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

Prepared by:

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NTS-Chesapeake Testing
4603B Compass Point Road
Belcamp, MD 21017

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Further dissemination only as directed by
Optima Ballistic Glass Colombia S.A., June 2021.

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1 Introduction

Optima Ballistic Glass Colombia S.A., provided three armor samples to NTS-Chesapeake Testing for ballistic resistance testing on 21 May 2021.

2 Threats and Instrumentation

2.1 Threats

- 9-mm, 124-grain 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. Calibration data is provided in Attachment A.

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 BR2 and the customer's request. Shot spacing between multiple impacts against a single sample was in accordance with the reference performance standard. Shots against the transparent armor samples were performed at 0.0° obliquity and ambient range temperature (68.6 °F).

For each shot, 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 (19.680 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 16.400 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.

Table 1. Summary of Ballistic Resistance Testing

Job No.	Sample No.	Size (mm)	Weight (lbs)	Threat	Target Obliq. (deg)	Shot No.	Penetration Data	
							Velocity (ft/s)	Result
3350-020-1	10041-109	500 x 500	15.43	9-mm, 124-grain FMJ	0.0	1	1301	None
						2	1342	None
						3	1335	None
3350-020-2	10041-110	500 x 500	15.42	9-mm, 124-grain FMJ	0.0	1	1282	None
						2	1345	None
						3	1324	None
3350-020-3	10042-108	500 x 500	15.39	9-mm, 124-grain FMJ	0.0	1	1297	None
						2	1336	None
						3	1323	None

BALLISTIC RESISTANCE TEST

NTS-Chesapeake Testing
4603B Compass Point Road
Belcamp, MD 21017

Client: Optima Ballistic Glass Columbia S.A.
Job No.: 3350-020-1
Test Date: 5/21/2021

Test Panel

Description: Transparent Armor.

Manufacturer: Optima Ballistic Glass Columbia S.A.

Sample No.: 10041-109

Size: 500 x 500 mm Avg. Thick: 0.562 in Thickness: 0.561 in; 0.560 in; 0.563 in; 0.564 in	Weight: 15.43 lbs Plies/Laminates: 0	Date Received: 5/20/2021 Via: FedEx Returned: NA

Setup

Shot Spacing: EN 1063 BR2 Witness Panel: .01 in Aluminum foil with splinter box Backing Material: NA Condition: Ambient	Primary Vel. Screens (ft): 6.500, 6.833, 11.166, 11.500 Primary Vel. Location (ft): 9.000 Range to Target (ft): 16.400 Target to Witness (in): 19.680	Range No.: 1 Temp: 68.6 °F BP: 30.5 inHg RH: 49.0% Barrel/Gun: Test Barrel Gunner: Glenn Snyder Recorder: M. Contreras

Ammunition

Projectile	Lot No.	Powder
(1) 9-mm, 124-grain FMJ	Remington 23558	Accurate No. 2

Applicable Standards or Procedures

(1) EN 1063 BR2
(2) Customer request

Shot No.	Ammo	Weight (gr)	Time 1 (µs)	Vel. 1 (ft/s)	Time 2 (µs)	Vel. 2 (ft/s)	Avg. Vel. (ft/s)	Penetration	Obliq. (°)	Footnotes
1	1	125.2	3846	1300	3329	1302	1301	None	0.0	
2	1	125.2	3727	1342	3226	1343	1342	None	0.0	
3	1	125.2	3749	1334	3243	1336	1335	None	0.0	

Remarks:
Required velocity: 1280-1344 ft/s

Footnotes:

BALLISTIC RESISTANCE TEST

NTS-Chesapeake Testing
4603B Compass Point Road
Belcamp, MD 21017

Client: Optima Ballistic Glass Columbia S.A.
Job No.: 3350-020-2
Test Date: 5/21/2021

Test Panel

Description: Transparent Armor.

Manufacturer: Optima Ballistic Glass Columbia S.A.

Sample No.: 10041-110

Size: 500 x 500 mm Avg. Thick: 0.562 in Thickness: 0.562 in; 0.560 in; 0.564 in; 0.561 in	Weight: 15.42 lbs Plies/Laminates: 0	Date Received: 5/20/2021 Via: FedEx Returned: NA

Setup

Shot Spacing: EN 1063 BR2 Witness Panel: .01 in Aluminum foil with splinter box Backing Material: NA Condition: Ambient	Primary Vel. Screens (ft): 6.500, 6.833, 11.166, 11.500 Primary Vel. Location (ft): 9.000 Range to Target (ft): 16.400 Target to Witness (in): 19.680	Range No.: 1 Temp: 68.6 °F BP: 30.5 inHg RH: 49.0% Barrel/Gun: Test Barrel Gunner: Glenn Snyder Recorder: M. Contreras

Ammunition

Projectile	Lot No.	Powder
(1) 9-mm, 124-grain FMJ	Remington 23558	Accurate No. 2

Applicable Standards or Procedures

(1) EN 1063 BR2
(2) Customer request

Shot No.	Ammo	Weight (gr)	Time 1 (µs)	Vel. 1 (ft/s)	Time 2 (µs)	Vel. 2 (ft/s)	Avg. Vel. (ft/s)	Penetration	Obliq. (°)	Footnotes
1	1	125.2	3900	1282	3380	1282	1282	None	0.0	
2	1	125.2	3719	1344	3221	1345	1345	None	0.0	
3	1	125.2	3778	1323	3270	1325	1324	None	0.0	

Remarks:
Required velocity: 1280-1344 ft/s

Footnotes:

BALLISTIC RESISTANCE TEST

NTS-Chesapeake Testing
4603B Compass Point Road
Belcamp, MD 21017

Client: Optima Ballistic Glass Columbia S.A.
Job No.: 3350-020-3
Test Date: 5/21/2021

Test Panel

Description: Transparent Armor.

Manufacturer: Optima Ballistic Glass Columbia S.A.

Sample No.: 10042-108

Size: 500 x 500 mm Avg. Thick: 0.561 in Thickness: 0.563 in; 0.560 in; 0.561 in; 0.561 in	Weight: 15.39 lbs Plies/Laminates: 0	Date Received: 5/20/2021 Via: FedEx Returned: NA

Setup

Shot Spacing: EN 1063 BR2 Witness Panel: .001 in Aluminum foil with splinter box Backing Material: NA Condition: Ambient	Primary Vel. Screens (ft): 6.500, 6.833, 11.166, 11.500 Primary Vel. Location (ft): 9.000 Range to Target (ft): 16.400 Target to Witness (in): 19.680	Range No.: 1 Temp: 68.6 °F BP: 30.5 inHg RH: 49.0% Barrel/Gun: Test Barrel Gunner: Glenn Snyder Recorder: M. Contreras

Ammunition

Projectile	Lot No.	Powder
(1) 9-mm, 124-grain FMJ	Remington 23558	Accurate No. 2

Applicable Standards or Procedures

(1) EN 1063 BR2
(2) Customer request

Shot No.	Ammo	Weight (gr)	Time 1 (µs)	Vel. 1 (ft/s)	Time 2 (µs)	Vel. 2 (ft/s)	Avg. Vel. (ft/s)	Penetration	Obliq. (°)	Footnotes
1	1	125.2	3856	1297	3338	1298	1297	None	0.0	
2	1	125.0	3744	1335	3243	1336	1336	None	0.0	
3	1	125.0	3780	1323	3273	1324	1323	None	0.0	

Remarks:
Required velocity: 1280-1344 ft/s

Footnotes:

ATTACHMENT A
CALIBRATION DATA

Job Number: 3350-020

Customer: Optima Ballistic Glass Columbia S.A. **Date:** 5/21/2021

Range: 1 **Range Lead:** Miguel Contreras

Equipment	Serial Number	NTS I.D. #	Cal. Date	Due Date	Range Lead Initials
Chronograph 1	105	WC027147	9/17/2020	9/17/2021	MAC
Chronograph 2	109	WC067008	9/17/2020	9/17/2021	MAC
Powder Scale	A20319477	WC075109	3/12/2021	9/12/2021	MAC
Floor Scale	25359073	WC060708	12/9/2020	12/9/2021	MAC
100 ft. Tape Measure	906	WC064334	3/10/2021	3/10/2022	MAC
25 ft. Tape Measure	WC074988	WC074988	10/19/2020	10/19/2022	MAC
Thermometer	210185096	WC075125	3/9/2021	3/9/2023	MAC
BFD Tool	19/010026	WC067359	1/21/2021	1/21/2022	MAC
BFD Bridge	19/190011	WC074146	12/9/2020	12/9/2021	MAC
Angle Block	842	WC027023	1/22/2021	1/22/2023	MAC
Faro Arm	W25-S5-19-19790	WC067336	2/10/2021	2/10/2022	MAC
Laser Probe	LLPH62023039	WC075079	11/24/2020	11/24/2021	MAC

END OF REPORT