



30 September 2019

Optima Ballistic Glass Colombia S.A.
Zona Franca La Cayena Mz K Lote In 45 A.
Barranquilla, Colombia

Attention: Mr. Julio Rodriguez

Subject: Optima Ballistic Glass Colombia S.A., Armor Protection Ballistic Resistance Test:
Job No. 3350-014A, Tested 26 September 2019, Purchase Order No. Julio Rodriguez

Dear Mr. Rodriguez:

Please find enclosed a report documenting the subject test series conducted by NTS-Chesapeake Testing on 26 September 2019. This report includes a summary of the test as well as a detailed shot record for each armor sample tested.

If you have any questions related to this test, please call Mr. Craig Thomas at 410-297-8154 or contact him via e-mail at craig.thomas@nts.com.

Sincerely,

A handwritten signature in black ink, appearing to read "CS", written over a horizontal line.

Chris Schueler
General Manager, NTS-Chesapeake Testing

lmd

Enc. a/s

This report shall not be used to claim product certification, approval or endorsement. The results of the testing relate only to the samples submitted for testing. This test report shall not be interpreted as an endorsement by NTS-Chesapeake Testing as to the continued quality or performance of any items of the same or similar design.

The information contained in this report may be subject to the provisions of the Export Administration Act (50 USC 2401 et seq.), the Export Administration Regulations (15 CFR 768-799), or the U.S. Arms Export Control Act (22 USC 2778 et seq.) and the International Traffic in Arms Regulations (22 CFR 120-130). These statutes and regulations impose restrictions on import, export and transfer to foreign entities and persons, whether within the U.S. or abroad, of certain data and articles without approved licenses from the U.S. Department of State and/or the U.S. Department of Commerce.

NTS-Chesapeake Testing is an independent testing facility
and has no affiliation with Optima Ballistic Glass Class Colombia S.A.

OPTIMA BALLISTIC GLASS COLOMBIA S.A. PROPRIETARY INFORMATION

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

Prepared by:

Craig A. Thomas
Laura M. Deptol

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

30 September 2019

*Further dissemination only as directed by
Optima Ballistic Glass Colombia S.A., September 2019.*

This report shall not be used to claim product certification, approval or endorsement. The results of the testing relate only to the samples submitted for testing. This test report shall not be interpreted as an endorsement by NTS-Chesapeake Testing as to the continued quality or performance of any items of the same or similar design.

The information contained in this report is subject to the provisions of the Export Administration Act (50 USC 2401 et seq.), the Export Administration Regulations (15 CFR 768-799), or the U.S. Arms Export Control Act (22 USC 2778 et seq.) and the International Traffic in Arms Regulations (22 CFR 120-130). These statutes and regulations impose restrictions on import, export and transfer to foreign entities and persons, whether within the U.S. or abroad, of certain data and articles without approved licenses from the U.S. Department of State and/or the U.S. Department of Commerce.

NTS-Chesapeake Testing is an independent testing facility and
has no affiliation with Optima Ballistic Glass Colombia S.A.

1 of 6

1 Introduction

Optima Ballistic Glass Colombia S.A., provided three armor samples to NTS-Chesapeake Testing for ballistic resistance testing on 26 September 2019.

2 Threats and Instrumentation

2.1 Threats

- 5.56 x 45-mm, 55-grain M193 Ball 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 STANAG 4569 KE Level 1 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 (69 ± 1 °F).

For each shot, the target was clamped to a rigid test fixture. A piece of 0.508 mm thick (0.020 in) type 2024 T3 aluminum was mounted along the shotline, approximately 152 mm \pm 13 mm (6 in \pm 0.5 in) behind the inside surface of the strike face, 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 25.000 ft from the target. The projectile velocities used for the test were in accordance with the customer's request.

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 (in)	Weight (lbs)	Threat	Target Obliq. (deg)	Shot No.	Penetration Data	
							Velocity (ft/s)	Result
3350-014-1	6215-108	19.50 x 19.50	49.93	5.56 x 45-mm, 55-grain M193 Ball	0.0	1	3110	None
						2	3103	None
						3	3074	None
3350-014-2	6215-109	19.50 x 19.50	50.10	5.56 x 45-mm, 55-grain M193 Ball	0.0	1	3026	None
						2	3082	None
						3	3065	None
3350-014-3	6215-110	19.50 x 19.50	49.99	5.56 x 45-mm, 55-grain M193 Ball	0.0	1	3080	None
						2	3093	None
						3	3102	None

BALLISTIC RESISTANCE TEST

NTS-Chesapeake Testing

4603B Compass Point Road
Belcamp, MD 21017

Client: Optima Ballistic Glass Columbia S.A.
Job No.: 3350-014-1
Test Date: 9/26/2019

Test Panel Description: Transparent armor.

Manufacturer: Optima Ballistic Glass Columbia S.A. Sample No.: 6215-108

Size: 19.50 x 19.50 in
Avg. Thick: 1.586 in
Thickness: 1.586 in; 1.588 in;
1.586 in; 1.585 in

Weight: 49.93 lbs
Plies/Laminates: NA

Date Received: 9/19/2019
Via: FedEx
Returned: FedEx

Setup

Shot Spacing: STANAG 4569 KE Level 1
Witness Panel: 0.02 in 2024-T3 Al
Backing Material: NA
Condition: Ambient

Primary Vel. Screens (ft): 10.000, 10.333,
19.667, 20.000
Primary Vel. Location (ft): 15.000
Range to Target (ft): 25.000
Target to Witness (in): 6.000

Range No.: 5
Temp: 69.2 °F
BP: 29.6 inHg
RH: 45.0%
Barrel/Gun: NA
Gunner: Bret DeMond
Recorder: T. Contreras

Ammunition

Projectile	Lot No.	Powder
(1) 5.56 x 45-mm, 55-grain M193 Ball	Military	N 110

Applicable Standards or Procedures

- (1) STANAG 4569 KE Level 1
- (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)	Striking Vel. (ft/s)	Penetration	Obliq. (°)	Footnotes
1	1	55.0	3203	3122	2989	3123	3122	3110	None	0.0	
2	1	55.1	3207	3118	2998	3113	3116	3103	None	0.0	
3	1	55.0	3239	3087	3024	3086	3087	3074	None	0.0	

Remarks:

Requested velocity: 3009 to 3139 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.: 3350-014-2
Test Date: 9/26/2019

Test Panel Description: Transparent armor.

Manufacturer: Optima Ballistic Glass Columbia S.A. Sample No.: 6215-109

Size: 19.50 x 19.50 in Avg. Thick: 1.591 in Thickness: 1.593 in; 1.594 in; 1.589 in; 1.587 in	Weight: 50.10 lbs Plies/Laminates: NA	Date Received: 9/19/2019 Via: FedEx Returned: FedEx
--	--	---

Setup

Shot Spacing: STANAG 4569 KE Level 1 Witness Panel: 0.02 in 2024-T3 Al Backing Material: NA Condition: Ambient	Primary Vel. Screens (ft): 10.000, 10.333, 19.667, 20.000 Primary Vel. Location (ft): 15.000 Range to Target (ft): 25.000 Target to Witness (in): 6.000	Range No.: 5 Temp: 69.4 °F BP: 29.6 inHg RH: 46.5% Barrel/Gun: NA Gunner: Bret DeMond Recorder: T. Contreras
---	---	--

Ammunition

Projectile	Lot No.	Powder
(1) 5.56 x 45-mm, 55-grain M193 Ball	Military	N 110

Applicable Standards or Procedures

- (1) STANAG 4569 KE Level 1
- (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)	Striking Vel. (ft/s)	Penetration	Obliq. (°)	Footnotes
1	1	55.3	3291	3039	3073	3037	3038	3026	None	0.0	
2	1	55.0	3229	3097	3018	3093	3095	3082	None	0.0	
3	1	55.2	3249	3078	3034	3076	3077	3065	None	0.0	

Remarks:
Requested velocity: 3009 to 3139 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.: 3350-014-3
Test Date: 9/26/2019

Test Panel Description: Transparent armor.

Manufacturer: Optima Ballistic Glass Columbia S.A. **Sample No.:** 6215-110

Size: 19.50 x 19.50 in Avg. Thick: 1.590 in Thickness: 1.589 in; 1.590 in; 1.591 in; 1.591 in	Weight: 49.99 lbs Plies/Laminates: NA	Date Received: 9/19/2019 Via: FedEx Returned: FedEx
--	--	---

Setup

Shot Spacing: STANAG 4569 KE Level 1 Witness Panel: 0.02 in 2024-T3 Al Backing Material: NA Condition: Ambient	Primary Vel. Screens (ft): 10.000, 10.333, 19.667, 20.000 Primary Vel. Location (ft): 15.000 Range to Target (ft): 25.000 Target to Witness (in): 6.000	Range No.: 5 Temp: 69.4 °F BP: 29.6 inHg RH: 46.9% Barrel/Gun: NA Gunner: Bret DeMond Recorder: T. Contreras
---	---	--

Ammunition

Projectile	Lot No.	Powder
(1) 5.56 x 45-mm, 55-grain M193 Ball	Military	N 110

Applicable Standards or Procedures

- (1) STANAG 4569 KE Level 1
- (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)	Striking Vel. (ft/s)	Penetration	Obliq. (°)	Footnotes
1	1	55.1	3233	3093	3018	3093	3093	3080	None	0.0	
2	1	55.3	3220	3106	3005	3106	3106	3093	None	0.0	
3	1	55.2	3210	3115	2998	3113	3114	3102	None	0.0	

Remarks:
Requested velocity: 3009 to 3139 ft/s

Footnotes: