

POC: Mr. Julio Rodriguez P.O. No.: Julio Rodriguez Test Date: 30 August 2019 Job No.: 3350-012D

Optima Ballistic Glass Colombia S.A., Armor Protection Ballistic Resistance Test

Prepared by:

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NTS-Chesapeake Testing

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5 September 2019

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OPTIMA BALLISTIC GLASS COLOMBIA S.A. PROPRIETARY INFORMATION

1 Introduction

Optima Ballistic Glass Colombia S.A., provided three armor samples to NTS-Chesapeake Testing for ballistic resistance testing on 30 August 2019.

2 Threats and Instrumentation

2.1 Threats

• 7.62 x 51-mm, 149-grain M80 full metal jacketed (FMJ) projectiles

*All projectiles were fired from a universal receiver which was fitted with the appropriate barrel and mounted on a NTS-Chesapeake Testing mount.

*The threat projectiles were required to have no greater than 5° total yaw. Projectile yaw was measured to ensure that the test impacts were within this constraint by placing a yaw card at the appropriate gun-to-target range during velocity verification shots.

2.2 Instrumentation

Projectile velocity measurements were obtained using Oehler Research model No. 57 infrared screens with Y.I.S. Cowden Group Chrono-USB chronographs.

3 Details of Test

The objective of this test was to conduct a ballistic resistance test on the transparent armor samples in accordance with EN 1063 BR6 and the customer's request. Shot spacing between multiple impacts against a single sample was in accordance with the reference performance standard. All shots against the transparent armor samples were performed at 0.0° obliquity and ambient range temperature (69.4 °F).

For each shot, the target was mounted in a rigid frame and clamped to a rigid test fixture. A piece of 0.0254 mm thick (0.001 in) aluminum foil with splinter box was mounted along the shotline, approximately 500 mm ± 13 mm (19.666 in ± 0.5 in) behind the target, to verify complete penetrations. A complete penetration was scored only when the witness material was perforated (i.e., light was visible through the material). All firings were conducted at 32.750 ft from the target. The projectile velocities used for the test were in accordance with the referenced performance standard.

4 Summary of Results

The results of the ballistic resistance test are shown in Table 1. The round-by-round ballistic data sheets for all testing performed are provided on the following pages.

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eSizeWeight (in)ThreatTarget Obliq. (deg)Shot Obliq. No.Penetration Data19.50 x 19.5047.88 $7.62 x 51$ -mm, 149-grain M80 FMJ0.012692None19.50 x 19.5047.88149-grain M80 FMJ0.022692None19.50 x 19.5047.88 $7.62 x 51$ -mm, 149-grain M80 FMJ0.012692None19.50 x 19.5047.88 $7.62 x 51$ -mm, 149-grain M80 FMJ0.022731None19.50 x 19.5047.84 $7.62 x 51$ -mm, 149-grain M80 FMJ0.022727None19.50 x 19.5047.84 149 -grain M80 FMJ0.022741None	None	2708	3		Q				
eSize (in)Weight (lbs)Threat (lbs)Target Obliq, Obliq, Obliq, (deg)Shot Velocity (deg)Penetration Data No.0.519.50 x 19.5047.88 $7.62 x 51$ -nnm, 149-grain M80 FMJ0.012692None0.519.50 x 19.5047.88 $7.62 x 51$ -nnm, 149-grain M80 FMJ0.022692None0.519.50 x 19.5047.88 $7.62 x 51$ -nnm, 149-grain M80 FMJ0.012694None0.519.50 x 19.5047.88 $7.62 x 51$ -nnm, 149-grain M80 FMJ0.012694None0.519.50 x 19.5047.88149-grain M80 FMJ0.012711None0.519.50 x 19.5047.88149-grain M80 FMJ0.012717None	None	2741	2	0.0	7.62 x 51-mm, 149-grain M80 FMJ	47.84	19.50 x 19.50	5994-105	3350-012-3
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eSizeWeight (in)ThreatTarget Obliq. (deg)Shot Obliq. No.Penetration Data(in)(lbs)ThreatObliq. (deg)No.Velocity (ft/s)Result (deg))519.50 x 19.5047.887.62 x 51-mm, 149-grain M80 FMJ 0.0 22692None)519.50 x 19.5047.887.62 x 51-mm, 149-grain M80 FMJ 0.0 22694None)519.50 x 19.5047.88149-grain M80 FMJ 0.0 22731None	None	2717	3		q				
eSizeWeight (in)ThreatTarget Obliq.Shot Obliq.Penetration Data(in)(ibs)ThreatObliq. (deg)No.Velocity (deg)Result (deg))519.50 x 19.5047.887.62 x 51-mm, 149-grain M80 FMJ0.012692None)519.50 x 19.5047.88149-grain M80 FMJ0.022692None)519.50 x 19.5047.88149-grain M80 FMJ0.122692None)519.50 x 19.5047.88149-grain M80 FMJ0.122692None	None	2731	2	0.0	7.62 x 51-mm, 149-grain M80 FMJ	47.88	19.50 x 19.50	5995-105	3350-012-2
eSizeWeight (in)ThreatTarget Obliq. (deg)Shot 	None	2694	1						
eSizeWeight (in)ThreatTarget Obliq.ShotPenetration Data(in)(lbs)ThreatObliq.No.VelocityResult(deg)12692None12692None0.019.50 x 19.5047.88149-grain M80 FMJ0.022692None	None	2716	3		q				
e Size Weight Threat (in) (lbs) Threat (deg) 1 2692 None 1 2692 None	None	2692	2	0.0	7.62 x 51-mm, 149-grain M80 FMJ	47.88	19.50 x 19.50	5993-105	3350-012-1
e Size Weight Threat (in) (lbs) Threat (deg) Velocity (t/s) Penetration Data	None	2692	1						
e Size Weight Threat Obliq. No. Velocity Result		(ft/s)		(deg)		(lbs)	(in)		
e Target Shot Penetration Data	Result	Velocity	No.	Obliq.	Threat	Weight	Size	No.	No.
	ion Data	Penetrat	Shot	Target				Sample	Joh

Table 1. Summary of Ballistic Resistance Testing

	BALLISTIC RESISTANCE TEST											
NTS 46031 Belca	5-Ches 3 Compass mp, MD 2	apeak Point Roa 1017	e Testir	ng				С	ilient: Opt	tima Balli	stic Gl Job Test	ass Colombia S.A. No.: 3350-012-1 Date: 8/30/2019
Tes	t Pane	el	Descriptio	on: Transp	oarent Ar	mor						
Manı	ufacture	r: Optima	a Ballistic (Glass Colon	nbia S.A.		Sample No	.: 5993-10)5			
	Av Tł	Size: g. Thick: nickness:	19.50 x 19 1.539 in 1.539 in; 1.537 in;	9.50 in 1.539 in; 1.541 in		۷ Plies/Lam	Veight: 47. inates: NA	88 lbs		Date Rece Retu	vived: Via: rned:	8/23/2019 FedEx FedEx
Set	up								·			
Ba	Shot Sµ Witness acking Ma Con	Dacing: E Panel: . saterial: N dition: A	EN 1063 BR 001 in Alur plinter boy NA Ambient	6 ninum foil <	with F	Primary Vel. Primary Vel. Range t Target to	. Screens (ft Location (ft to Target (ft Witness (in): 20.000 29.667): 25.000): 32.750): 19.666	, 20.333, , 30.000	Rang Barre G Rec	e No.: Temp: BP: RH: l/Gun: unner: corder:	2 69.4 °F 29.9 inHg 47.0% Test Barrel Matt Rixham Matt Rixham
Am	munit	ion			· ·							
		Projec	tile			No.			P	owder		
(1) 7	7.62 x 51	-mm, 149	-grain M80	FMJ		Mili	itary				N 110	
Applicable Standards or Procedures												
(1) EN 1063 BR6 (2) Customer request												
Shot No.	Ammo	Weight (gr)	Veight Time 1 Vel. 1 Time 2 Vel. 2 (gr) (µs) (ft/s) (µs) (ft/s)					Penetrat	ion Ob	liq. °)	l	Footnotes
1 2 3	1 1 1	NA NA NA	3714 3714 3680	2693 2693 2717	3468 3468 3439	2691 2691 2714	2692 2692 2716	None None None	0 0 0	.0 .0 .0		
<u>Rema</u> Requ	arks: ired velo	ocity: 269	1 to 2755 f	t/s								
Foot	notes:											

	BALLISTIC RESISTANCE TEST											
NTS 4603B Belcar	Compass	apeak Point Roa 1017	e Testir	ng				Cl	ient: Opt	ima Ballistic (Ji Te	Glass Colombia S.A. ob No.: 3350-012-2 st Date: 8/30/2019	
Test	t Pane	əl	Descriptio	on: Transp	oarent Ar	mor						
Manu	facture	r: Optima	a Ballistic (Glass Colon	nbia S.A.		Sample No	5995-10	5			
	Avı Tł	Size: g. Thick: nickness:	19.50 x 19 1.533 in 1.529 in; 1.536 in;	9.50 in 1.537 in; 1.530 in		۷ Plies/Lam	Veight: 47 inates: NA	.88 lbs	D	Date Received Via Returned	: 8/23/2019 : FedEx : FedEx	
Seti	q											
Ba	Shot Sp Witness cking Ma Con	pacing: E Panel: . s aterial: N dition: A	EN 1063 BR 001 in Alur plinter boy NA Ambient	6 ninum foil <	with F	Primary Vel. Primary Vel. Range t Target to	. Screens (ff Location (ff to Target (ff Witness (ir	 20.000, 29.667, 25.000 32.750 19.666 	20.333, 30.000	Range No Tem B Ri Barrel/Gu Gunne Recorde	n.: 2 p: 69.4 °F P: 29.9 inHg H: 46.8% n: Test Barrel r: Matt Rixham r: Matt Rixham	
Amr	nunit	ion										
Projectile Lot No. Powder										er		
(1) 7.62 x 51-mm, 149-grain M80 FMJ Mili										N 11	0	
Applicable Standards or Procedures												
(1) EN 1063 BR6 (2) Customer request												
Shot No.	Ammo	Ammo Weight Time 1 Vel. 1 Time 2 Vel. 2 (gr) (µs) (ft/s) (µs)						Penetratio	on Obl (°	liq. ')	Footnotes	
1 2 3	1 1 1	149.0 149.0 149.0	3717 3661 3683	2690 2731 2715	3461 3417 3434	2697 2731 2718	2694 2731 2717	None None None	0. 0. 0.	.0 .0 .0		
<u>Rema</u> Requi	<u>rks:</u> ired velo	ocity: 269	1 to 2755 f	t/s								
<u>Footn</u>	otes:											

	BALLISTIC RESISTANCE TEST											
NTS 46031 Belca	5-Ches 3 Compass mp, MD 2	apeak Point Roa 1017	e Testir	ng				Clie	ent: Opti	ma Ballistic G Jo Tes	lass Colombia S.A. b No.: 3350-012-3 t Date: 8/30/2019	
Tes	t Pane	əl	Descriptio	on: Transp	oarent Arn	nor						
Manı	ufacture	r: Optima	a Ballistic (Glass Colon	nbia S.A.		Sample No	.: 5994-105				
	Av Tł	Size: g. Thick: nickness:	19.50 x 19 1.538 in 1.537 in; 1.537 in;	9.50 in 1.538 in; 1.540 in		۷ Plies/Lam	Weight: 47. iinates: NA	84 lbs	Da	ate Received: Via: Returned:	8/23/2019 FedEx FedEx	
Set	up								·			
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Am	munit	ion							· ·			
Projectile Lot No.										Powde	r	
(1) 7.62 x 51-mm, 149-grain M80 FMJ Milit										N 110)	
Applicable Standards or Procedures												
(1) EN 1063 BR5 (2) Customer request												
Shot No.	Ammo	··nmoWeightTime 1(gr)(μs)(ft/s)(μs)					Avg. Vel. (ft/s)	Penetratio	n Oblie (°)	q.	Footnotes	
1 2 3	1 1 1	149.0 149.0 149.0	3670 3649 3692	2725 2740 2709	3421 3404 3448	2728 2742 2707	2727 2741 2708	None None None	0.0 0.0 0.0)		
<u>Rema</u> Requ	arks: ired velo	ocity: 269	1 to 2755 f	t/s								
<u>Foot</u>	notes:											