

## Department of Defense Legacy Resource Management Program

04-219

### Performance Testing of Historically Appropriate Blast-Resistant Windows Volume 2 – Test Data

Julie L. Webster and Patrick E. Reicher, ERDC-CERL

September 2007

Distribution authorized to U.S. Government Agencies only.



US Army Corps of Engineers<sub>●</sub>

Engineer Research and Development Center

### Performance Testing of Historically Appropriate Blast-Resistant Windows

Volume 2 – Test Data

Julie L. Webster and Patrick E. Reicher

September 2007



Distribution authorized to U.S. Government Agencies only; Test and Evaluation; 15 August 2007. Other requests for this document shall be referred to the Office of the Deputy Under Secretary of Defense for Environmental Security (ODUSD (ES) EQ-EQLP).

### Performance Testing of Historically Appropriate Blast-Resistant Windows

Volume 2 – Test Data

Julie L. Webster and Patrick E. Reicher

Engineer Research and Development Center Construction Engineering Research Laboratory PO Box 9005 Champaign, IL 61826-9005

#### **Final Report**

Distribution authorized to U.S. Government Agencies only; Test and Evaluation; 15 August 2007. Other requests for this document shall be referred to the Office of the Deputy Under Secretary of Defense for Environmental Security (ODUSD (ES) EQ-EQLP).

Prepared for Legacy Resource Management Program Washington, DC

Under Reimbursable Order 97/0100/701/A/W31RY041533803/P0

**ABSTRACT:** This study leverages findings of Legacy Project 03-176, *Antiterrorism Measures for Historic Properties.* The authors identified few sources of UFC 4-010-01compliant replacement windows appropriate for historic building applications. Most window suppliers will quote a job to produce prototype windows, but they (1) have no current blast test data for their product, and (2) have no experience with historic building applications. This suggested a need for window testing to help ensure that DoD has multiple trusted sources for historically compatible blast-resistant window products.

**DISCLAIMER:** The contents of this report are not to be used for advertising, publication, or promotional purposes. Citation of trade names does not constitute an official endorsement or approval of the use of such commercial products. All product names and trademarks cited are the property of their respective owners. The findings of this report are not to be construed as an official Department of the Army position unless so designated by other authorized documents.

DESTROY THIS REPORT WHEN NO LONGER NEEDED. DO NOT RETURN IT TO THE ORIGINATOR.

### **Preface**

This study was conducted by the U.S. Army Engineer Research and Development Center (ERDC) for the Office of the Deputy Under Secretary of Defense for Environmental Security under the Legacy Resource Management Program; Reimbursable Order 97/0100/701/A/W31RYO41533803/PO, *Blast Testing of Historically Appropriate Blast-Resistant Windows*, dated 23 July 2004. The technical monitor was L. Peter Boice, Director, ODUSD (ES) EQ-LP.

The work was performed by the Land and Heritage Conservation Branch (CN-C) of the Installations Division (CN), Construction Engineering Research Laboratory (CERL). The project manager was Julie L. Webster. Christopher M. White was Chief, CEERD-CN-C, and Dr. John T. Bandy was Chief, CEERD-CN during preparation of this report. Dr. William D. Severinghaus was the Technical Director of the Military Lands business area. Dr. Kirankumar V. Topudurti was the Deputy Director of CERL, and Dr. Ilker R. Adiguzel was Director.

Blast consulting and review services were provided by Edward J. Conrath and William J. Veys of the U.S. Army Corps of Engineers-Protective Design Center, Omaha, NE.

The Commander and Executive Director of ERDC was COL Richard B. Jenkins and the Director was Dr. James R. Houston.

### **Test Results**

Distribution authorized to U.S. Government Agencies only; Test and Evaluation; 15 August 2007. Other requests for this document shall be referred to the Office of the Deputy Under Secretary of Defense for Environmental Security (ODUSD (ES) EQ-EQLP).



### **Shock Tube Testing for Historic Windows**

Prepared for:

### US Army Engineering Research and Development Center Construction Engineering Research Laboratory

Conducted at:

ABSC Shock Tube Test Range San Antonio, Texas August 28-29, 2007

ABSC Project Number 1650234

Report date: September 19, 2007



### **Table of Contents**

Introduction	1
Test Protocol	1
Test Equipment	2
Applied Blast Loads	2
Test Specimens	3
Test Cubicle	3
Test Instrumentation	4
Discussion of Results	5

### **List of Figures**

Figure 1 Hazard Level Diagram per ASTM F-1642	2
Figure 2. ABS Consulting Shock Tube Apparatus	3
Figure 3. Steel Sub-frame with Window Mounted in Test Cubicle	4
Figure 4 Pressure Gauge Locations	5

### List of Appendices

Appendix A	- Window Data Sheets
Appendix B	- Window Drawings

Appendix C - Fixture Drawings

### Introduction

ABSG Consulting, Inc. (ABSC) conducted testing of two window systems for the US Army Engineering Research and Development Center - Construction Engineering Research Laboratory (ERDC). Testing was conducted to evaluate the ability of commercially available products, which match historic windows, to provide blast mitigation that meets UFC 4-010-01 for buildings subject to 36 CFR Part 67, *Secretary of the Interior's Standards for Rehabilitation* (SOI Standards). Testing was conducted at the ABSC facilities in San Antonio, Texas, USA on August 28-29, 2007.

This report describes the test fixture, test samples, and test results. Data sheets for each test item are included in Appendix A. Drawings of test items supplied by the window vendors are also included in Appendix B.

### **Test Protocol**

Testing was conducted in accordance with ASTM F1642, *Standard Test Method for Glazing and Glazing Systems Subject to Air-blast Loading*. Data sheets for each test item contain the information required by the test protocol.

Windows were received at the ABSC test range prior to testing. Windows were marked to identify the vendor and specimen number. Prior to testing, dimensions of the framing and glazing, including glass type and thickness, were verified to insure compliance with the drawings. Prior to testing, glazing and ambient temperatures were recorded.

Windows were installed in a sub-frame by the vendors and mounted in the text cubicle. Blast gauges were mounted on each side and above the test window. Photographs were taken of test specimens and the test setup prior to and following each test to document window performance. The shock tube was anchored to the test cubicle to limit leakage pressures and provide a reaction mechanism to prevent movement of the cubicle.

A Yokgawa data acquisition system, sampling at 1 MHz, was used to record pressure-time histories for the installed gauges. Following application of the blast load, the floor of the test cubicle was inspected for glass fragments. The witness panel was also inspected for fragment impact. Frame and glass panel deflections were recorded. For this testing, no fragments or penetrations were observed in the witness panel. Only glass dusting was observed on the interior of the cubicle. A hazard level was assigned to each test specimen based on the observed fragmentation using the rating system prescribed in the ASTM protocol as shown in Figure 1.



Figure 1 Hazard Level Diagram per ASTM F-1642

### **Test Equipment**

Blast loads were applied using a "shock tube" as shown in Figure 2. This device uses a sudden burst of compressed air to create a blast pulse, which travels down the tube and is applied to the test specimen mounted in an enclosure (test cubicle) attached to the end. The blast load creates a specified positive blast pressure and impulse on the test specimens. Negative phase blast loads are developed but are typically less than the negative pulse typical of a high explosive load.

Test windows were mounted in sub-frames by the manufacturers. These sub-frames were mounted in the test cubicle fully supported by a steel angle on all sides from the rear (non-loaded) face and by a flat "capture" plate on the front (loaded) face to restrain the window during rebound. A general elevation and section of this arrangement is shown in the fixture drawings in Appendix C.

### **Applied Blast Loads**

Testing commenced with blast loads prescribed by ERDC: peak pressure = 9.6 psi, positive impulse = 41.6 psi-ms within minus 5%. The same nominal blast pressure was applied to each specimen although loads for individual tests varied somewhat. A change in diaphragm material created loads significantly lower for one test specimen. A total of three tests were performed on this test item to develop the target blast load.



Figure 2. ABS Consulting Shock Tube Apparatus

### **Test Specimens**

Two vendors (Custom and Kawneer) prepared the complete window system for each test item Windows were installed in steel sub-frames by the vendors. These units were then installed in a fixture in the test cubicle. Drawings for the two window system are included in Appendix B. Three test specimens were prepared for each of the two window systems. Glazing for all of the windows tested consisted of laminated insulated glass units [IGU].

Custom Windows were double hung units. Kawneer windows were fixed lite on top and bottom with an operable project-out vent in the center section. Non-structural sealant was applied to the junction of the frame and the steel channel sub-frame for both window systems. Window frame assemblies were rigidly supported on all four sides. Window anchorage and attachment to the wall substructure was not evaluated in the testing. Figure 3 shows a typical window mounted in the test sub-frame affixed to the test fixture.

### **Test Cubicle**

The test cubicle, nominally 10 feet deep, 51 inches wide, and 96 inches high, was enclosed to prevent blast pressures from wrapping around the structure and reaching the back side of the window. This represents a typical window installation on an exterior wall. A witness panel was provided on the back wall to detect the impact of glass shards. The witness panel is nominally 10 ft. from the test window. Actual distance varies with window configuration. For the double

hung windows, the glazing components are at different locations along the axis of the cubicle. The minimum distance form glazing to the witness panel is approximately 110 in. This produces a somewhat conservative rating of hazard level with respect to fragments on the witness panel since fragments travel less than 120 in.



Figure 3. Steel Sub-frame with Window Mounted in Test Cubicle

### **Test Instrumentation**

Blast pressure gauges measuring reflected pressure were mounted on the front of the test cubicle facing the oncoming blast wave, immediately adjacent to the test specimen (see Figure 4). Data are recorded on a digital oscilloscope and waveforms are converted to pressure-time histories in DPlot format for each gauge.



**Figure 4 Pressure Gauge Locations** 

#### **Discussion of Results**

Both glazing systems performed well in the tests. All samples resulted in a Minimal Hazard level rating which means there was only glass dusting inside the test cubicle. This dusting was insufficient to weigh and created by flexure of the laminated inside lite. Three samples of each type were tested which is sufficient to obtain a rating in accordance with ASTM F-1642.

Only one instance of pvb interlayer tearing was noted (Test 3). This may have been caused by impact from the non-structural muntin. No frame or fastener failure was noted during the tests. In all cases, windows remained operable although significant force was typically required due to interference from deformed laminated glass lites.

Blast pressure-time histories for gauges in test 1 were not recorded due to an error in the acquisition system setup. Since the blast pressure duration and impulse are controlled by the driver burst pressure, it was possible to determine the blast loads for this test based on the recorded pressure-time histories for test 2 and 3. The burst pressure for test 2 and 3 was within 0.3% of the burst for test 1. The average pressure, duration and impulse for tests 2 and 3 were reported as the blast load for test 1.

New diaphragm material was used beginning with test 5 due to the presence of scratches in the diaphragms made from the original material. This material exhibited a significantly lower burst pressure than that used for tests 1-4. Consequently, the blast loads for test 5 were much lower, and in fact, did not produce glass breakage in sample K-2. New diaphragms were installed and

K-2 was retested (recorded as test 5A). The new diaphragm material again burst at a lower driver pressure although somewhat higher than test 5. The original diaphragm material was located and installed for another retest of K-2. This retest was recorded as test 5B. Blast loads for this test were consistent with tests 1-4 and met the target loads. Original diaphragm material was used for the final test 6.

During test 6, gauge 3 did not record data. This was attributed to a gauge connection failure. The remaining two gauges recorded data consistent with previous tests.

Submitted by:

Darrell D. Barker Test Director ABS Consulting

### Appendix A

### **Data Sheets**



Test Information								
Client:	EF	RDC	Te	st Method:	• ASTM F-1	642-04 "Stand	lard Test Method	
Project Number:	1650234				for Glazing and Glazing Systems Subjected			
SPECIMEN Number:	(	C1			to Airblast L	oadings"	-	
Description:	Doub	e Hung						
Test Date:	8/28	/2007						
Test Number:		1						
Test Report Number	165	0234						
Report Date	9/19	/2007		Notes:	Soo	drawing 01651	Page 1 D1	
Test Location:	ABS Te	est Range			See	arawing 01051	Fage I, DT	
Frame Information				Glazing Inf	ormation			
Width (in):		42	Mu	Itiple Lites?	Yes	]		
Height (in):		76		· •	Lite 1	Lite 2	Lite 3	
Width:	Ę	5.5		Width (in):	11.31	11.38	11.31	
Material:	Alur	ninum		Height (in):	16.34	16.34	16.22	
Note:	Acnhore	d to C channe	el with	IGU?	Yes	Air Gap (in):	1/2	
	#12x2"	screws @ 6"	0.C.	-	Inne	er Lite	Outer Lite	
Temperature	-30 min	- 5 min	Thi	ckness (in):		1/4	1/4	
Ambient (F):	93	93	(	Glass Type:	Annealed	-Laminated	Annealed-Monolithic	
Glass Surface (F):	91	90		Notes:	0.060" PVB interlayer		terlayer	
Blast Pressure Information								
	Gauge Nu	umber						
	1	2	3		Average <sup>1</sup>	Note 1:		
Peak Reflected Pressure (psi)					11.0	Data traces n	ot captured by instru	
Positive Phase Duration (ms)					16.9	Diaphragm b	urst = 112 psi. Test	
Positive Phase Impulse (psi-ms)					42.8	burst = 111.6	psi. Loads are ave	
						from test 2 ar	nd 3	
Damage Summary								
	0-	-1m	1	m-3m				
Mass of Glass (g)	D	ust		N/A				
United Dimension (in):	,	~0		~0				
	Int	erior	P	erimeter				
Length of Tears and Pullout (in):		0		0				

Witness Panel Information	Low Hazard	High Hazard
Perforations	N/A	N/A
Indents	N/A	N/A

Notes: Inside and outside lites fractured, no fragments in cube, operable following test

ASTM F-1642 Hazard Level:	Minimal Hazard	Certified for Test Pressure per ASTM F1642:	Yes
-		Certified Performace Level:	Minimal Hazard
		Specimen Number:	C1
		Other Specimens:	C2, C3





### Blast Trace

Not available. See Note 1



Length of Tears and Pullout

Witness Panel Information

(in):

Perforations

Indents

#### Data Sheet

Test Information									
Client:	EF	RDC	Te	st Method:	<ul> <li>ASTM F-1</li> </ul>	ASTM F-1642-04 "Standard Test Method			
Project Number:	1650234				for Glazing a	or Glazing and Glazing Systems Subjecte			
SPECIMEN Number:	(	C2			to Airblast Lo	badings"			
Description:	Doub	e Hung							
Test Date:	8/28	/2007							
Test Number:		2							
Test Report Number	165	0234							
Report Date	9/19	/2007		Notes:	Coo.	howing 01651			
Test Location:	ABS Te	st Range			Seed	arawing 01651	Page 1, D1		
F		0	8						
Frame Information				Glazing Inf	formation				
Width (in):		42	Mu	Itiple Lites?	Yes				
Height (in):		76			Lite 1	Lite 2	Lite 3		
Width:	Ę	5.5		Width (in):	11.31	11.38	11.31		
Material:	Alur	Aluminum		Height (in):	16.34	16.34	16.22		
Note:	Acnhore	d to C channe	el with	IGU?	Yes	Air Gap (in):	1/2		
	#12x2"	screws @ 6"	0.C.		Inne	er Lite	Outer Lite		
Temperature	-30 min	- 5 min	Thickness (in):			1/4	1/4		
Ambient (F):	89	86	(	Glass Type:	Annealed	-Laminated	Annealed-Monolithic		
Glass Surface (F):	89	91		Notes:	0.060" PVB interlayer		erlayer		
Blast Pressure Information			-						
	Gauge Nu	umber							
	1	2	3		Average				
Peak Reflected Pressure (psi)	11.2	10.6	11.3		11.0				
Positive Phase Duration (ms)	16.4	16.8	17.3		16.8				
Positive Phase Impulse (psi-ms)	45.7	36.8	44.4		42.3				
Damage Summary									
	0-	1m	1	m-3m					
Mass of Glass (g)	D	ust		N/A					
United Dimension (in):		~0		~0					

ASTM F-1642 Hazard Level:	Minimal Hazard	Certified for Test Pressure per ASTM F1642:	Yes
		Certified Performace Level:	Minimal Hazard
		Specimen Number:	C2
		Other Specimens:	C1, C3

Notes: Inside and outside lites fractured, no fragments in cube, operable following test

Perimeter

0

High Hazard

N/A

N/A

Interior

0

Low Hazard

N/A

N/A





Blast Trace





Test Information			_	_				
Client:	EF	RDC	Te	est Method:	ASTM F-1642-04 "Standard Test Method			
Project Number:	165	1650234 f		for Glazing and Glazing Systems Subjected				
SPECIMEN Number:	(	23	]		to Airblast Lo	oadings"		
Description:	Doubl	e Hung	]					
Test Date:	8/28	/2007	]					
Test Number:		3						
Test Report Number	165	0234						
Report Date	9/19	/2007		Notes:	See	trawing 01651	Page 1 D1	
Test Location:	ABS Te	st Range					rage i, Di	
Frame Information				Glazing Inf	ormation			
Width (in):	4	12	Mu	Itiple Lites?	Yes	1		
Height (in):	-	76			Lite 1	Lite 2	Lite 3	
Width:	5	5.5		Width (in):	11.31	11.38	11.31	
Material:	Alun	ninum		Height (in):	16.34	16.34	16.22	
Note:	Acnhore	d to C chann	el with	IGU?	Yes	Air Gap (in):	1/2	
	#12x2"	screws @ 6'	' O.C.		Inne	er Lite	Outer Lite	
Temperature	-30 min	- 5 min	Thi	ckness (in):		1/4	1/4	
Ambient (F):	82	79		Glass Type:	Annealed	-Laminated	Annealed-Monolithic	
Glass Surface (F):	82	81		Notes:		0.060" PVB int	erlayer	
Blast Pressure Information								
	Gauge Nu	ımber	-			-		
	1	2	3		Average			
Peak Reflected Pressure (psi)	12.4	10.5	10.2		11.0			
Positive Phase Duration (ms)	16.7	17.0	17.3		17.0			
Positive Phase Impulse (psi-ms)	45.7	38.7	45.1		43.2			

Damage Summary				
	0-1m	1m-3m		
Mass of Glass (g)	Dust	N/A		
United Dimension (in):	~0	~0	]	
	Interior	Perimeter	_	
Length of Tears and Pullout (in):	1-1/4"	0		
Witness Panel Information	Low Hazard		High Hazard	
Perforations	N/A		N/A	
Indents	N/A		N/A	
Notes: Insi	ide and outside lites frac	ctured, no fragments in c	ube, operable following test	

ASTM F-1642 Hazard Level: Minimal Hazard	Certified for Test Pressure per ASTM F1642:	Yes
	Certified Performace Level:	Minimal Hazard
	Specimen Number:	C3
	Other Specimens:	C2, C3











Test Information							
Client:	EF	RDC	Те	st Method:	• ASTM F-1	642-04 "Stand	ard Test Method
Project Number:	1650234				stems Subjected		
SPECIMEN Number:	ł	<b>&lt;</b> 1			to Airblast Lo	oadings"	
Description:	Fixed/P	roject Out					
Test Date:	8/29	/2007					
Test Number:		4					
Test Report Number	165	0234					
Report Date	9/19	/2007		Notes:	See Kawnee	er drawings KL	JD325801-01 thru
Test Location:	ABS Te	st Range			05		
Frame Information			-	Glazing Inf	ormation		
Width (in):	42	2.00	Multiple Lites?		Yes		
Height (in):	66	6.00			Lite 1	Lite 2	Lite 3
Width:	3	.25		Width (in):	37.88	35.00	
Material:	Alun	ninum		Height (in):	13.50	27.00	
Note:	Acnhored	to C channel	with 1/4	IGU?	Yes	Air Gap (in):	1/2
	x 2" s	crews @ 6" c	).C.		Inner Lite		Outer Lite
Temperature	-30 min	- 5 min	Thi	ckness (in):	5/16		1/4
Ambient (F):	84	88	(	Glass Type:	Annealed-Laminated		Annealed-Monolithic
Glass Surface (F):	84	88		Notes:		0.060" PVB int	terlayer
Blast Pressure Information							
	Gauge Nu	mber					
	1	2	3		Average		
Peak Reflected Pressure (psi)	11.5	10.8	11.4		11.2		
Positive Phase Duration (ms)	16.8	18.6	17.0		17.5		
Positive Phase Impulse (psi-ms)	42.7	44.1	42.3		43.0		
Damage Summary							

	0-1m	1m-3m	
Mass of Glass (g)	Dust	N/A	
United Dimension (in):	~0	~0	
	Interior	Perimeter	
Length of Tears and Pullout (in):	0	0	
Witness Panel Information	Low Hazard		High Hazard
Perforations	N/A		N/A
Indents	N/A		N/A

Notes: Inside and outside lites fractured on project out, no break of fixed, no fragments in cube, operable following test

ASTM F-1642 Hazard Level: Minimal Hazard	Certified for Test Pressure per ASTM F1642:	Yes
	Certified Performace Level:	Minimal Hazard
	Specimen Number:	K1
	Other Specimens:	K2, K3



#### Pre-Test Photograph









Test Information			_	-			
Client:	EI	RDC	Te	est Method:	<ul> <li>ASTM F-1642-04 "Standard Test Method</li> </ul>		
Project Number:	1650234				for Glazing a	ind Glazing Sy	stems Subjected
SPECIMEN Number:		<2	1		to Airblast Lo	badings"	
Description:	Fixed/P	roject Out	1		Soo Kawnoo	r drawings Kl	ID325801 01 thru
Test Date:	8/29	/2007	1			i ulawings ro	JD323001-01 tillu
Test Number:		5			05		
Test Report Number	165	0234					
Report Date	9/19	/2007		Notes:	Diaphra	am matorial no	w lot low burst
Test Location:	ABS Te	st Range	1		Diapriraç	gin material ne	
	_		-				
Frame Information	Glazing Information						
Width (in):	42	2.00	Mu	Itiple Lites?	Yes		
Height (in):	66	6.00	1		Lite 1	Lite 2	Lite 3
Width:	3	.25	1	Width (in):	37.88	35.00	
Material:	Alur	ninum	1	Height (in):	13.50	27.00	
Note:	Acnhored	to C channel	with 1/4	IGU?	Yes	Air Gap (in):	1/2
	x 2" s	crews @ 6" o	D.C.		Inne	er Lite	Outer Lite
Temperature	-30 min	- 5 min	Thi	ckness (in):	5/	/16	1/4
Ambient (F):	84	83		Glass Type:	Annealed	-Laminated	Annealed-Monolithic
Glass Surface (F):	84	84	1	Notes:		0.060" PVB in	terlayer
Blast Pressure Information							
	Gauge Nu	umber					
	1	2	3		Average		
Peak Reflected Pressure (psi)	9.3	7.4	9.3		8.7		
Positive Phase Duration (ms)	16.3	17.3	15.9		16.5		
Positive Phase Impulse (psi-ms)	28.9	28.7	30.4		29.2		

Damage Summary				
	0-1m	1m-3m		
Mass of Glass (g)	N/A	N/A		
United Dimension (in):	~0	~0	1	
	Interior	Perimeter	-	
Length of Tears and Pullout (in):	0	0	]	
Witness Panel Information	Low Hazard		High Hazard	
Perforations	N/A		N/A	
Indents	N/A		N/A	
Notes: No	breaks			
ASTM F-1642 Hazard Level:	No Break	Certified for Test I	Pressure per ASTM F1642: Certified Performace Level:	No

Specimen Number: Other Specimens:





Blast Trace **ERDC Historic Windows** Test 5 12 60 P1 P2 P3 54 10.5 48 9 11 12 42 7.5 13 36 6 Impulse (psi-ms) Pressure (psi) 30 4.5 24 3 18 1.5 0 12 中的 -1.5 6 0 -3 -4.5 -6 -12 -6 -10 50 -30 10 30 70 90 110 Time (ms)



Test Information			_					
Client:	EF	RDC	Те	st Method:	<ul> <li>ASTM F-10</li> </ul>	<ul> <li>ASTM F-1642-04 "Standard Test Method</li> </ul>		
Project Number:	165	0234			for Glazing a	or Glazing and Glazing Systems Subject		
SPECIMEN Number:	ł	K2			to Airblast Loadings"			
Description:	Fixed/P	roject Out			Soo Kownoo	r drowings Kl	ID225901 01 thru	
Test Date:	8/29	/2007				i urawings KC	JD325601-01 tillu	
Test Number:	Ę	5A			05			
Test Report Number	165	0234						
Report Date	9/19	/2007		Notes:	Second test	on same test i	tem. Diaphragm	
Test Location:	ABS Te	st Range			material new	lot, low burst		
Frame Information				Glazing Inf	ormation			
Width (in):	42	2.00	Mu	Itiple Lites?	Yes			
Height (in):	66	6.00			Lite 1	Lite 2	Lite 3	
Width:	3	.25		Width (in):	37.88	35.00		
Material:	Alun	ninum		Height (in):	13.50	27.00		
Note:	Acnhored	to C channel	with 1/4	IĠU?	Yes	Air Gap (in):	1/2	
	x 2" s	crews @ 6" o	).C.		Inne	r Lite	Outer Lite	
Temperature	-30 min	- 5 min	Thic	ckness (in):	5/	'16	1/4	
Ambient (F):	83	83	Glass Type:		Annealed	Laminated	Annealed-Monolithic	
Glass Surface (F):	83	83		Notes:	(	0.060" PVB int	erlayer	
Blast Pressure Information								
	Gauge Nu	ımber						
	1	2	3		Average			
Peak Reflected Pressure (psi)	10.2	9.1	10.2		9.8			
Positive Phase Duration (ms)	16.6	17.8	16.6		17.0			
Positive Phase Impulse (psi-ms)	36.7	36.7	36.3		36.6			
Damage Summary								
	0-	-1m	1	m-3m				
Mass of Glass (g)	N/A			N/A				
United Dimension (in):	~0			~0				
· · · ·	Int	erior	Pe	erimeter	-			
Length of Tears and Pullout		0		0				
(in):		0		U				
					-			

Witness Panel Information	Low Hazard	High Hazard
Perforations	N/A	N/A
Indents	N/A	N/A

Notes: Inside and outside lite fractured on project out, no other breaks

ASTM F-1642 Hazard Level:	No Hazard	Certified for Test Pressure per ASTM F1642:	No
-		Certified Performace Level:	
		Specimen Number:	
		Other Specimens:	





Blast Trace **ERDC Historic Windows** Test 5A 88 12 P1 P2 P3 10.5 80 72 9 11 7.5 64 12 13 6 56 Impulse (psi-ms) Pressure (psi) 48 4.5 40 3 1.5 32 0 24 WIT AN OF -1.5 16 -3 8 0 -4.5 -6 -8 -7.5 -16 -30 -10 10 30 50 70 90 110 Time (ms)



lest information			_					
Client:	EF	RDC	Те	st Method:	<ul> <li>ASTM F-1642-04 "Standard Test M</li> </ul>		ard Test Method	
Project Number:	165	0234			for Glazing and Glazing Systems Subjected			
SPECIMEN Number:	ł	<2			to Airblast Loadings"			
Description:	Fixed/Pi	roject Out			See Kawnee	Coo Kourpoor drowingo KUD225901.01 th		
Test Date:	8/29	/2007					D323001-01 tillu	
Test Number:	5	5B			05			
Test Report Number	165	0234						
Report Date	9/19	/2007		Notes:	Third test on	same test iter	n. Diaphragm	
Test Location:	ABS Te	st Range			material old	ot, correct bur	st	
			-					
Frame Information	Glazing Information							
Width (in):	42	2.00	Mu	Itiple Lites?	Yes			
Height (in):	66	6.00	1		Lite 1	Lite 2	Lite 3	
Width:	3.25			Width (in):	37.88	35.00		
Material:	Aluminum		1	Height (in):	13.50	27.00		
Note:	Acnhored to C channel		with 1/4	IGU?	Yes	Air Gap (in):	1/2	
	x 2" s	crews @ 6" o	o.c. In		Inne	er Lite	Outer Lite	
Temperature	-30 min	- 5 min	Thi	ckness (in):	5/16		1/4	
Ambient (F):	83	82		Glass Type:	Annealed-Laminated		Annealed-Monolithic	
Glass Surface (F):	83	82		Notes:	0.060" PVB in		erlayer	
Blast Pressure Information								
	Gauge Nu	ımber						
	1	2	3		Average			
Peak Reflected Pressure (psi)	11.6	9.5	11.6		10.9			
Positive Phase Duration (ms)	16.8	16.8	17.3		17.0			
Positive Phase Impulse (psi-ms)	48.2	49.6	47.4		48.4			
Damage Summary								
	0-	·1m	1	m-3m				

	0-1m	1m-3m	
Mass of Glass (g)	N/A	N/A	
United Dimension (in):	~0	~0	
	Interior	Perimeter	•
Length of Tears and Pullout (in):	0	0	
Witness Panel Information	Low Hazard		High Hazard
Perforations	N/A	]	N/A
Indents	N/A	1	N/A
Notes: Inc	side and outside lite fractu	ured on project out, no ot	her breaks

ASTM F-1642 Hazard Level: Minimal Hazard	Certified for Test Pressure per ASTM F1642:	No
	Certified Performace Level:	Minimal Hazard
	Specimen Number:	K2
	Other Specimens:	K1, K3









Blast Trace





Test Information							
Client:	EF	RDC	Те	st Method:	• ASTM F-1642-04 "Standard Test Method		
Project Number:	165	0234			for Glazing and Glazing Systems Subject		
SPECIMEN Number:	-	<b>&lt;</b> 3			to Airblast Lo	badings"	
Description:	Fixed/P	roject Out					
Test Date:	8/29	/2007					
Test Number:		6					
Test Report Number	165	0234					
Report Date	9/19	/2007		Notes:	See Kawnee	er drawings KL	JD325801-01 thru
Test Location:	ABS Te	est Range			05		
Frame Information			_	<b>Glazing Inf</b>	ormation		
Width (in):	42	2.00	Mu	Multiple Lites?			
Height (in):	66	6.00			Lite 1	Lite 2	Lite 3
Width:	3	.25		Width (in):	37.88	35.00	
Material:	Alur	ninum		Height (in):	13.50	27.00	
Note:	Acnhored	to C channel	with 1/4	IGU?	Yes	Air Gap (in):	1/2
	x 2" s	crews @ 6" c	D.C.		Inne	Outer Lite	
Temperature	-30 min	- 5 min	Thi	ckness (in):	5/16		1/4
Ambient (F):	82	80	(	Glass Type:	Annealed-Laminated		Annealed-Monolithic
Glass Surface (F):	81	84		Notes:		0.060" PVB in	terlayer
Blast Pressure Information							
	Gauge Nu	umber					
	1	2	3		Average	Note:	Gauge 3
Peak Reflected Pressure (psi)	12.7	8.9	N/A		10.8		malfunctioned
Positive Phase Duration (ms)	17.0	17.9	N/A		17.5		No Data
Positive Phase Impulse (psi-ms)	48.2	51.9	N/A		50.1		

Damage Summary				
	0-1m	1m-3m		
Mass of Glass (g)	N/A	N/A	]	
United Dimension (in):	~0	~0	]	
_	Interior	Perimeter	_	
Length of Tears and Pullout (in):	0	0	]	
Witness Panel Information	Low Hazard	7	High Hazard	
Perforations	N/A	1	N/A	
Indents	N/A	J	N/A	

Notes: Inside and outside lites fractured on project out, no break of fixed, no fragments in cube, operable following test

ASTM F-1642 Hazard Level:	Minimal Hazard	Certified for Test Pressure per ASTM F1642:	No
-		Certified Performace Level:	Minimal Hazard
		Specimen Number:	K2
		Other Specimens:	K1, K3



#### Pre-Test Photograph







### Appendix **B**

### Window Drawings

(	GLASS SCHEDULE	ABBREVIATIONS	GENERAL NOTES
SYMBOL	GLASS DESCRIPTION	R.O. = ROUGH OPENING	
	1" INSULATED LAMI OUTBOARD – 1/4" CLEAR ANN 1/2" STANDARD DUAL SEAL AIR SPACE INBOARD – 1/4" LAMI 1/8 X .06 INNERLAYER X .125 CLEAR ANN	F.D. = FRAME DIMENSION O.A.F.D. = OVER ALL FRAME DIMENSION D.L.O. = DAYLIGHT OPENING NBCW = NOT BY CLISTON WINDOW	IN THESE DRAWINGS REPRESENT COSTON WINDOW'S INTERPRETATION OF ARCHITECTORAL TI. INSUL INFORMATION PROVIDED. IT IS THE RESPONSIBILITY OF THE ARCHITECT AND GENERAL BERA'S CONTRACTOR TO REVIEW THESE DRAWINGS FOR ACCURACY AND COMPLIANCE WITH BREA'S ARCHITECTURAL INTENT. CUSTOM WINDOW ACCEPTS NO RESPONSIBILITY FOR INACCURACY UPON OF DIMENSIONS OR CONFIGURATIONS.
В		P.I. = PROJECT IN (HOPPER OR CASEMENT VENT) P.O. = PROJECT OUT (AWNING OR CASEMENT VENT)	2. ALL MATERIAL CODERING AND FABRICATION.     72. SILLS     PRIOR TO MATERIAL CODERING AND FABRICATION.     3. CUSTOM WINDOW WILL ASSUME NO RESPONSIBILITY FOR ERRORS RESULTING     FROM THE USE OF THESE DRAWINGS BY OTHER TRADES.
©		GLASS SIZE CALCULATION PRODUCT D.L.O. + COMMENTS SERIES RIM	ALL ITEMS MARKED "NECW" ARE NOT BY CUSTOM WINDOW AND ARE SHOWN FOR INFORMATION ONLY.     S. MATERIALS FOR THIS PROJECT WILL NOT BE RELEASED, NOR WILL FABRICATION BEGIN UNTIL CUSTOM WINDOW RECEIVES "APPROVED" OR "APPROVED AS NOTED" PRINTS.
D		SERIES 8100         3/4           SERIES 8200         1"           SERIES 8250         1"           SERIES 8260         1"	6. REVISIONS AFTER THIS PROJECT HAS BEEN RELEASED FOR FABRICATION     WILL RESULT IN HANDLING AND ENGINEERING CHARGES PLUS THE COST     OF ANY FABRICATED MATERIALS AND MAY RESULT IN DELAY TO DELIVERIES.     REVISIONS MUST BE APPROVED IN WRITING PRIOR TO FABRICATION.
E			<ul> <li>ALL GLASS, ALUMINUM, HARDWARE OR OTHER MATERIALS PROVIDED BY CUSTOM WINDOW MUST BE PROTECTED FROM STAINING BY MET CARDEDARD AND DAMAGE OF ALKALIS IN CONCRETE. STUCCO, MORTAR, PLASTER OR OTHER CHEMICALS. OTHER TRADES MUST BE CLOSELY SUPERVISED TO PREVENT DAMAGE TO CUSTOM WINDOW MATERIALS.</li> </ul>
F		SERIES 8800         5/8"           SERIES 8800         3/4"           SERIES 9100         3/4"           SERIES 9200         5/8"	8. ALL CAULKING AND SEALANT JOINTS MUST BE APPLIED FOLLOWING SEALANT MANUFACTURER'S     RECOMMENDATIONS AS TO SIZE, METHOD AND COMPATIBILITY WITH ADJOINING MATERIAL.      9. FINAL APPROVAL BY THE CUSTOMER CONSTITUTES ACCEPTANCE OF ALL     DEVIATIONS DRAWN BY CUSTOM WINDOW TO THE CONTRACT DRAWINGS.
		Iseries         9250-15         I1"           SERIES         9300         1"           SERIES         9420         1"           SERIES         9500         1"	10. PROTECT WINDOWS FROM MOISTURE DURING STORAGE, STORE WITH SILLS DOWN.
$\leq$			7 \



SHOP	DRAWING	APPROVAL	

THESE DRAWINGS ARE TO BE USED FOR THE PROJECT. THE GLAZING CONTRACTOR IS RES ACCURACY AND COMPLETENESS OF THE INFO WITHOUT YOUR SIGNATURE OF APPROVAL CL	CONSTRUCTION OF WINDOWS FOR THIS SPONSIBLE FOR VERIFICATION OF THE RMATION HEREIN. ISTOM WINDOW COMPANY CANNOT PROCEED
WITH PRODUCTION!	
APPROVED AS NOTED	APPROVED - NO EXCEPTIONS TAKEN
COMPANY	DATE
	<b>TT C</b>
SIGNATURE	

VENT OPERATION WINDOW HARDWARE

DOUBLE-HUNG - SELF BALANCE

STANDARD SELF BALANCE CABLES AND PULLIES SWEEP TYPE SASH LOCKS

## HISTORIC BLAST WINDOW

# ALUMINUM WINDOWS GLASS & GLAZING

(	GENERAL PRODUCT NOTES	۱f	FINISH SPECS
			MILL FINISH
FRAME	6063-T6 ALUMINUM EXTRUSION W/THERMAL BARRIER - SERIES 9250-TS		
GLAZING	FACTORY GLAZED - GLASS SET FROM INTERIOR BY CUSTOM WINDOW.		CLEAR ANODIZED
			DARK BRONZE ANODIZED
INSTALLATION	FRAMES INSTALLED IN STEEL BUCK BY CWC		
MISC.	CAULK, BACKER RODS, INSTALLATION SCREWS, SHIMS, BLOCKING - ALL BY CWC		BLACK ANODIZED
SUBFRAMES	NONE REQUIRED		
			DETERMINED)
SILLS	NONE REQUIRED		
SCREENS	NONE REQUIRED		_
ANCHOR CLIPS	NONE REQUIRED		
I IRIM OR PANNING	NONE REQUIRED	$\mathcal{F}$	

		$\sim$
ISULATED GL REATHER TU REATHER TU PON ARRIVA LLS DESIGNI	LASS SUPPLIED BY CUSTOM WINDOW WILL BE PROVIDED WITH A CAPILLARY BIE. THE TUBE WILL EXTEND FROM THE INTEROR TOP LEFT OR RIGHT CORNER. IBE NEEDS TO BE CUT, CRIMPED AND TUCKED PER ENCLOSED INSTRUCTIONS IL AT JOBSITE. PROTECT TUBES FROM MOISTURE UNTIL CRIMPED. ED FOR A 12 LB WATER PERFORMANCE RATING.	
		DATE         BY         PROJECT:         HISTORIC         BLAST         WIND(           -9-07         SR         PROJECT:         HISTORIC         BLAST         WIND(           -0-07         DR         PROJECT:         <
		SUBA
	SHEET         INDEX           SHEET         DESCRIPTION           1         COVER SHEET           2         FRAME ELEVATIONS/DETAILS	
	3     18       4     19       5     20	×
	6            7            22	COMTRACTC ZIP
	8         23           9	COMPANY ADDRESS CITY, STATE CALE:
	11	
	13         28           14         29           15         30	
	TAKE OFF CHECK LIST	ect: E ZIP contractor:
	SCREWS/FASTENERS         EXTRUSIONS           SIZE         9251G         HEAD           0         9252G         JAMB           1         0         9253G           1         0         9253G           1         0         9253G           1         0         9254G-TS           2254G-TS         SASH	P. ARCHIT O. COMPANY O. ADDRESS O. ADDRESS GENERAL
	**         9255-TS         PERIMETER         STOP           SIZE         9252G-SS         FRAME         STOP           **         9256G-TS         RAIL         *           **         9257G-TS         RAIL         *           **         9257G-TS         RAIL         *           **         9257G-TS         RAIL         *           **         9257G-TS         RAIL         *	8011 1
	9299G-15         LIFT KAL           SIZE         * 9255-C-TS	
		727 VGLEW 3722 255 255
	GENERAL PRODUCTS  SWEEP_LOCKS  NONE_REQUIRED	BOC
_	TAPE/VINYL NORTON 990 FOAM TAPE EPOM GLZING CASKET/SETTING BLOCKS SANTOPRENE BULB WEATHERSTRIP DOW CORNING 995 STRUCTURAL GLAZING	
_	END DAMS END DAMS NONE REQUIRED ANCHOR SCREWS STEEL BUCK	
_		




## 8325TL WINDOW - FIXED/PROJECT-OUT/FIXED (3) THUS REQUIRED

				REV.	DATE	REQUEST LETTER	BY
		E.(	E.C. NO. 95502-11 ??-??-07				
			PEAK APPLIED PRESSURE: 9.6 PSI POSITIVE PHASE IMPULSE: 42 PSI-MSEC		OMPANY INC.	KELUSIVE PROPERTY (E, PRIVILEGED OR (Y BE USED ONLY FOR ESE DRAWINGS TO Y PROHIBITED. THIS Y PROHIBITED. THIS SMAXNY MO	JMPANY, INC., 2005
			GLAZING SCHEDULE		ATION KAWNEER C	INGS ARE THE SOLE AND E EER AND CONTAIN SENSITIV AL INFORMATION WHICH MA TT. THE DISCLOSURE OF TH RIZED PERSONS IS STRICTL' AT AND ALL COPIES MUST BE	© COPYRIGH I KAWNEER UL
TYPE	NOMINAL THICKNESS	TYPICAL THICKNESS	DESCRIPTION		INFORM	THESE DRAW OF KAWNI CONFIDENTIA ITS BENEF UNAUTHOF DOCUMEN	DEMAND.
1	1"	TI	THIS DRAWING IS FO BLAST MITIGATION				
GLAS	S SIZE I	FORMUL	A: DLO + 1"	~	PRODU	JCT TESTING ONLY	;
GLASS G1-1: G1-2:	<u>S SIZES:</u> : 38–7, : 36" X	/8" X 14 28" =	4-1/2" = 8 REQ'D. 4 REQ'D.				
			NOTES			SM	
	1. 2. 3. 4. 5. 6.	FINISH TO WINDOWS SEE SHEE LOCATIONS SEE SHEE SEE SHEE SILICONES TREMCO T TREMCO S TREMCO F	D BE #17 CLEAR ANODIZED. SHIPPED FABRICATED, ASSEMBLED, AND GLAZED. ET 2 OF 5 FOR FASTENER SCHEDULE, PERIMETER FASTENER S. ET 2 OF 5 HARDWARE SCHEDULE. ET 2 OF 5 FOR TYPICAL GLAZING DETAIL. S USED: IREMSIL 600 - WEATHER SEALS E SPECTRUM II - PERIMETER SEALS E PROGLAZE SSG - STRUCTURAL SEALS S		555 GUTHRIDGE COURT NORCROSS, GEORGIA 30092	TEST UNIT DRAWINGS 8325TL FIXED / PROJECT OUT / FIXED PERFORMANCE OF HISTORICALLY APPROPRIATE BLAST-RESISTANT WD	ASTM f 1642, & UFC 4-010-0 scale: None
				DRWG.	 №. TUD.32	04/16/07	
				SHEET	of 5		
					-		



### FASTENER SCHEDULE

WINDOW HARDWARE: (4) BAR HINGES CAM HANDLES [(3) PER VENT] SNUBBERS

	MATERIAL	DESCRIPTION	SUBSTRATE	LOCATION	MIN. EMBED.	MAX. SPACING
V	GRADE 5 STEEL	1/4" X 1 1/2" ELCO DRILFLEX	STEEL	HEAD/SILL/JAMB	FULL	SEE ELEVATION

REV.	DATE	REQUEST LETTER	BY
E.C.	NO. 9	5502-11 ??-??-07	
CONFIDENTIAL AND PROPRIETARY	INFORMATION KAWNEER COMPANY INC.	THESE DRAWINGS ARE THE SOLE AND EXCLUSIVE PROPERTY OF KAWNEER AND CONTAIN SENSITIVE, PRIVILEGED OR CONFIDENTIAL INFORMATION WHICH MAY BE USED ONLY FOR ITS BENEFIT. THE DISCLOSURE OF THESE DRAWINGS TO UNAUTHORIZED PERSONS IS STRICTLY PROHIBITED. THIS DOCUMENT AND ALL COPIES MUST BE RETURNED UPON	DEMAND. © COPYRIGHT KAWNEER COMPANY, INC., 2005
TH	IS DR. BLAST PRODU	AWING IS F MITIGATION ICT TESTING ONLY	OR I G
<sup>1</sup> New Y			
KAWNEER	565 GUTHRIDGE COURT ORCROSS, GEORGIA 30092 DUMARE TATA AN AN DECREMA	FAX (770) 734-1560 DRAWINGS ED / PROJECT OUT / FIXED ANCE OF HISTORICALLY ATE BLAST-RESISTANT WDWS	2, & UFC 4-010-0
DRAWN E	ž	APPROPRIL	ASTM f 164 scale: NONE
DRWG. N		<u> </u>	
SHEET	0032	.5801-02	
	of 5		



REV. DAT	E RE	QUEST LETTER	BY						
E.C. NO.	95502	-11 ??-??-07							
CONFIDENTIAL AND PROPRIETARY INFORMATION KAWNEER COMPANY INC.	THESE DRAWINGS ARE THE SOLE AND EXCLUSIVE PROPERTY	OF KAWNEER AND CONTAIN SENSITIVE, PRIVILEGED OR CONFIDENTIAL INFORMATION WHICH MAY BE USED ONLY FOR ITS BENEFIT. THE DISCLOSURE OF THESE DRAWINGS TO UNAUTHORIZED PERSONS IS STRICTLY PROHIBITED. THIS DOCUMENT AND ALL COPIES MUST BE RETURNED UPON DEMAND. © COPYRIGHT KAWNEER COMPANY. INC 2005							
THIS DRAWING IS FOR BLAST MITIGATION PRODUCT TESTING ONLY									
		<ul> <li>TEST UNIT DRAWINGS</li> <li>8325TL FIXED / PROJECT OUT / FIXED</li> <li>PERFORMANCE OF HISTORICALLY</li> <li>APPROPRIATE BLAST-RESISTANT WDWS</li> </ul>							
		04/16/07							
	)3258	301-03							
3 of 5									



# , , ,

}

REV. DA	TE RE	EQUEST LETTER	BY							
E.C. NO	. 95502	2-11 ??-??-07								
	THESE DRAWINGS ARE THE SOLE AND EXCLUSIVE PROPERTY	OF KAWNEER AND CONTAIN SENSITIVE, PRIVILEGED OR CONFIDENTIAL INFORMATION WHICH MAY BE USED ONLY FOR ITS BENEFIT. THE DISCLOSURE OF THESE DRAWINGS TO UNAUTHORIZED PERSONS IS STRICTLY PROHIBITED. THIS DOCUMENT AND ALL COPPES MUST BE RETURNED UPON DEMANY. INC. 2005								
THIS BL PR	THIS DRAWING IS FOR BLAST MITIGATION PRODUCT TESTING ONLY									
KAWNEER	555 GUTHRIDGE COURT NORCROSS, GEORGIA 30092 PHONE (770) 744-5555 FAX (770) 734-1560		SCALE: NONE							
DRAWN BY	EH	date 04/16/07								
TU	D325	801-04								
4 of :	5									

.



REV.	DA	TE		RE	QUE	STL	ETT	ER	_	BY
	500.44									
E.0	. NO		90	502 ~	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	11-1	7-0	/		—
CONFIDENTIAL AND PROPRIETARY INFORMATION KAWNEER COMPANY INC				THESE DRAWINGS ARE THE SOLE AND EXCLUSIVE PROPERTY OF KAWNEER AND CONTAIN SENSITIVE, PRIVILEGED OR CONFIDENTIAL INFORMATION WHICH MAY BE USED ONLY FOR ITS BENEFIT. THE DISCLOSURE OF THESE DRAWINGS TO UNAUTHORIZED PERSONS IS STRICTLY PROHIBITED. THIS DOCUMENT AND ALL COPIES MUST BE RETURNED UPON DEMAND. © COPYRIGHT KAWNEER COMPANY, INC., 2005						
THIS DRAWING IS FOR BLAST MITIGATION PRODUCT TESTING ONLY									DR	
KKAWNEER		T 555 GUTHRIDGE COURT NORCROSS GEORGIA 30092	PHONE (770) 449-5555	FAX (770) 734-1560	DATE	04/	16/	07		SCALE: NONE
٦	٢U	D3	2	58	30	1 -	-0	)5	;	
SHEET	of	5								
 	5.1	-								

#### 128-414 #10 X 7/16" PHTF LOCATE AT 3" FROM EACH END AND 12" O.C.

### Appendix C

#### **Fixture Drawings**







ERDC Historic Windows Test 2



ERDC Historic Windows Test 2



ERDC Historic Windows Test 2



ERDC Historic Windows Test 3



ERDC Historic Windows Test 3



ERDC Historic Windows Test 3



ERDC Historic Windows Test 4



ERDC Historic Windows Test 4



ERDC Historic Windows Test 4



ERDC Historic Windows Test 5



ERDC Historic Windows Test 5





ERDC Historic Windows Test 5A



ERDC Historic Windows Test 5A



ERDC Historic Windows Test 5A



ERDC Historic Windows Test 5B





ERDC Historic Windows Test 5B



ERDC Historic Windows Test 6



ERDC Historic Windows Test 6



ERDC Historic Windows Test 6





















Histo<u>ric Windows T</u>est 1



















































#### Historic Windows Test 1







































































#### Histo<u>ric Windows T</u>est 1













#### Historic Windows Test 1


































Histo<u>ric Windows T</u>est 2

Tear













































































Histo<u>ric Windows T</u>est 4

























































































Histo<u>ric Windows T</u>est 5





















































### Histo<u>ric Windows T</u>est 6





























					Form Approved	
REPORT DOCUMENTATION PAGE				OMB No. 0704-0188		
the data needed, and completing and reviewing this collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for						
VA 22202-4302. Respondents should be aware that notwithstanding any other provision of law, no person shall be subject to any penalty for failing to comply with a collection of information if it does not						
1. REPORT DATE (DD Sontambar 2007	-MM-YYYY)	REPORT TYPE	ABOVE ADDRESS.	3. [	DATES COVERED (From - To)	
4. TITLE AND SUBTITLE				5a.		
Performance Test Test Data	Appropriate Blast-Resista	nt Windows: Volu	me 2 – <b>5b.</b>	GRANT NUMBER		
				5c.	PROGRAM ELEMENT NUMBER	
6. AUTHOR(S) Julie L. Webster a	er		5d.	PROJECT NUMBER		
					TASK NUMBER	
					WORK UNIT NUMBER	
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)				8. F	PERFORMING ORGANIZATION REPORT	
U.S. Army Engineer Research and Development Center				]	ERDC/CERL TR-07-39	
P.O. Box 9005						
Champaign, IL 61826-9005						
9. SPONSORING / MONITORING AGENCY NAME(S) AND ADDRESS(ES)				10.	SPONSOR/MONITOR'S ACRONYM(S)	
DoD Legacy Resource Management Program					ODUSD (ES) EQ-EQLP	
1225 Clark Street, Suite 1500 Arlington, VA 22202				11.	11. SPONSOR/MONITOR'S REPORT	
					04 219	
12. DISTRIBUTION / AVAILABILITY STATEMENT						
shall be referred to the Office of the Deputy Under Secretary of Defense for Environmental Security (ODUSD (ES) EQ-EQLP)						
13. SUPPLEMENTARY NOTES						
14. ABSTRACT						
This study leverages findings of Legacy Project 03-1/6, Antiterrorism Measures for Historic Properties. The authors identified few sources of LEC 4.010.01, compliant raplacement windows appropriate for historic building applications. Most window suppliers will						
guote a job to produce prototype windows, but they (1) have no current blast test data for their product, and (2) have no experience						
with historic building applications. This suggested a need for window testing to help ensure that DoD has multiple trusted sources for						
historically compatible blast-resistant window products.						
<b>15. SUBJECT TERMS</b> Unified Facilities Criteria 4-010-01, antiterrorism. Secretary of the Interior's Standards for Rehabilitation, historic preservation						
16. SECURITY CLASS		17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES	19a. NAME OF RESPONSIBLE PERSON		
a. REPORT	b. ABSTRACT	c. THIS PAGE			19b. TELEPHONE NUMBER (include	
Unclassified	Unclassified	Unclassified		82	area cuuej	
					andard Form 208 (Rev. 8-08)	