

National Technical Systems Test Report for Ballistic Resistance Testing

Project No.: OH000004635 **Tested:** 13 September 2022 **Purchase Order No.:** Signed quote

Prepared For

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

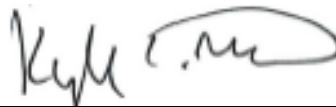
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Further dissemination only as directed by Optima Ballistic Glass Colombia S.A.S, 30 September 2022.

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

Revision History

Rev.	Description	Issue Date
0	Initial Release	30 September 2022

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1 Introduction

Optima Ballistic Glass Colombia S.A.S provided two armor samples to NTS-Chesapeake Testing for ballistic testing on 13 September 2022.

2 Threats and Instrumentation

2.1 Threats*

- 5.56 x 45-mm, 55-grain M193 projectiles
- 7.62 x 39-mm, 123-grain full metal jacketed lead core (FMJLC) CJ projectiles

*All projectiles were fired from a universal receiver which was fitted with the appropriate barrel and mounted on an 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. The Calibration checklist is presented in Attachment A. A digital still camera was used to document the test. Photographs are presented in Attachment B.

3 Details of Test

The objective of this test was to conduct a ballistic resistance test on the armor samples in accordance with the customer's request. Shot spacing between multiple impacts on a single sample was in accordance with the customer's request. Shots against the armor samples were performed at 0° obliquity and ambient range temperature (64.2 °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 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 velocity for each armor sample was in accordance with the customer's request.

4 Summary of Results

The results of the ballistic resistance test are summarized in Table 1. The detailed ballistic data sheets for all testing performed are provided on the following pages.

Table 1. Summary of Ballistic Resistance Results

Project No.	Sample No.	Size (in)	Weight (lbs)	Threat	Target Obliq. (deg)	Shot No.	Penetration Data	
							Velocity (ft/s)	Result
OH000004635-1	13892-149	19.75 x 19.75	28.280	5.56 x 45-mm, 55-grain M193	0	1	3102	None
						2	3126	None
						3	3139	None
						4	3111	None
OH000004635-2	13892-150	19.75 x 19.75	28.300	7.62 x 39-mm, 123-grain FMJLC CJ	0	1	2345	None
						2	2334	None
						3	2330	None
						4	2323	None
						5	2345	None

BALLISTIC RESISTANCE TEST

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

Client: Optima Ballistic Glass Colombia S.A.S.
 Project No.: OH000004635-1
 Test Date: 09/13/2022
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Test Panel | Description: Transparent armor.

Manufacturer: Optima Ballistic Glass Colombia S.A. | **Sample No.:** (M193, V0) 13892-149

Size: 19.75 x 19.75 in Avg. Thickness: 0.955 in Thicknesses: 0.955 in, 0.954 in, 0.954 in, 0.955 in	Weight: 28.280 lbs Plies/Laminates: N/A	Date Received: 09/12/2022 Received Via: N/A Returned Via: N/A
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Setup

Shot Spacing: Customer request Witness Panel: 0.02 in 2024-T3 Al Backing Material: N/A Condition: Ambient	Primary Vel. Screens (ft): 10.000, 10.333, 19.666, 20.000 Primary Vel. Location (ft): 15.000 Range to Target (ft): 25.000 Target to Witness (in): 6.000	Range No.: Range 6 Temp: 64.2 °F BP: 30.1 inHg RH: 49.4 % Barrel/Gun: WC078572 Gunner: Cody Schilling Recorder: William Ellis
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Ammunition

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

Applicable Standards or Procedures

(1) 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)	Striking Vel. (ft/s)	Penetration	Obliq. (°)	Footnotes
1	1	18.0	55	3212	3113	2995	3116	3115	3102	None	0	
2	1	18.0	55	3186	3139	2973	3139	3139	3126	None	0	
3	1	18.0	55	3173	3152	2960	3153	3152	3139	None	0	
4	1	18.0	55	3203	3122	2986	3126	3124	3111	None	0	

Remarks:
 Required Velocity: 3084-3150 ft/s
 Projectile yaw check: 0° yaw on all shots.

Footnotes:
 N/A

BALLISTIC RESISTANCE TEST

NTS-Chesapeake Testing

4603B Compass Point Road
Belcamp, MD 21017

Client: Optima Ballistic Glass Colombia S.A.S.

Project No.: OH000004635-2

Test Date: 09/13/2022

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Test Panel Description: Transparent armor.

Manufacturer: Optima Ballistic Glass Colombia S.A.

Sample No.: (7.62x39mm FMJ LC, V0) 13892-150

Size: 19.75 x 19.75 in
Avg. Thickness: 0.954 in
Thicknesses: 0.951 in, 0.955 in,
0.955 in, 0.953 in

Weight: 28.300 lbs
Plies/Laminates: N/A

Date Received: 09/12/2022
Received Via: N/A
Returned Via: N/A

Setup

Shot Spacing: Customer request
Witness Panel: 0.02 in 2024-T3 Al
Backing Material: N/A
Condition: Ambient

Primary Vel. Screens (ft): 10.000, 10.333,
19.666, 20.000
Primary Vel. Location (ft): 15.000
Range to Target (ft): 25.000
Target to Witness (in): 6.000

Range No.: Range 6
Temp: 64.2 °F
BP: 30.1 inHg
RH: 49.4 %
Barrel/Gun: WC067279
Gunner: Cody Schilling
Recorder: William Ellis

Ammunition

Projectile	Lot No.	Manufacturer	Powder
(1) 7.62 x 39-mm, 123-grain FMJ LC CJ	NA	Winchester	N 120

Applicable Standards or Procedures

(1) 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)	Striking Vel. (ft/s)	Penetration	Obliq. (°)	Footnotes
1	1	19.8	123.2	4245	2356	3963	2355	2355	2345	None	0	
2	1	19.8	123.2	4267	2344	3980	2345	2344	2334	None	0	
3	1	19.8	123.3	4271	2341	3989	2340	2341	2330	None	0	
4	1	19.8	123.3	4284	2334	4002	2332	2333	2323	None	0	
5	1	19.8	123.3	4245	2356	3963	2355	2355	2345	None	0	

Remarks:

Required Velocity: 2297-2363 ft/s
Projectile yaw check: 0° yaw on all shots.

Footnotes:

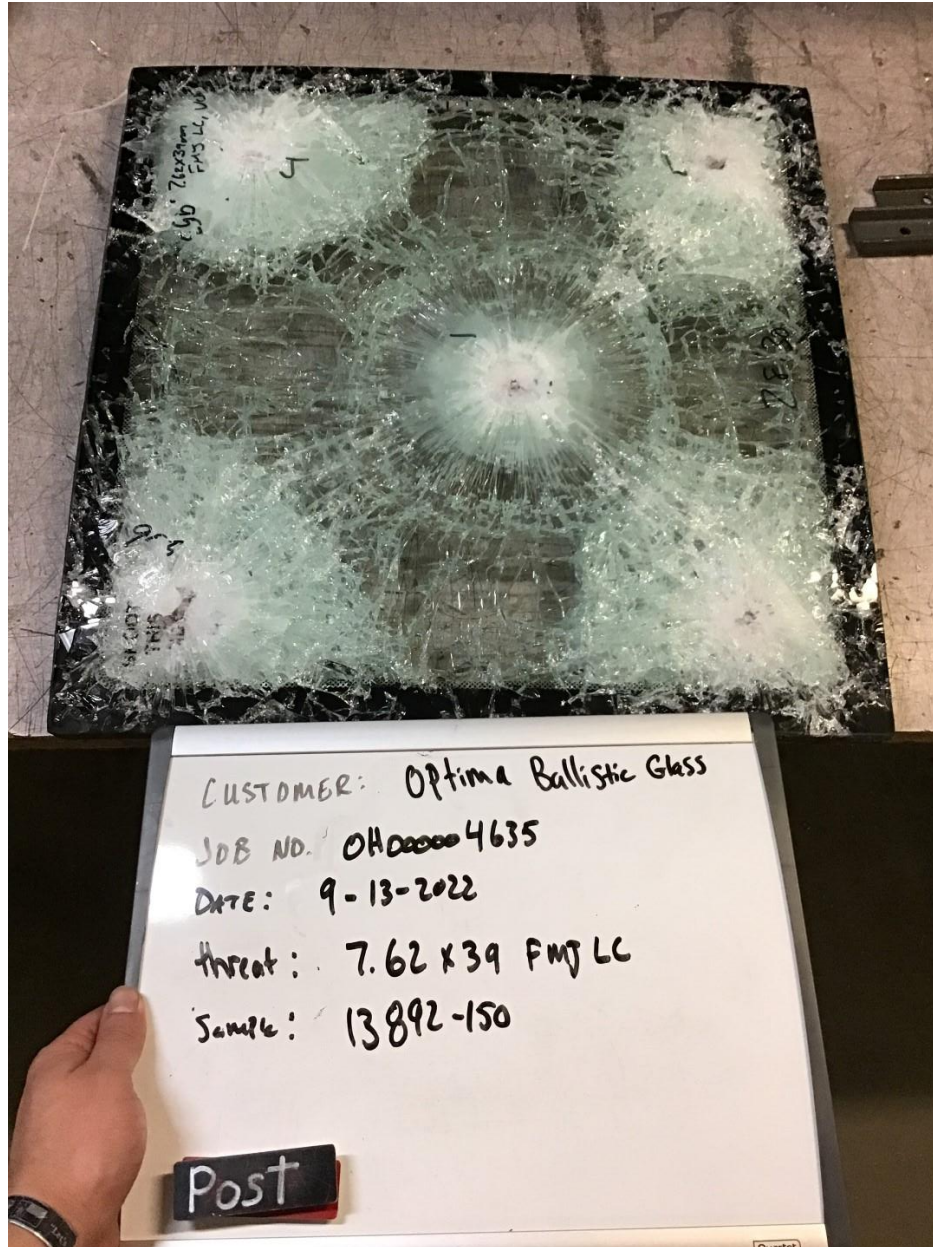
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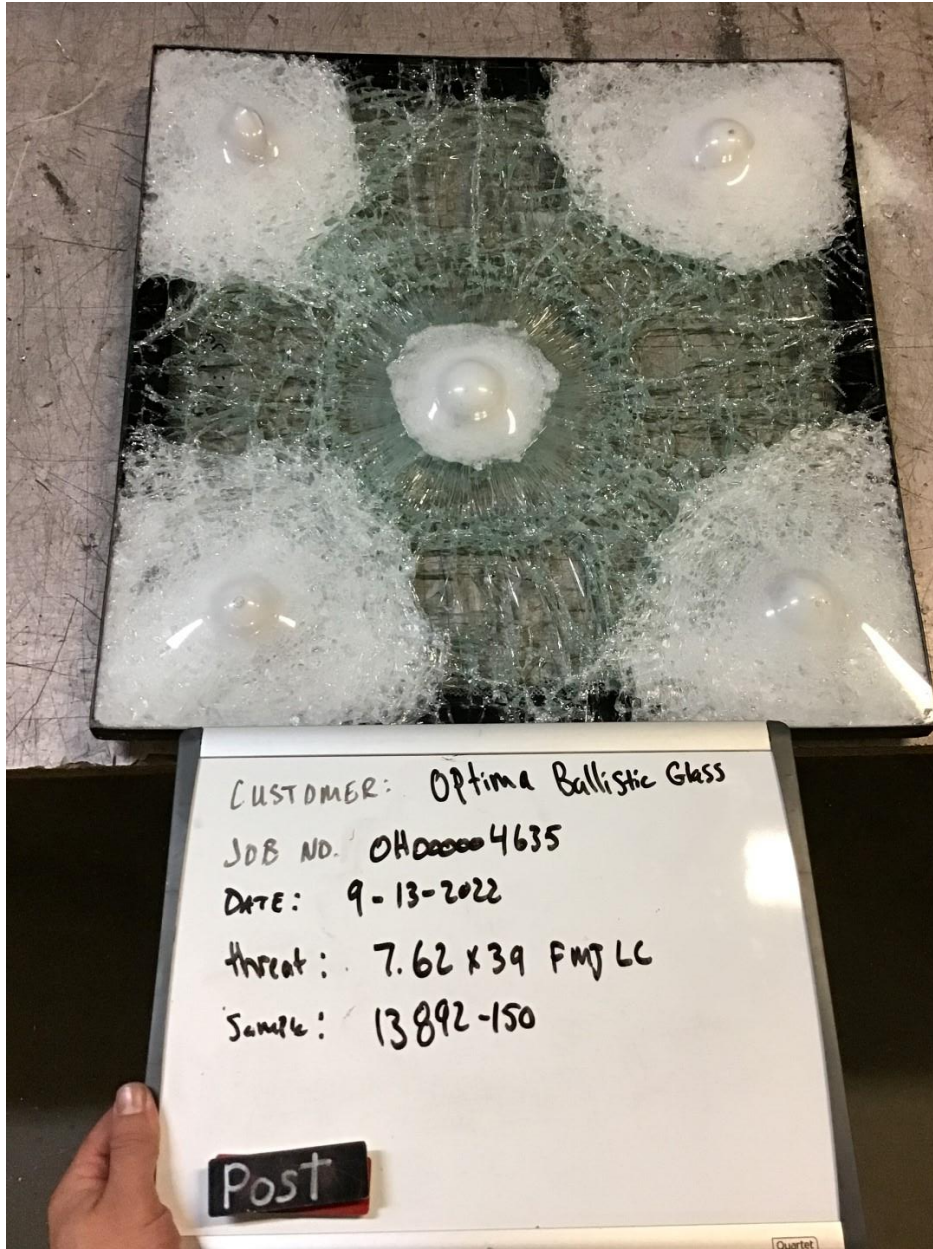


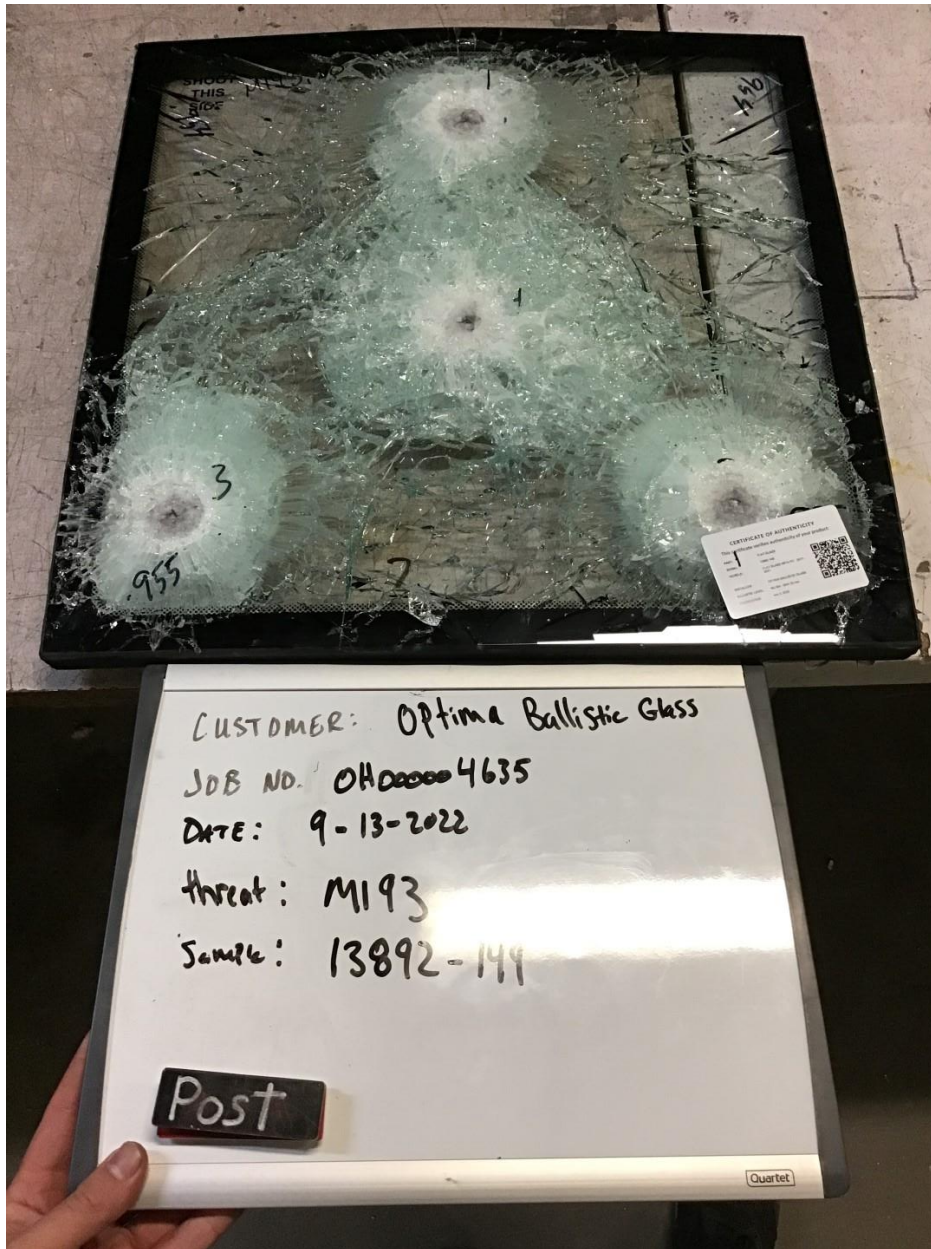
ATTACHMENT A CALIBRATION CHECKLIST

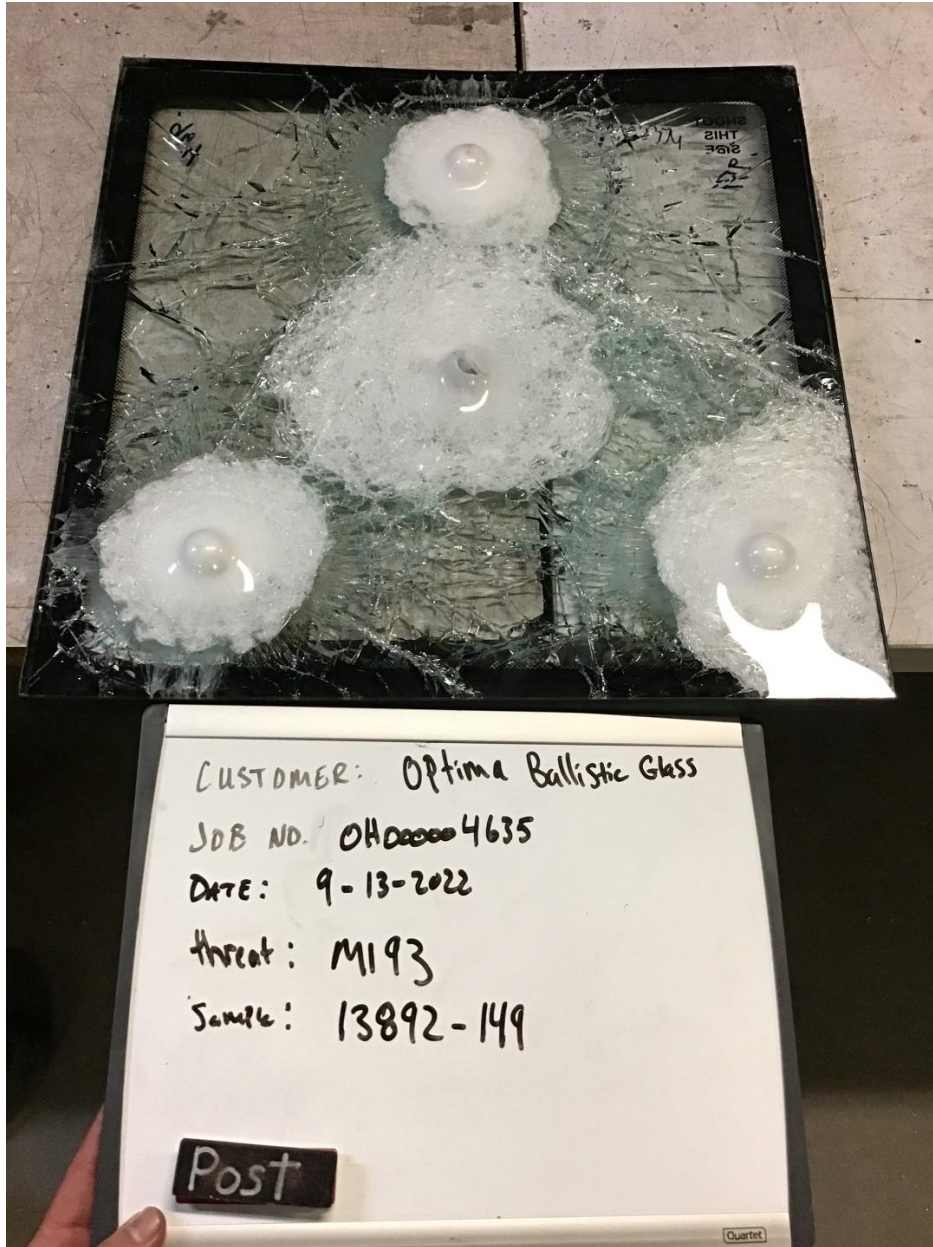
**NCR = No Calibration Required.
Range 6**

Equipment Inventory								
Work Center #	Serial Number	Make	Model	Description	Assigned To	Calibration Date	Calibration Due Date	
WC067373	202	YIS/Cowden Group,	Chrono USB	Chronograph 1	Range 6	8/4/2022	8/4/2023	
WC067372	203	YIS/Cowden Group,	Chrono USB	Chronograph 2	Range 6	8/4/2022	8/4/2023	
WC067323	A18117177	RCBS	1500	Powder Scale	Range 6	11/22/2021	11/22/2022	
WC060228	AE20150917107	Sartorius	Combics	Floor scale	Range 6	12/6/2021	12/6/2022	
WC075049	200597920	Control Company	4040	Therm./Clock/Humidity Monitor	Range 6	10/6/2020	10/6/2022	
WC075065	WC075065	Starrett	530-100	100 ft Tape Measure	Range 6	11/11/2020	11/11/2022	
WC078631	WC078631			25 ft Tape Measure	Range 6	9/1/2021	9/1/2023	
WC078620	WC078620	Dewalt Industrial Toc	DWHT36107	25 ft Tape Measure	Range 6	6/25/2021	6/25/2023	
WC075094	200741201	Control Company	4378	Thermometer	Range 6	11/20/2020	11/20/2022	
WC075095	200741175	Control Company	4371	Thermometer	Range 6	11/20/2020	11/20/2022	
WC079392	18/060036	Starrett	3753A-6/150	BFD Tool	Range 6	7/13/2022	7/13/2023	
WC079240	21/090003	Starrett	3753A-6/150	BFD Bridge	Range 6	10/11/2021	10/11/2022	
WC075110	M21050300	Omega Engineering	ZW-CM-BTH	Temp/ Humidity/BP Sensor	Range 6	3/18/2021	3/18/2023	
WC064273	844	SPI	91-317-8	Angle Block	Range 6	1/8/2022	1/8/2024	

**ATTACHMENT B
PHOTOGRAPHS**







END OF REPORT