Ballistic Testing and Design Services
Phone: 800-513-4291 Email: technicalsupport@CloseFocusResearch.com

Report Number: BTR-11-03-2004-Sample 1
CloseFocusResearch.com

Name: **T & M Protection Resources**
Website: http://tandmprotection.com
Date: November 3, 2004

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Ballistic Results

General Information

Type of Products to be tested:	Armor Side Vehicle Window
Test Specimen Sample size(s):	22 inch x 20 inch
Number of test specimens:	2Sample(s)
Weight of all samples:	15
Are Materials a Health Hazard:	No
Need the Tests performed by:	November 13, 2004
Need products shipped back:	Yes
Purchase Order Number:	T.B.D.

International Ballistic Standards / Specifications Testing

☐ ASTM ☐ Brunswick ☐ FRA ☐ NIJ ☐ CFR Pass All
☐ Australian ☐ Canadian ☐ Germ DIN ☐ State Dept ☐ CFR SYA
☐ British ☐ EN 1063 ☐ MIL-SAMIT ☐ UL 752 ☑ Other

Test Standard:	Cartridge / Projectile Type Test
Particular Test:	9mm Parabellum and .357 magnum
Velocity Range:	9mm = 1,165 to 1,198 & .357 = 1,250 to 1,375 ft/s
Number of Shots:	9mm = 3 shots and .357 = 3 shots
Spacing / Pattern:	4.0 to 5.0 inch triangle

Test Results

	Test 1			Test 2		
Product Number:	Sample 1			Sample 1 (same sample)		
Sample Type:	Armor Side Vehicle Window			Armor Side Vehicle Window		
Sample Size:	22 inch x 20 inch			22 inch x 20 inch		
Thickness:	0.6 inch			0.6 inch		
Weight:	15 lbs			15 lbs		
Weapon Type:	9 mm handgun			.357 Magnum handgun		
Cartridge / Projectile Type:	9 mm Parabellum FMJ			.357 Magnum JSP		
Projectile Weight:	124 gr			158 gr		
Target Distance:	20 ft			20 ft		
Number of Shots:	3 shots			3 shots		
Shot Sequence:	Shot 1	Shot 2	Shot 3	Shot 1	Shot 2	Shot 3
Impact Velocity (ft/sec) *:	1,168	1,175	1,170	1,267	1,275	1,272
Impact Energy (ft-lbs):	376	380	377	563	570	568
Impact Momentum (lb-sec):	0.64	0.65	0.64	0.89	0.89	0.89
Impact Spacing (inches) **:	5.50	4.50	4.25	3.75	4.50	4.50
Impact Angle (degrees):	0 °	0 °	0 °	0 °	0 °	0 °
Penetration Effect:	NP	NP	NP	NP	NP	CP
Bulge Height (inches) ***:	0.50	0.25	0.25	0.75	0.75	N/A
Impact Spacing / Pattern:	4.75 inch (average)			4.25 inch (average)		
Witness plate material:	None			None		
Witness Plate Distance:	N/A			N/A		
Spall Occurrence:	Yes / Yes / Yes			No / No / Yes		
Test Temperature:	70 °F			70 °F		
Test Date:	November 3, 2004			November 3, 2004		
Comments:	Polycarbonate rear ply cracked			3rd shot penetrated sample		


Pre-test Impact side


Post-test-9mm and .357 impact side


Post-test-9mm and .357 inside view

Comments and Test Descriptions

* Velocity measurements were taken at a distance of 15 feet from the target.
** Impact Spacing is the distance between shots. (shot 1= 3 to 1, shot 2 = 1 to 2, shot 3 = 2 to 3)
*** The post impact Bulge Height is the distance between the apex of the extruded deformation bulge to the tangent plane of the flat surface. This measurement is taken from the side opposite to the impacts.

NP = No Penetration
CP = Complete Penetration

Test and Report Engineers

Tested and Reported by: Sam Wilson Signature: *Sam Wilson* Date: November 3, 2004

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Phone: 800-513-4291 Email: technicalsupport@CloseFocusResearch.com

Name: T & M Protection Resources Report Date: November 3, 2004

Ballistic Test Results and Photographs

Requirement and Goal

To determine the Ballistic Threat capability of the unknown Transparent Armor Side Vehicle Window.

Cross Section Design and Ballistic Capability Analysis

In order to determine the possible threat capabilities of the submitted Transparent Armor Side Vehicle Window sample, we had to first determine the material properties of the sample. We first measured the overall thickness of the sample and then the individual ply thicknesses within the laminate cross section. The cross section design was determined to be a Glass / Polycarbonate security glazing as illustrated below.

We then performed an Engineering Ballistic Capability analysis of the cross section design and found it to be within the range of both the 9mm Parabellum and .357 magnum calibers. Base on this analysis, the sample would then be tested to a custom ballistic test specification that closely matches and similar to both the German DIN C1 and UL 752 Level 2 Ballistic Standard specifications. The following table outlines both the German DIN C1 and UL 752 Level 2 Ballistic Standards.

Ballistic Test Results:

This Transparent Armor Side Vehicle Window was subjected to both 9mm Parabellum and .357 magnum handgun testing. There was a total of two tests preformed on the same sample. In in first Test #1, all three 9mm Parabellum bullets were defeated by the sample. There was no penetration of the by the bullets, but the rear face ply, made from plastic (probably polycarbonate), cracked in a circular pattern around each shot. In the second Test #2, two of three .357 magnum bullets were defeated by the sample. The third shot completely penetrated the sample most likely due to the insufficient material left from the damage caused from the previous shots. The first two .357 magnum shots caused approximate 3/4 inch high bulges in the rear polycarbonate face ply.

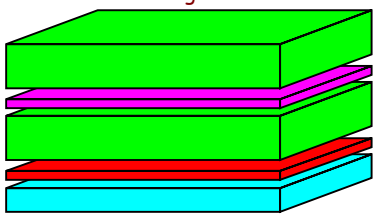
Conclusion

Based on the Ballistic Testing performed, this particular Transparent Armor Side Vehicle Window would most likely pass the following International Ballistic Standards.

Standard	Velocity Range (ft/sec)	# of shots	Shot Spacing (in.)	Shot Pattern
9 mm Parabellum				
DIN C1-SF (9 mm Parabellum FMJ)	1,165 to 1,198	3	5.1	4.9 to 5.3 in. triangle
DIN C1-SA (9 mm Parabellum FMJ)	1,165 to 1,198	3	5.1	4.9 to 5.3 in. triangle
.357 Magnum				
UL Level 2 Part 1 (.357 Magnum JSP)	1,250 to 1,375	3	4.5	4.5 inch triangle
UL Level 2 Part 3 (.357 Magnum JSP)	1,250 to 1,375	1	-	-

Thickness	Material
0.213 in.	Annealed Clear Glass
0.030 in.	Interlayer
0.213 in.	Annealed Clear Glass
0.025 in.	Interlayer
0.119 in.	Clear Polycarbonate
0.600 in.	Total Thickness

Cross section Design



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Test and Report Engineers

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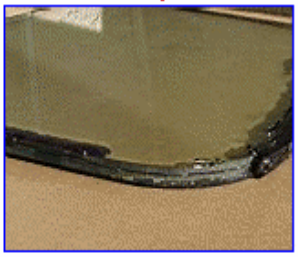
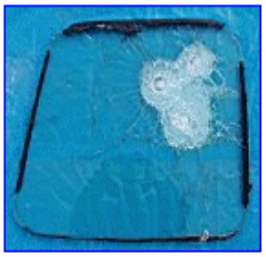
Ballistic Test Results and Photographs

Sample 1: Armor Side Vehicle Window


Pre Test Impact Side


Pre Test Cross Section Corner

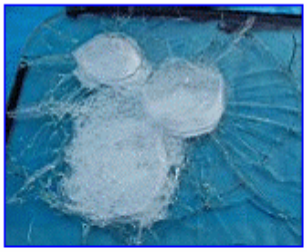

Pre Test Cross Section Edge


Post Test 9mm Impact Side

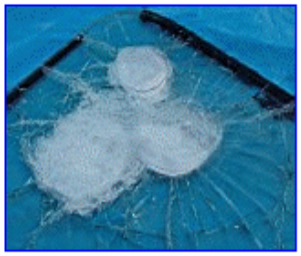

Post Test 9mm Inside View

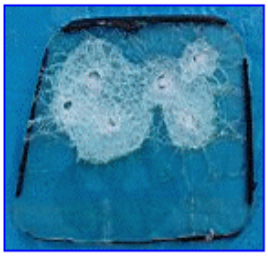

Post Test 9mm Impact Side


Post Test 9mm Impact Side


Post Test 9mm Inside View


Post Test 9mm Inside View


Post Test 9mm Inside View


Post Test 9mm and 357 Impact Side


Post Test 9mm and 357 Impact Side


Post Test 357 Impact Side


Post Test 357 Impact Side


Post Test 9mm and 357 Impact Side


Post Test 9mm and 357 Inside View


Post Test 9mm and 357 Inside View


Post Test 9mm and 357 Inside View

Photographs

The photographs show both the pre and post-test Transparent Armor Side Vehicle Window Test Sample. Additional larger sized photographs are included with this report.

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