



www.chesapeaketesting.com

31 December 2013

TenCate Advanced Armor USA
1051 O'Neill Drive
Hebron, OH 43025

Attention: Ms. Kae Ecker

Subject: TenCate Advanced Armor USA, Armor Protection Ballistic Resistance Test:
Job No. 2029-259, Tested 10 December 2013, Purchase Order No. PO-001318, Test
Report No. CT-RD-13-1668

Dear Ms. Ecker:

Please find enclosed a report documenting the subject test series conducted by Chesapeake Testing on 10 December 2013. 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@chesapeaketesting.com.

Sincerely,

A handwritten signature in cursive script that reads "James A. Martin".

James A. Martin
VP Operations, Chesapeake Testing

jav

Enc. a/s
cc: Mr. Jason Woodall, TenCate Advanced Armor USA
Mr. Nate Paykel, TenCate Advanced Armor USA

Chesapeake Testing is an independent testing facility and has no affiliation with TenCate Advanced Armor USA.

TENCATE ADVANCED ARMOR USA PROPRIETARY INFORMATION

INTENTIONALLY LEFT BLANK



POC: Ms. Kae Ecker
POC Phone No.: 740-345-5574
Purchase Order No.: PO-001318
Report No.: CT-RD-13-1668

**TenCate Advanced Armor USA,
Armor Protection Ballistic Resistance Test:
Job No. 2029-259, Tested 10 December 2013**

Prepared by:

**Craig A. Thomas
Jennifer A. Vass**

Chesapeake Testing
*4603B Compass Point Road
Belcamp, MD 21017*

26 December 2013

*Further dissemination only as directed by
TenCate Advanced Armor USA, December 2013.*

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.

Chesapeake Testing is an independent testing facility and
has no affiliation with TenCate Advanced Armor USA.

TENCATE ADVANCED ARMOR USA PROPRIETARY INFORMATION

INTENTIONALLY LEFT BLANK

1 Introduction

TenCate Advanced Armor USA provided five armor panels to Chesapeake Testing for ballistic resistance testing on 10 December 2013. Prior to testing, the panels were dimensioned and weighed. The results are shown in Table 1.

Table 1. Physical Data for Armor Panels

Job No.	Sample No.	Armor Description	Length x Width (in)	Weight (lbs)	Avg. Thickness (in)
2029-259-1	D1706-01-03	Steel composite panel	12.00 x 12.00	8.85	0.246
2029-259-2	D1706-01-07	Steel composite panel	12.00 x 12.00	8.84	0.245
2029-259-3	D1706-01-04	Steel composite panel	12.00 x 12.00	8.88	0.247
2029-259-4	D1706-01-05	Steel composite panel	12.00 x 12.00	8.87	0.246
2029-259-5	D1706-01-06	Steel composite panel	12.00 x 12.00	8.83	0.245

2 Threats and Instrumentation

2.1 Threats

The threats used for this ballistic resistance test were:

- 5.56 x 45-mm, 55-grain M193 ball projectiles.
- 5.56 x 45-mm, 62-grain M855 ball projectiles.
- 7.62 x 39-mm, 123-grain PS ball projectiles.
- 7.62 x 54R-mm, 148-grain LPS projectiles.
- 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 Chesapeake Testing mount.

2.2 Instrumentation

Projectile velocity measurements were obtained using Oehler Research model No. 57 infrared screens with Hewlett-Packard (HP) counter chronographs (universal counters, HP model No. 53131A).

3 Details of Test

The objective of this test was to conduct a ballistic resistance test on the armor samples in accordance with NIJ-STD-0108.01 Level III and the customer's request. Shot spacing between multiple impacts on a single sample was in accordance with the referenced performance standard. Shots against the armor samples were performed at 0.0° obliquity and ambient range temperature (66 ±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 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 50.000 ft from the target. The projectile velocities used for the test were in accordance with the customer's request.

The threat projectiles were required to have no greater than 3° 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.

4 Summary of Results

The results of the ballistic resistance test are shown in Table 2. The round-by-round ballistic data sheets for all testing performed are provided on the following pages.

Table 2. Summary of Ballistic Resistance Test

Job No.	Sample No.	Threat	Target Obliq. (deg)	Shot No.	Penetration Data	
					Velocity (ft/s)	Result
2029-259-1	D1706-01-03	5.56 x 45-mm, 55-grain M193 ball	0.0	1	3205	None
				2	3194	None
				3	3167	None
				4	3223	None
				5	3246	None
2029-259-2	D1706-01-07	5.56 x 45-mm, 62-grain M855 ball	0.0	1	3041	None
				2	3053	None
				3	3007	None
				4	3014	None
				5	3121	None
2029-259-3	D1706-01-04	7.62 x 39-mm, 123-grain PS ball	0.0	1	2428	None
				2	2415	None
				3	2431	None
				4	2409	None
				5	2405	None
2029-259-4	D-1706-01-05	7.62 x 54R-mm, 148-grain LPS	0.0	1	2869	None
				2	2871	None
				3	2860	None
				4	2842	None
				5	2869	None
2029-259-5	D-1706-01-06	7.62 x 51-mm, 149-grain M80 FMJ	0.0	1	2731	None
				2	2787	None
				3	2767	None
				4	2781	None
				5	2712	None

BALLISTIC RESISTANCE TEST

Chesapeake Testing

4603B Compass Point Road
Belcamp, MD 21017

Client: TenCate Advanced Armor USA
Job No.: 2029-259-1
Test Date: 12/10/2013

Test Panel Description: Steel composite panel

Manufacturer: TenCate Advanced Armor USA

Sample No.: D1706-01-03

Size: 12.00 x 12.00 in
Thickness: 0.247 in; 0.246 in;
0.247 in; 0.246 in
Avg. Thick: 0.246 in

Heat No.: NA
Weight: 8.85 lbs
Hardness: NA
Plies/Laminates: NA

Date Received: 12/6/2013
Via: UPS
Returned: FedEx

Setup

Shot Spacing: NIJ-STD-0108.01 Level III
Witness Panel: 0.02 in 2024-T3 Al
Obliquity: 0.0°
Backing Material: NA
Condition: Ambient

Primary Vel. Screens (ft): 6.500, 6.833,
9.166, 9.500
Primary Vel. Location (ft): 8.000
Range to Target (ft): 50.000
Target to Witness (in): 6.000

Range No.: 6
Temp: 67.8 °F
BP: 29.8 inHg
RH: 34.9%
Barrel/Gun: CT-4014
Gunner: Joe Moore
Recorder: S. McDowell

Ammunition

Projectile	Lot No.	Powder
(1) 5.56 x 45-mm, 55-grain M193 ball	Military	N 120

Applicable Standards or Procedures

- (1) NIJ-STD-0108.01 Level III (modified)
- (2) Customer request

Shot No.	Ammo	Time 1 (µs)	Vel. 1 (ft/s)	Time 2 (µs)	Vel. 2 (ft/s)	Avg. Vel. (ft/s)	Penetration	Footnotes
1	1	937	3202	727	3209	3205	None	
2	1	940	3191	730	3196	3194	None	
3	1	948	3165	736	3170	3167	None	
4	1	932	3219	723	3227	3223	None	
5	1	925	3243	718	3249	3246	None	

Remarks:

Requested velocity: 3200 ±30 ft/s

Footnotes:

BALLISTIC RESISTANCE TEST

Chesapeake Testing

4603B Compass Point Road
Belcamp, MD 21017

Client: TenCate Advanced Armor USA
Job No.: 2029-259-2
Test Date: 12/10/2013

Test Panel Description: Steel composite panel

Manufacturer: TenCate Advanced Armor USA Sample No.: D1706-01-07

Size: 12.00 x 12.00 in	Heat No.: NA	Date Received: 12/6/2013
Thickness: 0.246 in; 0.245 in;	Weight: 8.84 lbs	Via: UPS
0.244 in; 0.245 in	Hardness: NA	Returned: FedEx
Avg. Thick: 0.245 in	Plies/Laminates: NA	

Setup

Shot Spacing: NIJ-STD-0108.01 Level III	Primary Vel. Screens (ft): 6.500, 6.833, 9.166, 9.500	Range No.: 6
Witness Panel: 0.02 in 2024-T3 Al	Primary Vel. Location (ft): 8.000	Temp: 67.6 °F
Obliquity: 0.0°	Range to Target (ft): 50.000	BP: 29.9 inHg
Backing Material: NA	Target to Witness (in): 6.000	RH: 34.9%
Condition: Ambient		Barrel/Gun: CT-4014
		Gunner: Joe Moore
		Recorder: S. McDowell

Ammunition

Projectile	Lot No.	Powder
(1) 5.56 x 45-mm, 62-grain M855 ball	Military	N 120

Applicable Standards or Procedures

- (1) NIJ-STD-0108.01 Level III (modified)
- (2) Customer request

Shot No.	Ammo	Time 1 (µs)	Vel. 1 (ft/s)	Time 2 (µs)	Vel. 2 (ft/s)	Avg. Vel. (ft/s)	Penetration	Footnotes
1	1	988	3036	766	3046	3041	None	
2	1	984	3049	763	3058	3053	None	
3	1	999	3003	775	3010	3007	None	
4	1	997	3009	773	3018	3014	None	
5	1	962	3119	747	3123	3121	None	

Remarks:
Requested velocity: 3050 ±30 ft/s

Footnotes:

BALLISTIC RESISTANCE TEST

Chesapeake Testing

4603B Compass Point Road
Belcamp, MD 21017

Client: TenCate Advanced Armor USA
Job No.: 2029-259-3
Test Date: 12/10/2013

Test Panel Description: Steel composite panel

Manufacturer: TenCate Advanced Armor USA

Sample No.: D1706-01-04

Size: 12.00 x 12.00 in
Thickness: 0.247 in; 0.247 in;
0.247 in; 0.247 in
Avg. Thick: 0.247 in

Heat No.: NA
Weight: 8.88 lbs
Hardness: NA
Plies/Laminates: NA

Date Received: 12/6/2013
Via: UPS
Returned: FedEx

Setup

Shot Spacing: NIJ-STD-0108.01 Level III
Witness Panel: 0.02 in 2024-T3 Al
Obliquity: 0.0°
Backing Material: NA
Condition: Ambient

Primary Vel. Screens (ft): 6.500, 6.833,
9.166, 9.500
Primary Vel. Location (ft): 8.000
Range to Target (ft): 50.000
Target to Witness (in): 6.000

Range No.: 6
Temp: 67.4 °F
BP: 29.9 inHg
RH: 34.9%
Barrel/Gun: CT-4052
Gunner: Joe Moore
Recorder: S. McDowell

Ammunition

Projectile	Lot No.	Powder
(1) 7.62 x 39-mm, 123-grain PS ball	Russian	IMR 4227

Applicable Standards or Procedures

- (1) NIJ-STD-0108.01 Level III (modified)
- (2) Customer request

Shot No.	Ammo	Time 1 (µs)	Vel. 1 (ft/s)	Time 2 (µs)	Vel. 2 (ft/s)	Avg. Vel. (ft/s)	Penetration	Footnotes
1	1	1237	2425	960	2430	2428	None	
2	1	1244	2412	965	2418	2415	None	
3	1	1236	2427	958	2435	2431	None	
4	1	1247	2406	967	2413	2409	None	
5	1	1249	2402	969	2408	2405	None	

Remarks:

Requested velocity: 2380 ±30 ft/s

Footnotes:

BALLISTIC RESISTANCE TEST

Chesapeake Testing

4603B Compass Point Road
Belcamp, MD 21017

Client: TenCate Advanced Armor USA

Job No.: 2029-259-4

Test Date: 12/10/2013

Test Panel Description: Steel composite panel

Manufacturer: TenCate Advanced Armor USA

Sample No.: D-1706-01-05

Size: 12.00 x 12.00 in
Thickness: 0.248 in; 0.247 in;
0.246 in; 0.245 in
Avg. Thick: 0.246 in

Heat No.: NA
Weight: 8.87 lbs
Hardness: NA
Plies/Laminates: NA

Date Received: 12/6/2013
Via: UPS
Returned: FedEx

Setup

Shot Spacing: NIJ-STD-0108.01 Level III
Witness Panel: 0.02 in 2024-T3 Al
Obliquity: 0.0°
Backing Material: NA
Condition: Ambient

Primary Vel. Screens (ft): 6.500, 6.833,
9.166, 9.500
Primary Vel. Location (ft): 8.000
Range to Target (ft): 50.000
Target to Witness (in): 6.000

Range No.: 6
Temp: 66.9 °F
BP: 29.9 inHg
RH: 34.9%
Barrel/Gun: CT-4060
Gunner: Joe Moore
Recorder: S. McDowell

Ammunition

Projectile	Lot No.	Powder
(1) 7.62 x 54R-mm, 148-grain LPS	Military	N133

Applicable Standards or Procedures

- (1) NIJ-STD-0108.01 Level III (modified)
- (2) Customer request

Shot No.	Ammo	Time 1 (µs)	Vel. 1 (ft/s)	Time 2 (µs)	Vel. 2 (ft/s)	Avg. Vel. (ft/s)	Penetration	Footnotes
1	1	1047	2865	812	2873	2869	None	
2	1	1046	2868	812	2873	2871	None	
3	1	1050	2857	815	2863	2860	None	
4	1	1057	2838	820	2845	2842	None	
5	1	1047	2865	812	2873	2869	None	

Remarks:

Requested velocity: 2840 ±30 ft/s

Footnotes:

BALLISTIC RESISTANCE TEST

Chesapeake Testing

4603B Compass Point Road
Belcamp, MD 21017

Client: TenCate Advanced Armor USA

Job No.: 2029-259-5

Test Date: 12/10/2013

Test Panel Description: Steel composite panel

Manufacturer: TenCate Advanced Armor USA

Sample No.: D-1706-01-06

Size: 12.00 x 12.00 in
Thickness: 0.245 in; 0.245 in;
0.245 in; 0.245 in
Avg. Thick: 0.245 in

Heat No.: NA
Weight: 8.83 lbs
Hardness: NA
Plies/Laminates: NA

Date Received: 12/6/2013
Via: UPS
Returned: FedEx

Setup

Shot Spacing: NIJ-STD-0108.01 Level III
Witness Panel: 0.02 in 2024-T3 Al
Obliquity: 0.0°
Backing Material: NA
Condition: Ambient

Primary Vel. Screens (ft): 6.500, 6.833,
9.166, 9.500
Primary Vel. Location (ft): 8.000
Range to Target (ft): 50.000
Target to Witness (in): 6.000

Range No.: 6
Temp: 66.5 °F
BP: 29.9 inHg
RH: 35.1%
Barrel/Gun: CT-4060
Gunner: Joe Moore
Recorder: S. McDowell

Ammunition

Projectile	Lot No.	Powder
(1) 7.62 x 51-mm, 149-grain M80 FMJ	Military	N133

Applicable Standards or Procedures

- (1) NIJ-STD-0108.01 Level III
- (2) Customer request

Shot No.	Ammo	Time 1 (µs)	Vel. 1 (ft/s)	Time 2 (µs)	Vel. 2 (ft/s)	Avg. Vel. (ft/s)	Penetration	Footnotes
1	1	1100	2727	853	2735	2731	None	
2	1	1078	2783	836	2791	2787	None	
3	1	1086	2762	842	2771	2767	None	
4	1	1080	2778	838	2784	2781	None	
5	1	1108	2708	859	2716	2712	None	

Remarks:

Requested velocity: 2750 ±50 ft/s

Footnotes: