

# National Technical Systems Test Report for Ballistic Resistance and Protection Ballistic Limit, V<sub>50</sub> BL(P) Testing

**Project No.:** PH00004433 **Tested:** 7 December 2022 **PO No.:** Wire

**Prepared For**

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Further dissemination only as directed by Ballistic Protection S.L., 13 December 2022.

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NTS-Belcamp is an independent testing facility and has no affiliation with Ballistic Protection S.L.

### Revision History

Rev.	Description	Issue Date
0	Initial Release	13 December 2022

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## 1 Introduction

Ballistic Protection S.L. provided five armor samples to NTS-Belcamp for ballistic testing on 7 December 2022. This is a three-part report, Section 2 is the ballistic resistance test report and Section 3 is the ballistic limit testing,  $V_{50}$  BL(P) test report.

## 2 Ballistic Resistance Testing

Four samples were used for ballistic resistance testing.

### 2.1 Threats and Instrumentation

#### 2.1.1 Threats\*

- .357 SIG, 125-grain full metal jacket flat nose (FMJ FN) projectiles
- .44-mag, 240-grain semi jacketed hollow point (SJHP) 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.

#### 2.1.2 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.

### 2.2 Details of Test

The objective of this test was to conduct a ballistic resistance test on the armor sample in accordance with NIJ-STD-0101.06 Level IIIA (Modified), NIJ-STD-0106.01 (Modified) and the customer's request. Shot spacing between multiple impacts against a single sample was in accordance with NIJ-STD-0106.01. Shots against the armor sample were performed at 0.0° obliquity and ambient range temperature (18.6 °C).

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 76 mm ±13 mm (3 in ±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 4.999 m from the target. The projectile velocities used for the test were in accordance with the referenced performance standard.

### 2.3 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	Weight (kg)	Threat	Target Obliq. (deg)	Shot No.	Penetration Data	
							Velocity (m/s)	Result
PH00004433-1	Helmet #1	Large	1.320	.357 SIG, 125-grain FMJ FN	0.0	1	448.67	None
						2	449.88	None
						3	448.06	None
						4	446.23	None
PH00004433-2	Helmet #2	Large	1.340	.357 SIG, 125-grain FMJ FN	0.0	1	446.84	None
						2	447.75	None
						3	450.49	None
						4	449.28	None
PH00004433-3	Helmet #3	Large	1.320	.44-mag, 240-grain SJHP	0.0	1	439.83	None
						2	441.05	None
						3	438.61	None
						4	438.3	None
PH00004433-4	Helmet #4	Large	1.320	.44-mag, 240-grain SJHP	0.0	1	440.44	None
						2	439.22	None
						3	439.83	None
						4	441.96	None

# BALLISTIC RESISTANCE TEST

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

Client: Ballistic Protection S.L.  
 Project No.: PH00004433-1  
 Test Date: 12/07/2022  
 Page 1 of 1

**Test Panel** | Description: Ballistic Helmet with retention system and pads

Manufacturer: Ballistic Protection S.L. | Sample No.: (9-mm, V0) Helmet #1

Size: Large  
 Avg. Thickness: 8.477 mm  
 Thicknesses: 9.322 mm, 8.661 mm, 7.823 mm, 8.103 mm

Weight: 1.320 kg  
 Plies/Laminates: N/A

Date Received: 11/21/2022  
 Received Via: DHL  
 Returned Via: DHL

## Setup

Shot Spacing: NIJ-STD-0106.01  
 Witness Panel: 0.02 in 2024-T3 Aluminum  
 Backing Material: N/A  
 Condition: Ambient

Primary Vel. Screens (m): 1.980, 2.900  
 Primary Vel. Location (m): 2.440  
 Range to Target (m): 4.999  
 Target to Witness (mm): 76.200

Range No.: Range 1  
 Temp: 18.6 °C  
 BP: 30.1 inHg  
 RH: 59.1 %  
 Barrel/Gun: CT-3011  
 Gunner: Justin Long  
 Recorder: James Eveland

## Ammunition

Projectile	Lot No.	Manufacturer	Powder
(1) .357 SIG, 125-grain FMJ FN	M30W	Speer	Accurate No. 2

## Applicable Standards or Procedures

- (1) NIJ-STD-0101.06 Level IIIA (Modified)
- (2) NIJ-STD-0106.01 (Modified)
- (3) Customer Request

Shot No.	Ammo	Powder/Seating	Weight (gr)	Time 1 (µs)	Vel. 1 (m/s)	Time 2 (µs)	Vel. 2 (m/s)	Avg. Vel. (m/s)	Penetration	Obliq. (°)	Footnotes
1	1	7.0	125.0	2035	449.3	2040	448.4	448.67	None	0.0	(a)
2	1	7.0	125.0	2030	450.5	2035	449.3	449.88	None	0.0	(b)
3	1	7.0	125.0	2040	448.4	2043	447.4	448.06	None	0.0	(c)
4	1	7.0	125.0	2047	446.8	2052	445.6	446.23	None	0.0	(d)

Remarks:  
 Required Velocity: 448 ± 9 m/s.  
 Projectile yaw check: 0° yaw on all impacts.

Footnotes:  
 (a) Front  
 (b) Back  
 (c) Right  
 (d) Left

# BALLISTIC RESISTANCE TEST

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

Client: Ballistic Protection S.L.  
 Project No.: PH00004433-2  
 Test Date: 12/07/2022  
 Page 1 of 1

**Test Panel** Description: Ballistic Helmet with retention system and pads

**Manufacturer:** Ballistic Protection S.L

**Sample No.:** (9-mm, V0, Wet) Helmet #2

Size: Large  
 Avg. Thickness: 8.547 mm  
 Thicknesses: 9.169 mm, 8.915 mm, 7.849 mm, 8.255 mm

Weight: 1.340 kg  
 Plies/Laminates: N/A

Date Received: 11/21/2022  
 Received Via: DHL  
 Returned Via: DHL

## Setup

Shot Spacing: NIJ-STD-0106.01  
 Witness Panel: 0.02 in 2024-T3 Aluminum  
 Backing Material: N/A  
 Condition: Wet per NIJ-STD-0106.01

Primary Vel. Screens (m): 1.980, 2.900  
 Primary Vel. Location (m): 2.440  
 Range to Target (m): 4.999  
 Target to Witness (mm): 76.200

Range No.: Range 1  
 Temp: 18.6 °C  
 BP: 30.1 inHg  
 RH: 58.3 %  
 Barrel/Gun: CT-3011  
 Gunner: Justin Long  
 Recorder: James Eveland

## Ammunition

Projectile	Lot No.	Manufacturer	Powder
(1) .357 SIG, 125-grain FMJ FN	M30W	Speer	Accurate No. 2

## Applicable Standards or Procedures

- (1) NIJ-STD-0101.06 Level IIIA (Modified)
- (2) NIJ-STD-0106.01 (Modified)
- (3) Customer Request

Shot No.	Ammo	Powder/ Seating	Weight (gr)	Time 1 (µs)	Vel. 1 (m/s)	Time 2 (µs)	Vel. 2 (m/s)	Avg. Vel. (m/s)	Penetration	Obliq. (°)	Footnotes
1	1	7.0	125.0	2045	447.1	2047	446.8	446.84	None	0.0	(a)
2	1	7.0	125.0	2040	448.4	2045	447.1	447.75	None	0.0	(b)
3	1	7.0	125.0	2028	450.8	2032	449.9	450.49	None	0.0	(c)
4	1	7.0	125.0	2033	449.9	2037	449.0	449.28	None	0.0	(d)

Remarks:  
 Required Velocity: 448 ± 9 m/s.  
 Projectile yaw check: 0° yaw on all impacts.

Footnotes:  
 (a) Front  
 (b) Back  
 (c) Right  
 (d) Left

# BALLISTIC RESISTANCE TEST

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

Client: Ballistic Protection S.L.  
 Project No.: PH00004433-3  
 Test Date: 12/07/2022  
 Page 1 of 1

**Test Panel** Description: Ballistic Helmet with retention system and pads

**Manufacturer:** Ballistic Protection S.L

**Sample No.:** (.44-mag, V0) Helmet #3

Size: Large  
 Avg. Thickness: 8.477 mm  
 Thicknesses: 9.144 mm, 8.890 mm, 8.103 mm, 7.772 mm

Weight: 1.320 kg  
 Plies/Laminates: N/A

Date Received: 11/21/2022  
 Received Via: DHL  
 Returned Via: DHL

## Setup

Shot Spacing: NIJ-STD-0106.01  
 Witness Panel: 0.02 in 2024-T3 Aluminum  
 Backing Material: N/A  
 Condition: Ambient

Primary Vel. Screens (m): 1.980, 2.900  
 Primary Vel. Location (m): 2.440  
 Range to Target (m): 4.999  
 Target to Witness (mm): 76.200

Range No.: Range 1  
 Temp: 18.6 °C  
 BP: 30.1 inHg  
 RH: 56.2 %  
 Barrel/Gun: CDS-191  
 Gunner: Justin Long  
 Recorder: James Eveland

## Ammunition

Projectile	Lot No.	Manufacturer	Powder
(1) .44-mag, 240-grain SJHP	4453	Speer	Accurate No. 5

## Applicable Standards or Procedures

- (1) NIJ-STD-0101.06 Level IIIA (Modified)
- (2) NIJ-STD-0106.01 (Modified)
- (3) Customer Request

Shot No.	Ammo	Powder/Seating	Weight (gr)	Time 1 (µs)	Vel. 1 (m/s)	Time 2 (µs)	Vel. 2 (m/s)	Avg. Vel. (m/s)	Penetration	Obliq. (°)	Footnotes
1	1	15.0	240.0	2077	440.1	2082	439.2	439.83	None	0.0	
2	1	15.0	240.0	2072	441.4	2074	440.7	441.05	None	0.0	
3	1	15.0	240.0	2082	439.2	2087	438.0	438.61	None	0.0	
4	1	15.0	240.0	2084	438.9	2089	437.7	438.3	None	0.0	

Remarks:

Required Velocity: 435 ± 9 m/s.  
 Projectile yaw check: 0° yaw on all impacts.

Footnotes:

- (a) Front
- (b) Back
- (c) Right
- (d) Left



# BALLISTIC RESISTANCE TEST

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

Client: Ballistic Protection S.L.  
Project No.: PH00004433-4  
Test Date: 12/07/2022  
Page 1 of 1

**Test Panel** Description: Ballistic Helmet with retention system and pads

**Manufacturer:** Ballistic Protection S.L

**Sample No.:** (.44-mag, V0, Wet) Helmet #4

Size: Large  
Avg. Thickness: 8.420 mm  
Thicknesses: 9.093 mm, 8.636 mm, 8.001 mm, 7.950 mm

Weight: 1.320 kg  
Plies/Laminates: N/A

Date Received: 11/21/2022  
Received Via: DHL  
Returned Via: DHL

## Setup

Shot Spacing: NIJ-STD-0106.01  
Witness Panel: 0.02 in 2024-T3 Aluminum  
Backing Material: N/A  
Condition: Wet per NIJ-STD-0106.01

Primary Vel. Screens (m): 1.980, 2.900  
Primary Vel. Location (m): 2.440  
Range to Target (m): 4.999  
Target to Witness (mm): 76.200

Range No.: Range 1  
Temp: 18.6 °C  
BP: 30.1 inHg  
RH: 56.3 %  
Barrel/Gun: CDS-191  
Gunner: Justin Long  
Recorder: James Eveland

## Ammunition

Projectile	Lot No.	Manufacturer	Powder
(1) .44-mag, 240-grain SJHP	4453	Speer	Accurate No. 5

## Applicable Standards or Procedures

- (1) NIJ-STD-0101.06 Level IIIA (Modified)
- (2) NIJ-STD-0106.01 (Modified)
- (3) Customer Request

Shot No.	Ammo	Powder/Seating	Weight (gr)	Time 1 (µs)	Vel. 1 (m/s)	Time 2 (µs)	Vel. 2 (m/s)	Avg. Vel. (m/s)	Penetration	Obliq. (°)	Footnotes
1	1	15.0	240.0	2074	440.7	2079	439.8	440.44	None	0.0	(a)
2	1	15.0	240.0	2079	439.8	2084	438.9	439.22	None	0.0	(b)
3	1	15.0	240.0	2076	440.4	2081	439.5	439.83	None	0.0	(c)
4	1	15.0	240.0	2067	442.3	2072	441.4	441.96	None	0.0	(d)

### Remarks:

Required Velocity: 435 ± 9 m/s.  
Projectile yaw check: 0° yaw on all impacts.

### Footnotes:

- (a) Front
- (b) Back
- (c) Right
- (d) Left

### **3 Protection Ballistic Limit Test, V<sub>50</sub> BL(P)**

One sample was used for ballistic limit, V<sub>50</sub> BL(P) testing.

#### ***3.1 Threats and Instrumentation***

##### ***3.1.1 Threats\****

- .22-cal., 17-grain fragment simulating projectiles (FSP)

\*The 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 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.

##### ***3.1.2 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.

#### ***3.2 Details of Test***

The objective of this test was to conduct a ballistic limit, V<sub>50</sub> performance test on the sample in accordance with MIL-STD-662F (dated 18 December 1997) and the customer's request. Shot spacing between multiple impacts against a single sample was in accordance with the customer's request. Shots against the armor sample were performed at 0.0° obliquity and ambient range temperature (18.7 °C).

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 76 mm ±13 mm (3 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 4.572 m from the target. The projectile velocities used for the test were in accordance with the referenced performance standard. Velocities for subsequent shots were based on the result of the previous shot.

#### ***3.3 Summary of Results***

The results of the V<sub>50</sub> ballistic limit testing are summarized in Table 2. The round-by-round data sheets and scatter plots for all testing performed are provided on the following pages.

The following is a list of abbreviations used in the test data sheets:

- C = Complete penetration (same as CP).
- Gap = For  $V_{50}$  data, the difference in velocities between the highest partial penetration and the lowest complete penetration when the complete penetration occurs at a higher velocity than the partial penetration.
- HP = For  $V_{50}$  data, the highest velocity at which a partial penetration occurred.
- LC = For  $V_{50}$  data, the lowest velocity at which a complete penetration occurred.
- P = Partial penetration (same as PP).
- ROR = Range of results; for  $V_{50}$  data, difference between the highest and lowest velocities.
- $V_{50}$  = Statistical velocity at which the threat defeats the armor 50% of the time.
- RMR = Range of mixed results; for  $V_{50}$  data, the difference in velocities between the highest partial penetration and the lowest complete penetration when the partial penetration occurs at a higher velocity than the complete penetration.
- Yes = Round was used in calculating a  $V_{50}$  or an approximate  $V_{50}$ .
- No = Round was not used in calculating a  $V_{50}$  or an approximate  $V_{50}$ .



Table 2. Summary of V<sub>50</sub> Ballistic Limit Test Results

Project No.	Sample No.	Weight (kg)	Size	Threat	Target Obliq. (deg)	Ballistic Limit Data				
						V <sub>50</sub> (m/s)	No. of Points	RMR (m/s)	GAP (m/s)	ROR (m/s)
PH00004433-A	Helmet #5	1.220	Large	.22-cal., 17-grain FSP	0.0	677.3	6	28.96	NA	37.19

BALLISTIC PROTECTION S.L. PROPRIETARY INFORMATION

# PROTECTION BALLISTIC LIMIT TEST, V<sub>50</sub> BL(P)

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

Client: Ballistic Protection S.L.  
Project No.: PH00004433-A  
Test Date: 12/07/2022  
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**Test Panel** | Description: Ballistic Helmet Shell.

**Manufacturer:** Ballistic Protection S.L

**Sample No.:** (17gr, V50) Helmet #5

Size: Large  
Avg. Thickness: 8.579 mm  
Thicknesses: 8.839 mm, 8.611 mm, 8.788 mm, 8.077 mm

Weight: 1.220 kg  
Plies/Laminates: N/A  
Required BL(P): N/A

Date Received: 11/21/2022  
Received Via: DHL  
Returned Via: DHL

## Setup

Shot Spacing: MIL-STD-662F  
Witness Panel: 0.02 in 2024-T3 Aluminum  
Backing Material: N/A  
Condition: Ambient

Primary Vel. Screens (m): 1.520, 1.630, 2.950, 3.050  
Primary Vel. Location (m): 2.288  
Range to Target (m): 4.572  
Target to Witness (mm): 76.200

Range No.: Range 1  
Temp: 18.7 °C  
BP: 30.1 inHg  
RH: 58.3 %  
Barrel/Gun: WC001125  
Gunner: Justin Long  
Recorder: James Eveland

## Ammunition

Projectile	Lot No.	Manufacturer	Powder
(1) .22-cal., 17-grain FSP	17090821	Contra Threat Sciences	Bullseye

## Applicable Standards or Procedures

- (1) MIL-STD-662F
- (2) Customer Request

Shot No.	Ammo	Powder/ Seating	Weight (gr)	Time 1 (µs)	Vel. 1 (m/s)	Time 2 (µs)	Vel.2 (m/s)	Avg. Vel. (m/s)	Striking Vel. (m/s)	Result	Include in V <sub>50</sub>	Obliq. (°)	Footnotes
1	1	8.8	17.0	2196	694.0	1901	694.6	694.3	664.8	C	Yes	0.0	(a)
2	1	8.0	17.0	2291	665.1	1984	665.7	665.4	637.0	P	No	0.0	(b)
3	1	8.6	17.0	2216	687.6	1918	688.5	688.2	658.7	P	Yes	0.0	(c)
4	1	9.2	17.0	2106	723.6	1820	725.7	724.5	693.7	P	Yes	0.0	(d)
5	1	9.6	17.0	2098	726.3	1816	727.3	726.9	695.9	C	Yes	0.0	(e)
6	1	9.2	17.0	2152	708.1	1864	708.7	708.4	678.2	C	Yes	0.0	(a)
7	1	8.8	17.0	2172	701.6	1879	702.9	702.3	672.1	P	Yes	0.0	

Remarks:  
Projectile yaw check: 0° yaw on all impacts.

- Footnotes:
- (a) Crown
  - (b) Front
  - (c) Left
  - (d) Back
  - (e) Right

**V<sub>50</sub> Summary:**  
No. of Points: 3 and 3  
V<sub>50</sub>: 677.3 m/s  
High Partial: 693.7 m/s  
Low Complete: 664.8 m/s  
Range of Results (ROR): 37.19 m/s  
Range of Mix Results (RMR): 28.96 m/s  
Gap: N/A

# PROTECTION BALLISTIC LIMIT TEST, V<sub>50</sub> BL(P)

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

Client: Ballistic Protection S.L.  
 Job No.: PH00004433-A  
 Test Date: 12/07/2022  
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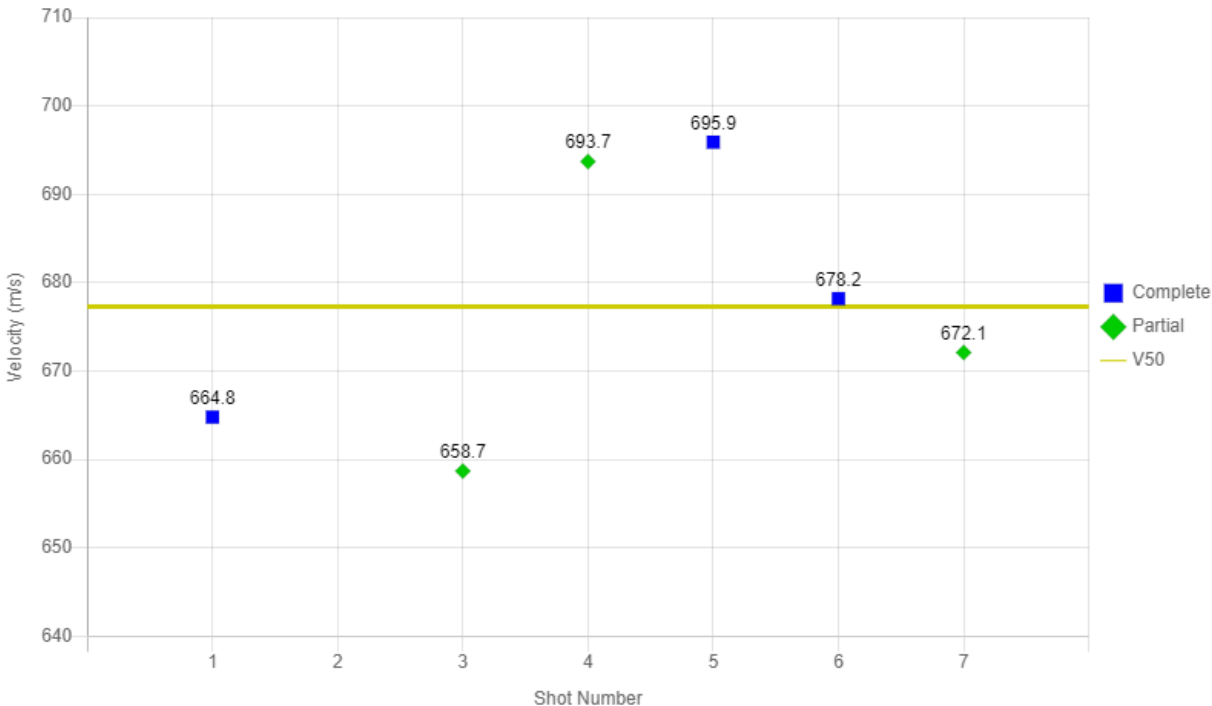
**Manufacturer:** Ballistic Protection S.L

**Sample No.:** (17gr, V50) Helmet #5

**V<sub>50</sub> Summary:**

No. of Points: 3 and 3  
 V<sub>50</sub>: 677.3 m/s  
 High Partial: 693.7 m/s  
 Low Complete: 664.8 m/s  
 Range of Results (ROR): 37.19 m/s  
 Range of Mix Results (RMR): 28.96 m/s  
 Gap: N/A

**Velocity vs. Shot Number**



## ATTACHMENT A CALIBRATION DATA

**NCR = No Calibration Required.**

Asset Number	Asset Type	Manufacturer	Model	Calibrated	Due
WC060418	Barrel (gun)	Bill Wiseman & Company	N/A	NCR	NCR
WC060800	Range (shooting)	YIS/Cowden Group, Inc	N/A	NCR	NCR
WC027146	Chronograph 1	YIS/Cowden Group, Inc	Chrono USB	8/26/2022	8/26/2023
WC067022	Chronograph 2	RCBS	Chrono USB	8/26/2022	8/26/2023
WC075083	Powder Scale	Torbil Scales	1500	12/20/2021	12/20/2022
WC079302	Floor scale	Control Company	BA153C	8/29/2022	2/28/2023
WC067386	Therm. Clock. Humidity Monitor	Starrett	4040	7/26/2022	7/26/2023
WC027077	100 ft Tape Measure	Craftsman	530-100	4/26/2022	4/26/2024
WC078615	25 ft Tape Measure	Craftsman	CMHT37525	6/25/2021	6/25/2023
EL00003997	25 ft Tape Measure	Control Company	CMHT37525	11/11/2022	11/11/2024
WC067353	Thermometer	Starrett	4378	6/23/2022	6/23/2023
WC075057	BFD Tool	Starrett	3753A-6/150	11/15/2022	11/15/2023
WC079397	BFD Bridge	Omega Engineering	3753A-6/150	7/29/2022	7/29/2023
WC075115	Temp/ Humidity/BP Sensor	SPI	ZW-CM-BTH	3/18/2022	3/18/2023
WC027023	Angle Block	YIS/Cowden Group, Inc	91-316-0	1/22/2021	1/22/2023

**END OF REPORT**