

National Technical Systems Test Report for Ballistic Resistance Testing

Project No.: PH00005031 **Tested:** 17 January 2023 **PO No.:** PO23-00056

Prepared For

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Further dissemination only as directed by Hardwire, LLC, 2 February 2023.

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NTS-Belcamp is an independent testing facility and has no affiliation with Hardwire, LLC.

Revision History

Rev.	Description	Issue Date
0	Initial Release	27 January 2023
1	Correct number of samples used and change sample name per customer request	2 February 2023

TABLE OF CONTENTS

Page(s)

COVER PAGE..... 1
REVISION HISTORY.....2
TABLE OF CONTENTS.....3

SECTION 1 INTRODUCTION4
SECTION 2 THREATS AND INSTRUMENTATION..... 4
SECTION 3 DETAILS OF TEST (OBJECTIVE/STANDARDS/PROCEDURES)..... 4
SECTION 4 RESULTS..... 4
TABLE 1 SUMMARY OF OVERALL RESULTS..... 5
TEST RESULTS (DATA SHEETS).....6-10

ATTACHMENT A (CALIBRATION DATA).....11
END OF REPORT.....12

1 Introduction

Hardwire, LLC provided one armor sample to NTS-Belcamp for ballistic testing on 17 January 2023.

2 Threats and Instrumentation

2.1 Threats*

- 7.62 x 51-mm, 149-grain M80 full metal jacket (FMJ) projectiles
- 7.62 x 39-mm, 123-grain mild steel core (MSC) projectiles
- 5.56 x 45-mm, 62-grain M855 projectiles
- 5.56 x 45-mm, 55-grain M193 projectiles

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

*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.

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 presented in Attachment A.

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 (modified) and the customer's request. Shot spacing between multiple impacts against a single sample was in accordance with the referenced performance standard. Shots against the armor sample were performed at 0.0° obliquity and ambient range temperature (70±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 ±13 mm (6 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 50.000 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

Project No.	Sample No.	Size (mm)	Weight (lbs)	Threat	Target Obliq. (deg)	Shot No.	Penetration Data	
							Velocity (ft/s)	Result
PH00005031-1	Part number: 007-007-1100 Serial Number: SR23-016263 (M193)	18.00 x 20.00	23.940	5.56 x 45-mm, 55-grain M193	0.0	1	3198	None
						2	3173	None
						3	3183	None
						4	3168	None
						5	3168	None
						6	3183	None
PH00005031-2	Part number: 007-007-1100 Serial Number: SR23-016263 (M855)	18.00 x 20.00	23.940	5.56 x 45-mm, 62-grain M855	0.0	1	3015	None
						2	3030	None
						3	3043	None
						4	3020	None
						5	3043	None
PH00005031-3	Part number: 007-007-1100 Serial Number: SR23-016263 (MSC)	18.00 x 20.00	23.940	7.62 x 39-mm, 123-grain MSC	0.0	1	2420	None
						2	2412	None
						3	2402	None
						4	2415	None
						5	2412	None

Table 1. Summary of Ballistic Resistance Testing (continued)

Project No.	Sample No.	Size (mm)	Weight (lbs)	Threat	Target Obliq. (deg)	Shot No.	Penetration Data	
							Velocity (ft/s)	Result
PH00005031-4	Part number: 007-007-1100 Serial Number: SR23-016263 (M80)	18.00 x 20.00	23.940	7.62 x 51-mm, 149-grain M80 FMJ	0.0	1	2757	None
						2	2762	None
						3	2773	None
						4	2762	None
						5	2752	None
						6	2740	None
						7	2752	None
						8	2747	None

BALLISTIC RESISTANCE TEST

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

Client: Hardwire LLC
 Project No.: PH00005031-1
 Test Date: 01/17/2023
 Page 1 of 1

Test Panel Description: Emergency Response Shield.

Manufacturer: Hardwire, LLC

Sample No.:
 Part number: 007-007-1100
 Serial Number: SR23-016263
 (M193)

Size: 18.00 x 20.00 in
 Avg. Thickness: 0.225 in
 Thicknesses: 0.226 in, 0.226 in,
 0.224 in, 0.224 in

Weight: 23.940 lbs
 Plies/Laminates: N/A

Date Received: 01/17/2023
 Received Via: FEDEX Ground
 Returned Via: FEDEX Ground

Setup

Shot Spacing: NIJ-STD-0108.01
 (modified)
 Witness Panel: 0.02 in 2024-T3
 Aluminum
 Backing Material: N/A
 Condition: Ambient

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

Range No.: Range 5
 Temp: 70.7 °F
 BP: 29.9 inHg
 RH: 35 %
 Barrel/Gun: WC024524
 Gunner: Luke Brannock
 Recorder: Joseph Gerdes

Ammunition

Projectile	Lot No.	Manufacturer	Powder
(1) 5.56 x 45-mm, 55-grain M193	N/A	Military	

Applicable Standards or Procedures

- (1) NIJ-STD-0108.01 (Modified)
- (2) Customer Request

Shot No.	Ammo	Powder/ Seating	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	18.4	55.1	938	3198	938	3198	3198	None	0.0	
2	1	18.3	55.1	947	3168	944	3178	3173	None	0.0	
3	1	18.3	55.1	942	3185	943	3181	3183	None	0.0	
4	1	18.2	55.1	947	3168	947	3168	3168	None	0.0	
5	1	18.2	51.1	947	3168	947	3168	3168	None	0.0	
6	1	18.2	51.1	942	3185	943	3181	3183	None	0.0	(a)

Remarks:
 Required velocity: 3100-3200 ft/s.
 Projectile Yaw Check: 0° on all impacts.

Footnotes:
 (a) Shot impacted on the top left bolt.

BALLISTIC RESISTANCE TEST

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

Client: Hardwire LLC
 Project No.: PH00005031-2
 Test Date: 01/17/2023
 Page 1 of 1

Test Panel Description: Emergency Response Shield.

Manufacturer: Hardwire, LLC

Sample No.:
 Part number: 007-007-1100
 Serial Number: SR23-016263
 (M855)

Size: 18.00 x 20.00 in
 Avg. Thickness: 0.225 in
 Thicknesses: 0.226 in, 0.226 in,
 0.224 in, 0.224 in

Weight: 23.940 lbs
 Plies/Laminates: N/A

Date Received: 01/17/2023
 Received Via: FEDEX Ground
 Returned Via: FEDEX Ground

Setup

Shot Spacing: NIJ-STD-0108.01
 (modified)
 Witness Panel: 0.02 in 2024-T3
 Aluminum
 Backing Material: N/A
 Condition: Ambient

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

Range No.: Range 5
 Temp: 70.4 °F
 BP: 29.9 inHg
 RH: 34 %
 Barrel/Gun: WC024524
 Gunner: Luke Brannock
 Recorder: Joseph Gerdes

Ammunition

Projectile	Lot No.	Manufacturer	Powder
(1) 5.56 x 45-mm, 62-grain M855	NA	Military	N 110

Applicable Standards or Procedures

- (1) NIJ-STD-0108.01 (Modified)
- (2) Customer Request

Shot No.	Ammo	Powder/ Seating	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	18.0	62.2	995	3015	995	3015	3015	None	0.0	
2	1	18.1	62.3	990	3030	990	3030	3030	None	0.0	
3	1	18.1	62.3	986	3043	986	3043	3043	None	0.0	
4	1	18.1	62.3	995	3015	992	3024	3020	None	0.0	
5	1	18.1	62.3	986	3043	986	3043	3043	None	0.0	

Remarks:
 Required velocity: 3000-3100 ft/s.
 Projectile Yaw Check: 0° on all impacts.

Footnotes:
 N/A

BALLISTIC RESISTANCE TEST

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

Client: Hardwire LLC
 Project No.: PH00005031-3
 Test Date: 01/17/2023
 Page 1 of 1

Test Panel Description: Emergency Response Shield.

Manufacturer: Hardwire, LLC
Sample No.:
 Part number: 007-007-1100
 Serial Number: SR23-016263
 (MSC)

Size: 18.00 x 20.00 in
 Avg. Thickness: 0.225 in
 Thicknesses: 0.226 in, 0.226 in,
 0.224 in, 0.224 in

Weight: 23.940 lbs
 Plies/Laminates: N/A

Date Received: 01/17/2023
 Received Via: FEDEX Ground
 Returned Via: FEDEX Ground

Setup

Shot Spacing: NIJ-STD-0108.01
 (modified)
 Witness Panel: 0.02 in 2024-T3
 Aluminum
 Backing Material: N/A
 Condition: Ambient

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

Range No.: Range 5
 Temp: 70.0 °F
 BP: 29.9 inHg
 RH: 38 %
 Barrel/Gun: WC024524
 Gunner: Luke Brannock
 Recorder: Joseph Gerdes

Ammunition

Projectile	Lot No.	Manufacturer	Powder
(1) 7.62 x 39-mm, 123-grain MSC	76-75-31	Chinese	N 110

Applicable Standards or Procedures

- (1) NIJ-STD-0108.01 (Modified)
- (2) Customer Request

Shot No.	Ammo	Powder/ Seating	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	20.2	122.5	1242	2415	1237	2425	2420	None	0.0	
2	1	20.2	122.6	1246	2408	1242	2415	2412	None	0.0	
3	1	20.2	122.7	1251	2398	1247	2406	2402	None	0.0	
4	1	20.2	122.8	1242	2415	1242	2415	2415	None	0.0	
5	1	20.2	122.9	1246	2408	1242	2415	2412	None	0.0	

Remarks:
 Required velocity: 2350-2450 ft/s.
 Projectile Yaw Check: 0° on all impacts.

Footnotes:
 N/A

BALLISTIC RESISTANCE TEST

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

Client: Hardwire LLC
 Project No.: PH00005031-4
 Test Date: 01/17/2023
 Page 1 of 1

Test Panel Description: Emergency Response Shield.

Manufacturer: Hardwire, LLC

Sample No.:
 Part number: 007-007-1100
 Serial Number: SR23-016263
 (M80)

Size: 18.00 x 20.00 in
 Avg. Thickness: 0.225 in
 Thicknesses: 0.226 in, 0.226 in,
 0.224 in, 0.224 in

Weight: 23.940 lbs
 Plies/Laminates: N/A

Date Received: 01/17/2023
 Received Via: FEDEX Ground
 Returned Via: FEDEX Ground

Setup

Shot Spacing: NIJ-STD-0108.01
 (modified)
 Witness Panel: 0.02 in 2024-T3
 Aluminum
 Backing Material: N/A
 Condition: Ambient

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

Range No.: Range 5
 Temp: 70.4 °F
 BP: 29.8 inHg
 RH: 39 %
 Barrel/Gun: WC024524
 Gunner: Luke Brannock
 Recorder: Joseph Gerdes

Ammunition

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

Applicable Standards or Procedures

- (1) NIJ-STD-0108.01 (Modified)
- (2) Customer Request

Shot No.	Ammo	Powder/ Seating	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	41.0	148.0	1090	2752	1086	2762	2757	None	0.0	
2	1	41.0	148.1	1086	2762	1086	2762	2762	None	0.0	
3	1	41.0	148.1	1082	2773	1082	2773	2773	None	0.0	
4	1	40.9	148.2	1086	2762	1086	2762	2762	None	0.0	
5	1	40.9	148.3	1090	2752	1090	2752	2752	None	0.0	
6	1	40.9	148.3	1095	2740	1095	2740	2740	None	0.0	(a,c)
7	1	40.9	148.9	1090	2752	1090	2752	2752	None	0.0	(b,c)
8	1	40.9	149.8	1094	2742	1090	2752	2747	None	0.0	(b)

Remarks:
 Required velocity: 2700-2800 ft/s.
 Projectile Yaw Check: 0° on all impacts.

Footnotes:
 (a) Shot impacted on the bottom right bolt.
 (b) Shot impacted on the top right bolt.
 (c) Shot impacted just off intended bolt.

ATTACHMENT A CALIBRATION CHECKLIST

NCR = No Calibration Required.

Asset Number	Asset Type	Manufacturer	Model	Calibrated	Due
WC024524	Barrel (gun)	Bill Wiseman & Company	N/A	NCR	NCR
WC060370	Scale (Floor)	Sartorius	Combics	01/09/2023	01/09/2024
WC060415	Measurement Tools (Angle Gauge)	SPI	S501-201	10/15/2021	10/15/2023
WC060804	Range (shooting)	N/A	N/A	NCR	NCR
WC074990	Measurement Tools (Tape Measure)	Dewalt Industrial Tool	DWHT36107	08/18/2021	08/18/2023
WC075047	Monitor (Thermometer/Clock/Humidity)	Control Company	4040	10/28/2022	10/28/2023
WC075067	Measurement Tools (Tape Measure)	Starrett	530-100	11/11/2022	11/11/2024
WC075102	Gauge (Depth)	Starrett	3753A-6/150	12/14/2022	12/14/2023
WC075113	Sensor (Temperature/Humidity)	Omega Engineering	ZW-CM-BTH	03/18/2022	03/18/2023
WC075123	Meter (Thermometer)	Control Company	4378, 98768-49	03/09/2021	03/09/2023
WC078616	Measurement Tools (Tape Measure)	Craftsman	CMHT37525	06/25/2021	06/25/2023
WC079238	Gauge (Depth)	Starrett	3753A-6/150	10/27/2022	10/27/2023
WC079246	Scale (Digital)	RCBS	Charge Master 1500	11/29/2022	11/29/2023
WC079409	Meter (Chronograph)	YIS/Cowden Group, Inc	N/A	07/21/2022	07/21/2023
WC079410	Meter (Chronograph)	YIS/Cowden Group, Inc	Chrono-USB	07/21/2022	07/21/2023

END OF REPORT