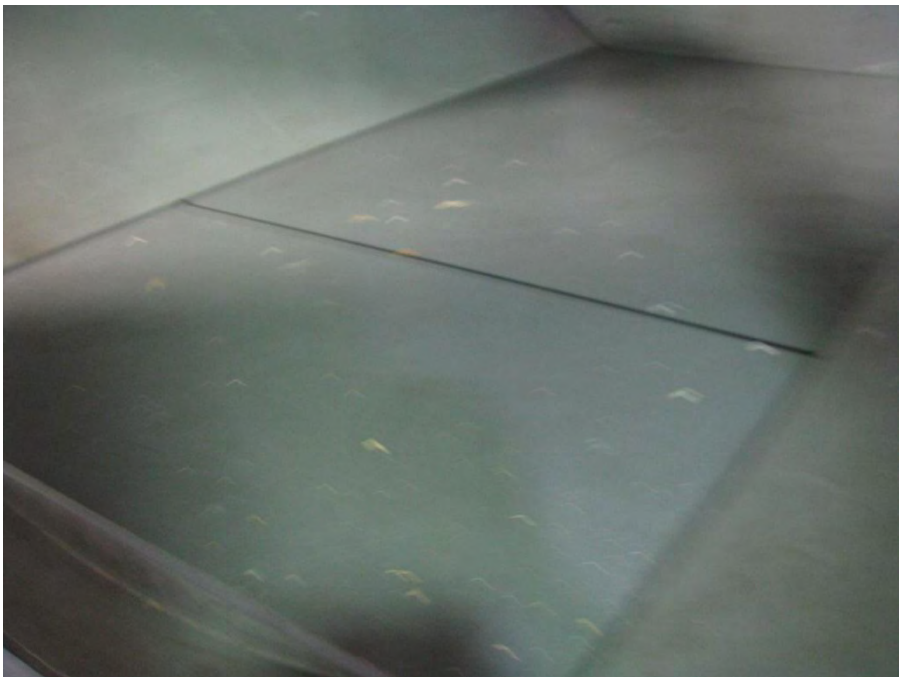


Photo No. 78
Post-test Specimen #26, Witness Chamber

Photo No. 79
Pre-test Specimen #27, Interior

Photo No. 80
Post-test Specimen #27, Interior

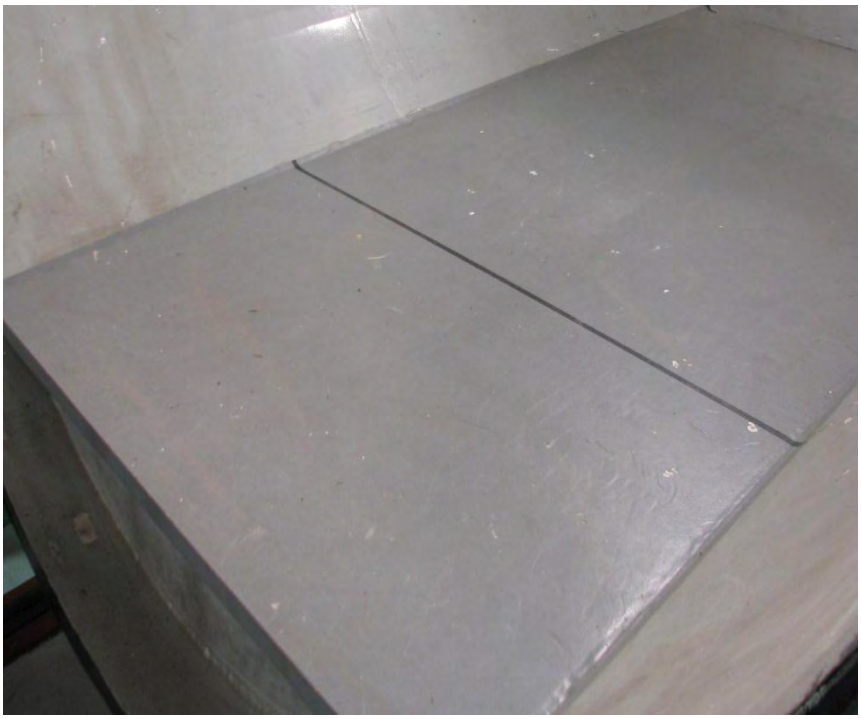


Photo No. 81
Post-test Specimen #27, Witness Chamber

Photo No. 82
Pre-test Specimen #28, Interior

Photo No. 83
Post-test Specimen #28, Interior

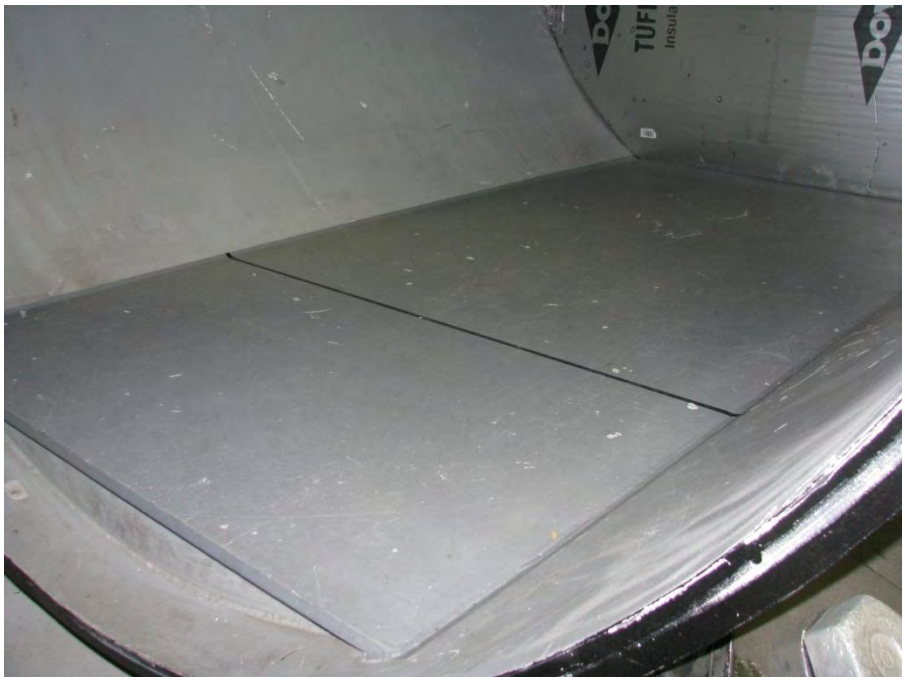


Photo No. 84
Post-test Specimen #28, Witness Chamber

Photo No. 85
Pre-test Specimen #29, Interior

Photo No. 86
Post-test Specimen #29, Interior

Photo No. 87
Post-test Specimen #29, Witness Chamber

Photo No. 88
Pre-test Specimen #30, Interior

Photo No. 89
Post-test Specimen #30, Interior

Photo No. 90
Post-test Specimen #30, Witness Chamber

Photo No. 91
Pre-test Specimen #31, Exterior

Photo No. 92
Post-test Specimen #31, Interior

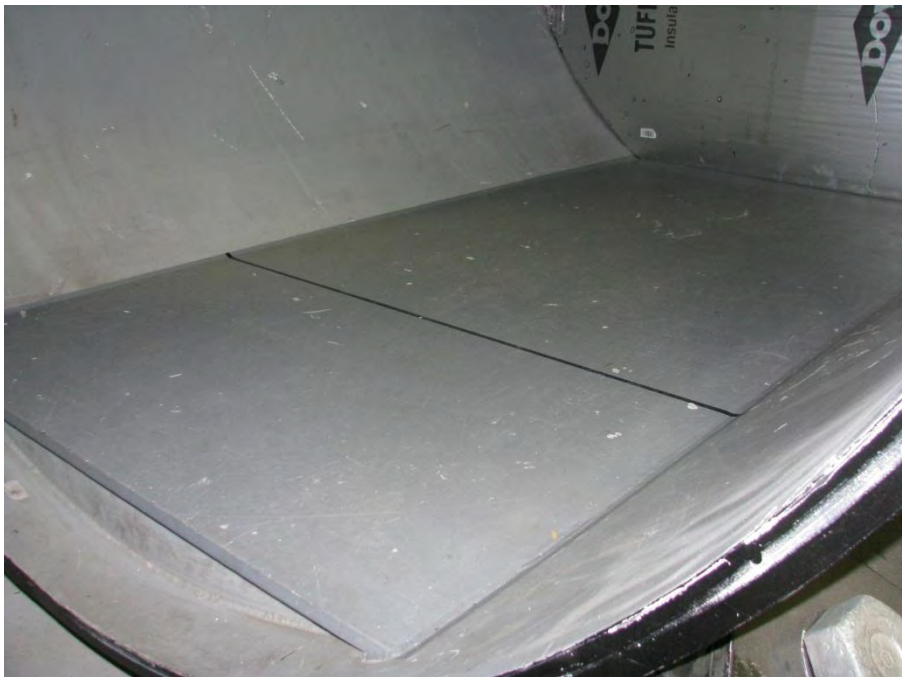


Photo No. 93
Post-test Specimen #31, Witness Chamber

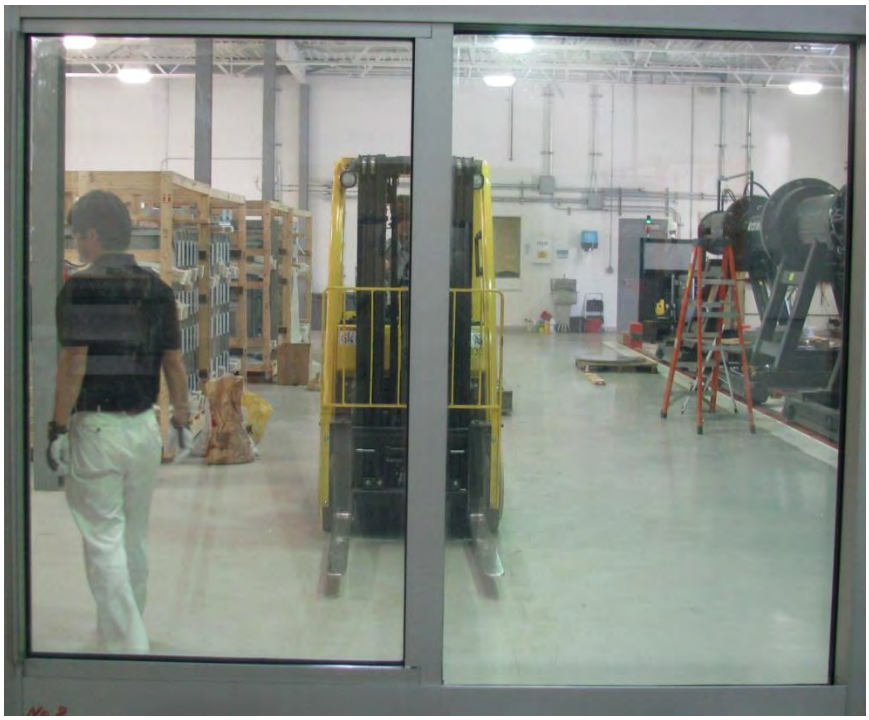


Photo No. 94
Pre-test Specimen #32, Interior

Photo No. 95
Post-test Specimen #32, Interior

Photo No. 96
Post-test Specimen #32, Witness Chamber

Photo No. 97
Pre-test Specimen #33, Interior

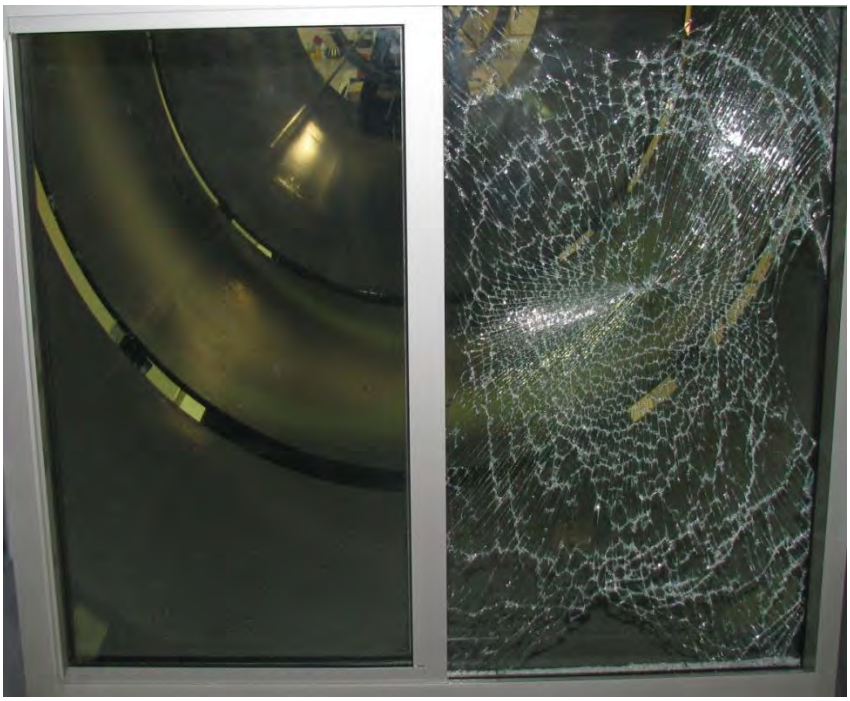


Photo No. 98
Post-test Specimen #33, Interior

Photo No. 99
Post-test Specimen #33, Witness Chamber

Photo No. 100
Pre-test Specimen #34, Interior

Photo No. 101
Post-test Specimen #34, Interior

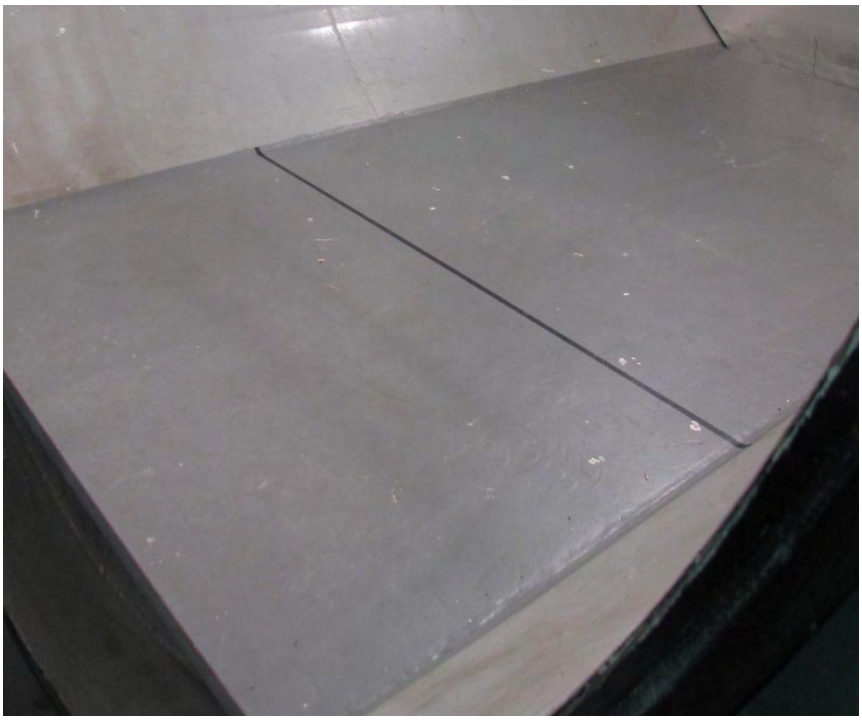


Photo No. 102
Post-test Specimen #34, Witness Chamber

Photo No. 103
Pre-test Specimen #35, Interior

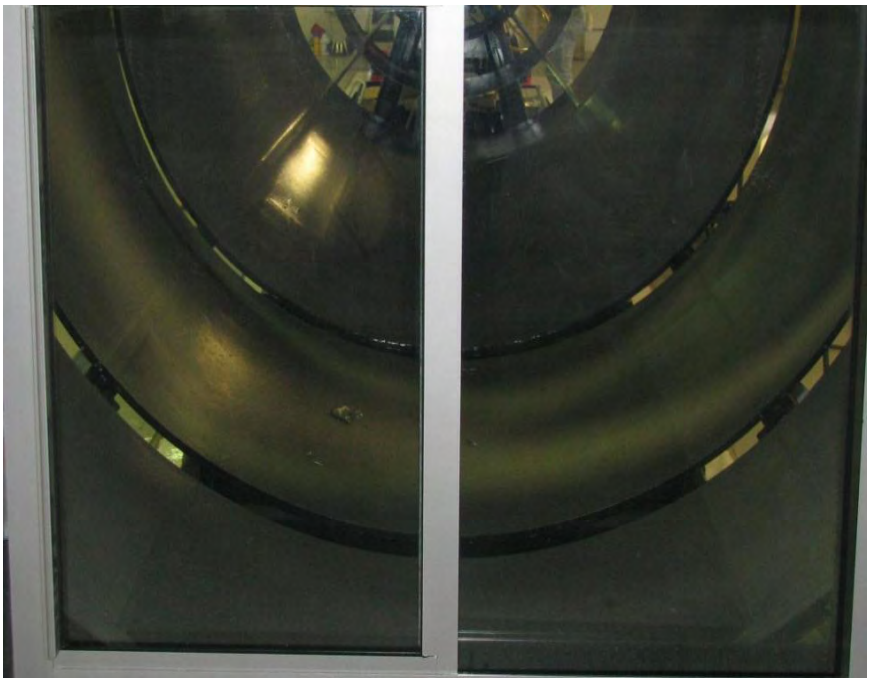


Photo No. 104
Post-test Specimen #35, Interior

Photo No. 105
Post-test Specimen #35, Witness Chamber

Photo No. 106
Pre-test Specimen #36, Interior

Photo No. 107
Post-test Specimen #36, Interior

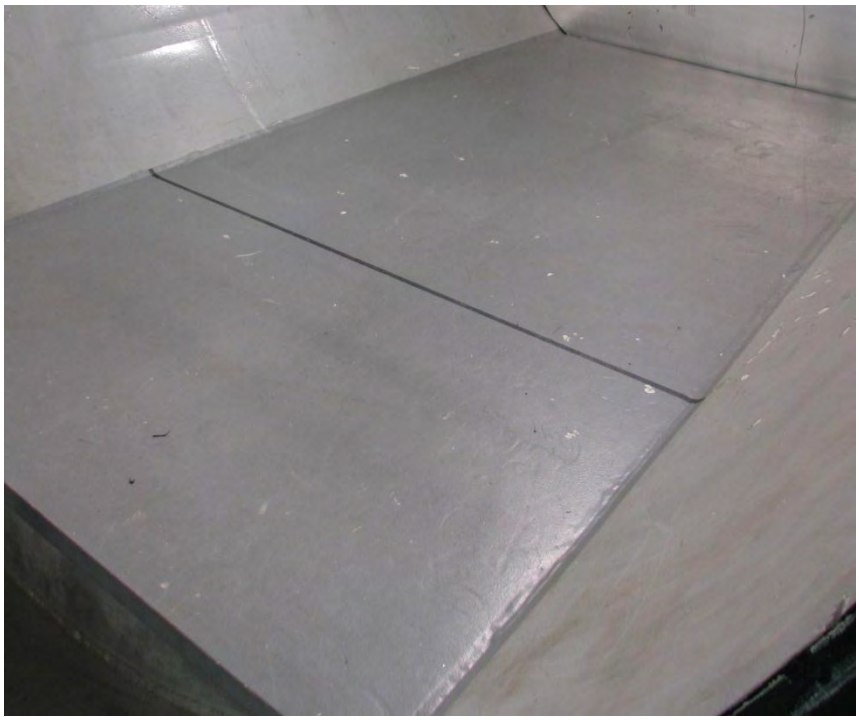


Photo No. 108
Post-test Specimen #36, Witness Chamber

Appendix D

Drawings

Drawings have been removed for client confidentiality.