




Environmental Tests on
(3) RECON13 Antennas (Ribbed Surface) and
(3) RECON13 Antennas (Flat Surface)

For	Airgain Inc 7860 E McClain Dr, Ste 2 Scottsdale, AZ 85260
P.O. Number	4000079383
Date Tested	11/8-10/2023
Test Personnel	David Way
Test Documents	Airgain RECON13 SOW_09-25-2023 ISO 20653 Edition 2.2 (2013-08)

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1. REPORT REVISION HISTORY

Revision	Date	Description
-	November 14, 2023	Initial release
A	November 15, 2023 by David Way	<ul style="list-style-type: none">- Throughout report: Added Rev. A to the report number in the header.- Sections 11.1.4, 11.2.4, 11.3.4: Added additional post-test photographs

2. INTRODUCTION

This document presents the results of a series of environmental (ENV) tests that were performed on (6) antennas, (3) RECON13 Antennas (Ribbed Surface) and (3) RECON13 Antennas (Flat Surface) (hereinafter referred to as the Device Under Test (DUT)). The DUTs were identified as follows:

RECON13 Antenna (Ribbed Surface)	S/N 1
RECON13 Antenna (Ribbed Surface)	S/N 2
RECON13 Antenna (Ribbed Surface)	S/N 3
RECON13 Antenna (Flat Surface)	S/N 4
RECON13 Antenna (Flat Surface)	S/N 5
RECON13 Antenna (Flat Surface)	S/N 6

3. TEST DOCUMENTS

The tests were performed in accordance with Airgain RECON13 SOW_09-25-2023 and ISO 20653 Edition 2.2 (2013-08).

4. MODIFICATIONS MADE TO DUT AND/OR DEVIATIONS TO THE TEST DOCUMENTS DURING TESTING

No modifications were made to the DUTs during the testing. No deviations from the test documents were made during the testing.

5. SUMMARY

The following ENV tests were performed, and the results are shown below:

Test Description	Document Section	Test Results	S/N	Date Tested
Dust (IP6K)	Airgain RECON13 SOW_09-25-2023 with reference to ISO 20653 Edition 2.2 (2013-08) IP6K	Compliant	1, 4	11/8/2023
Immersion (IPX7)	Airgain RECON13 SOW_09-25-2023 with reference to ISO 20653 Edition 2.2 (2013-08) IPX7	Compliant	3, 5	11/9/2023
Pressure Spray (IPX9K)	Airgain RECON13 SOW_09-25-2023 with reference to ISO 20653 Edition 2.2 (2013-08) IPX9K	Compliant	2, 6	11/10/2023

6. OPERATION STATES

The ENV tests were performed with the DUTs operating in one or more of the test modes described below.

6.1. Unpowered

The DUTs were unpowered throughout the tests.

7. PERFORMANCE MONITORING

No monitoring was required during the tests.

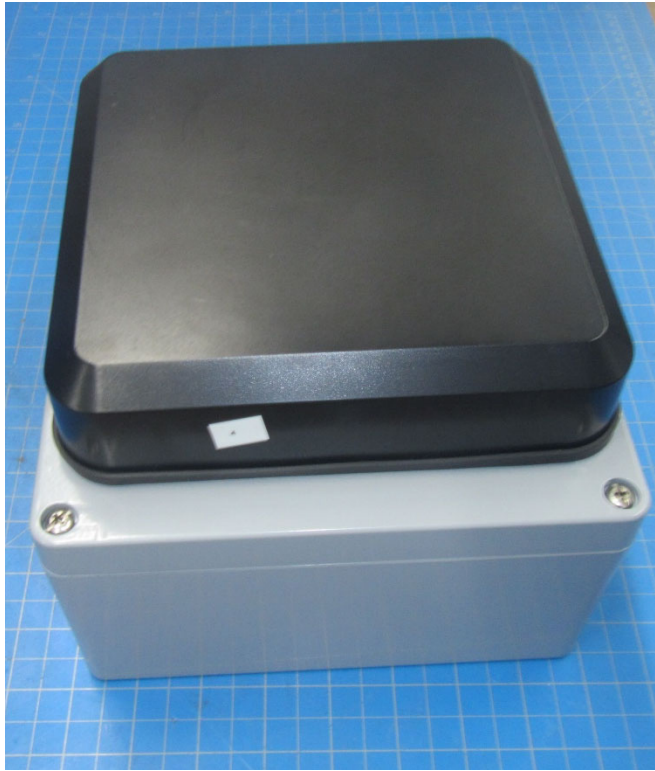
8. ACCEPTANCE CRITERIA

The DUTs must adhere to the requirements found in sections 11.1.1, 11.2.1, and 11.3.1.

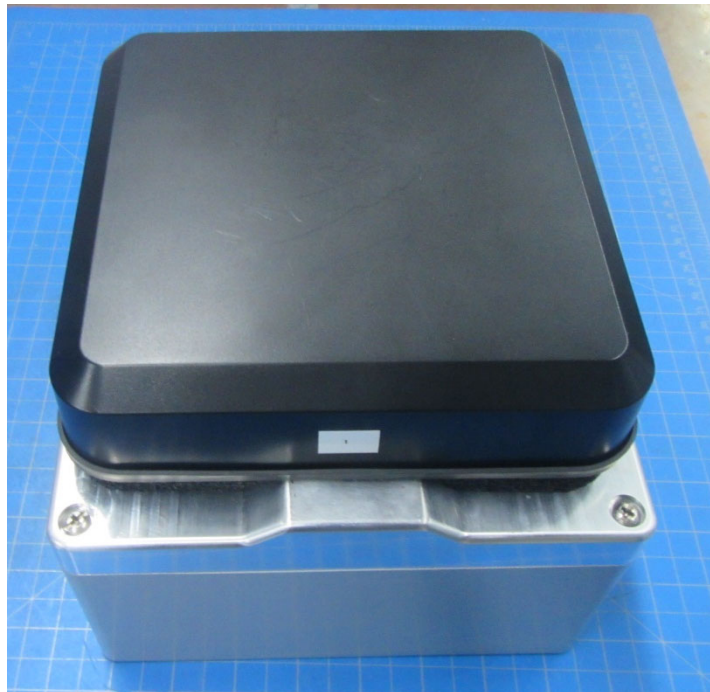
9. CERTIFICATION

Elite Electronic Engineering Incorporated certifies that the information contained in this report was obtained under conditions which meet or exceed those specified in the test documents, except if noted otherwise. The data presented in this test report pertains to the DUTs as provided by the customer at the test date as operated and monitored by Elite personnel. Any electrical or mechanical modification made to the DUTs subsequent to the specified test date will serve to invalidate the data and void this certification.

10. DEVICE UNDER TEST



RECON13 Antenna (Flat Surface)



RECON13 Antenna (Ribbed Surface)

11. TEST SECTIONS

11.1. Dust (IP6K)

11.1.1. Requirements:

The DUTs shall satisfactorily withstand exposure to dust without physical damage or dust intrusion.

11.1.2. Test Procedure:

The test was conducted in accordance with Airgain RECON13 SOW_09-25-2023 with reference to ISO 20653 Edition 2.2 (2013-08) IP6K. The DUTs were then placed inside the chamber.

The chamber conditions were maintained for a period of five (5) hours at ambient room temperature. The dust was agitated for six (6) seconds every 15 minutes for a total duration of 5 hours (20 cycles). The chamber temperature, duration and dust density were adjusted as follows:

Step	Temperature	Dust Density (kg/M3)	Duration (Hours)
1	Room Ambient	2	5

The dust used was A2 Arizona dust.

11.1.3. Description of Test Apparatus:

Eq ID	Equipment Description	Manufacturer	Model No.	Serial No.	Frequency Range	Cal Date	Due Date
ENVC12	SETTLING DUST CHAMBER	LINEAR KINETICS	JAL 2011	1001	---	6/14/2023	6/14/2024
XWG0	DIGITAL SCALE	METTLER	PC 4400	C69225	4000 GRAMS	6/6/2023	6/6/2024

CNR: Calibration Not Required

CBU: Calibrate Before Use

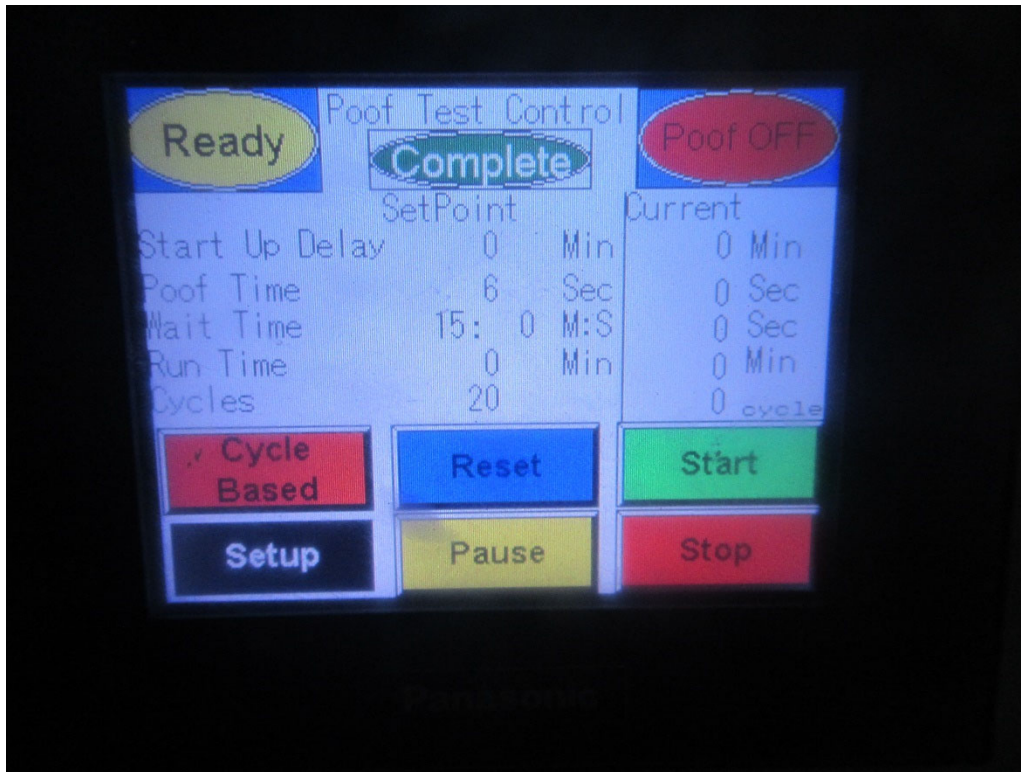
I/O: Initial Only

N/A: Not Applicable

Note 1: For the purpose of this test, the equipment was calibrated prior to the test or monitored by a calibrated instrument.

11.1.4. Test Results:

The DUTs completed the Dust testing per Airgain RECON13 SOW_09-25-2023 with reference to ISO 20653 Edition 2.2 (2013-08) IP6K. Following the test, the DUTs were visually inspected for physical damage and dust intrusion. The DUTs had no evidence of physical damage or dust intrusion. The DUTs were then returned to the customer for further evaluation.



Test Profile



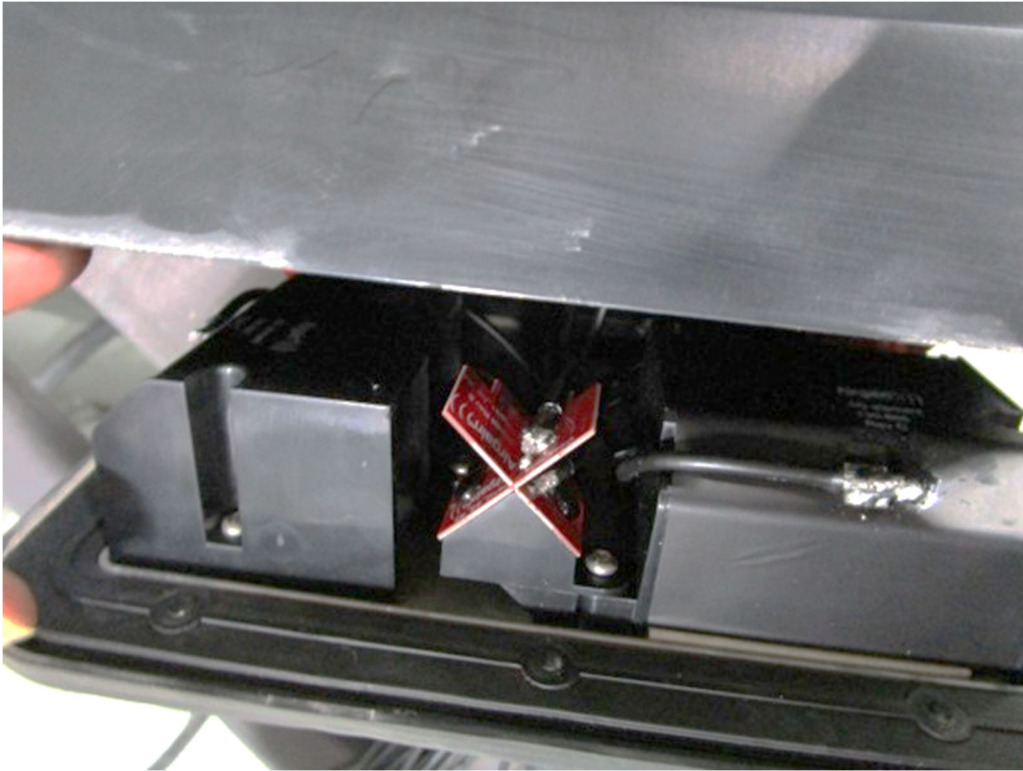
Test Setup Photograph



Completed Profile



Post-Test Photograph



DUT1 Post-Test Photograph



DUT1 Post-Test Photograph



DUT4 Post-Test Photograph



DUT4 Post-Test Photograph

11.2. Immersion (IPX7)

11.2.1. Requirements:

The DUTs shall satisfactorily withstand exposure to water immersion without physical damage or water intrusion that would interfere with proper operation.

11.2.2. Test Procedure:

The test was conducted in accordance with Airgain RECON13 SOW_09-25-2023 with reference to ISO 20653 Edition 2.2 (2013-08) IPX7. The DUTs were then placed inside the water immersion tank.

The DUTs were then submerged in water. The lowest point on the sample was located 1,000 millimeters below the surface of the water. The DUTs remained submerged for thirty (30) minutes. The water in the tank was at room ambient conditions and did not differ by more than 5°C of the DUT temperature. The DUTs were inspected for evidence of water intrusion after the exposure to the immersion test.

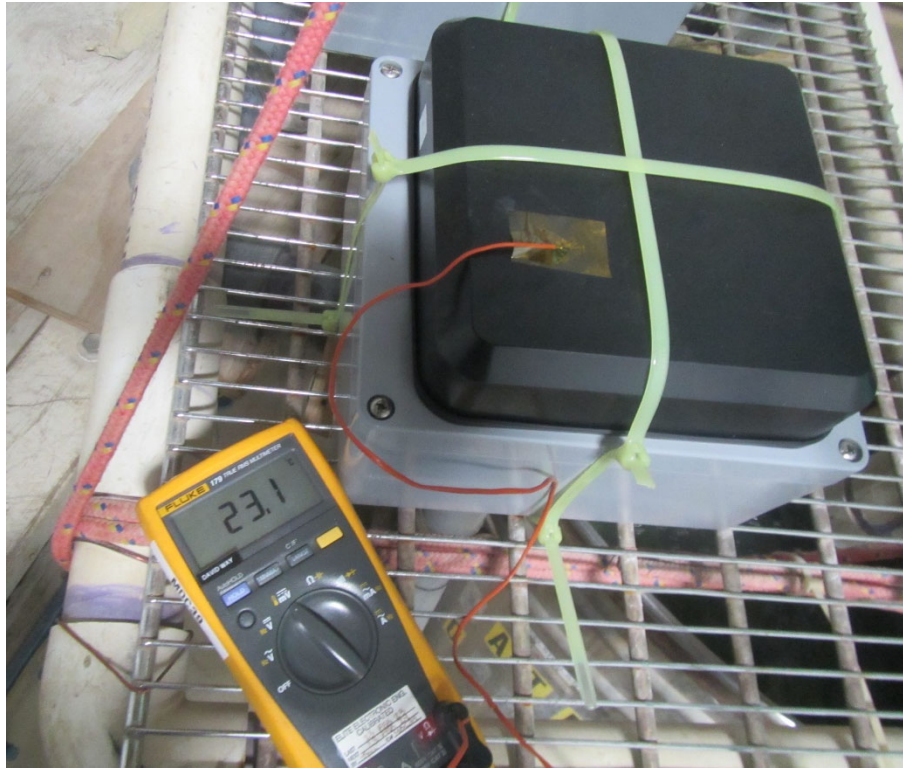
11.2.3. Description of Test Apparatus:

Eq ID	Equipment Description	Manufacturer	Model No.	Serial No.	Frequency Range	Cal Date	Due Date
EMS4	METER STICK (1M)	FAIRGATE	33-300		1M	2/27/2023	2/27/2025
EST0	STAINLESS STEEL IMMERSION TANK	LOMAX	ST500	2293	6FT DEPTH/44 INCH DIAMETER	NOTE 1	
MDC39	MULTIMETER (D. WAY)	FLUKE	179	21040206	I;VDC;VAC;R	2/23/2023	2/23/2024
MZD0	TIMER/STOPWATCH	OAKTON	220	001	0.01% ACCURACY	3/25/2023	3/25/2025

CNR: Calibration Not Required CBU: Calibrate Before Use I/O: Initial Only N/A: Not Applicable
 Note 1: For the purpose of this test, the equipment was calibrated prior to the test or monitored by a calibrated instrument.

11.2.4. Test Results:

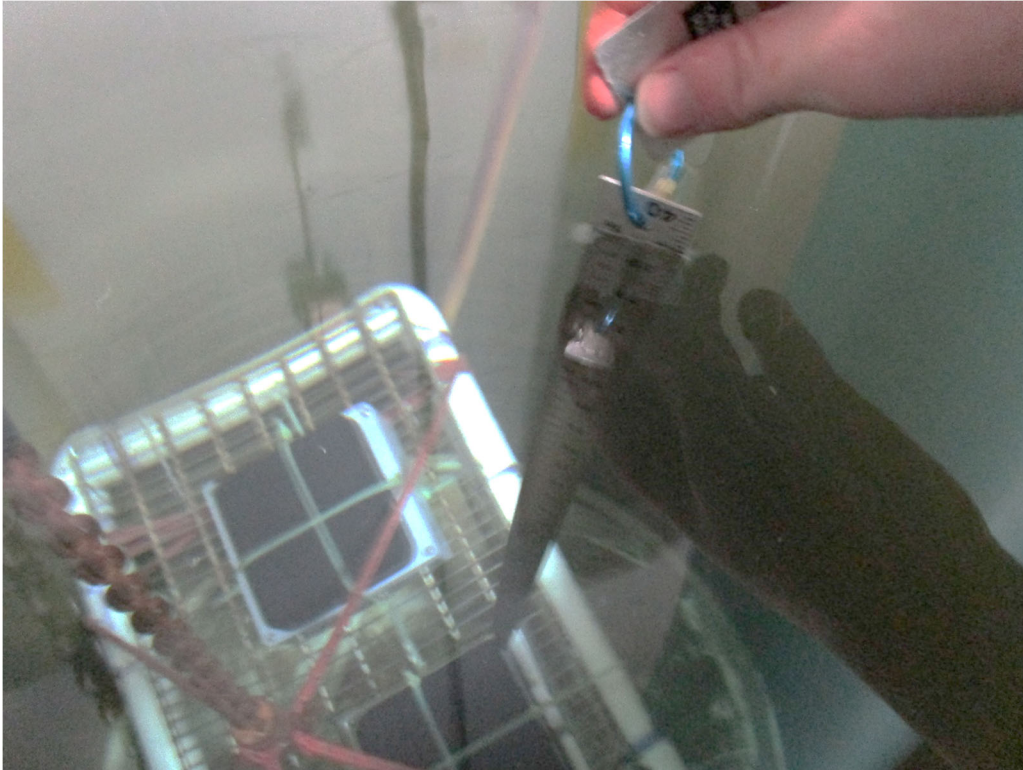
The DUTs were subjected to and completed the Immersion testing per Airgain RECON13 SOW_09-25-2023 with reference to ISO 20653 Edition 2.2 (2013-08) IPX7. There was no evidence of water intrusion after the thirty (30) minutes of immersion. Following the test, the DUTs were returned to the customer for further evaluation.



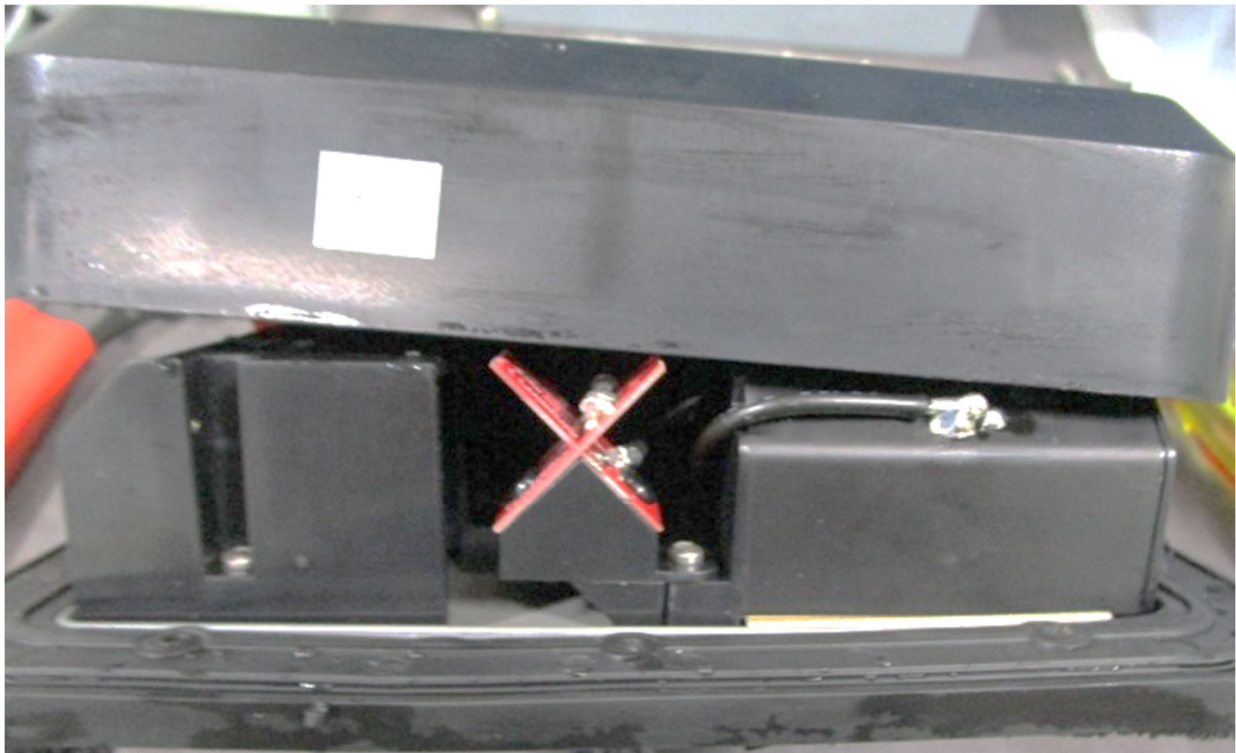
Test Setup Photograph (DUT Temperature)



Test Setup Photograph (Water Temperature)



Test Setup Photograph (Depth)



DUT 3 Post-Test Photograph



DUT 3 Post-Test Photograph



DUT 5 Post-Test Photograph



DUT 5 Post-Test Photograph

11.3. Pressure Spray (IPX9K)

11.3.1. Requirements:

The DUTs shall satisfactorily withstand exposure to a pressurized stream of water without physical damage or water intrusion that shall interfere with normal operation.

11.3.2. Test Procedure:

The test was conducted in accordance with Airgain RECON13 SOW_09-25-2023 with reference to ISO 20653 Edition 2.2 (2013-08) IPX9K. The DUTs were then placed inside the test area.

The DUTs were then subjected to water spray from a distance of 100 to 150 mm (4-6 inches). The water was sprayed through a 35° (±5°) fan nozzle at a pressure of 8,000kPa to 10,000kPa (1160PSI to 1450PSI) with a flow rate of 3.69GPM to 4.22GPM (14 Liters/Minute to 16 Liters/Minute). The water was heated and maintained at a temperature of 80°C ±5°C throughout the entire exposure. The DUTs were subjected to the water spray for a period of 30 seconds per position (90°, 60°, 30°, 0°) with the DUTs rotating at 5 rpm for a total exposure of 2 minutes. Following the exposure, the DUTs were visually inspected for physical damage and water intrusion.

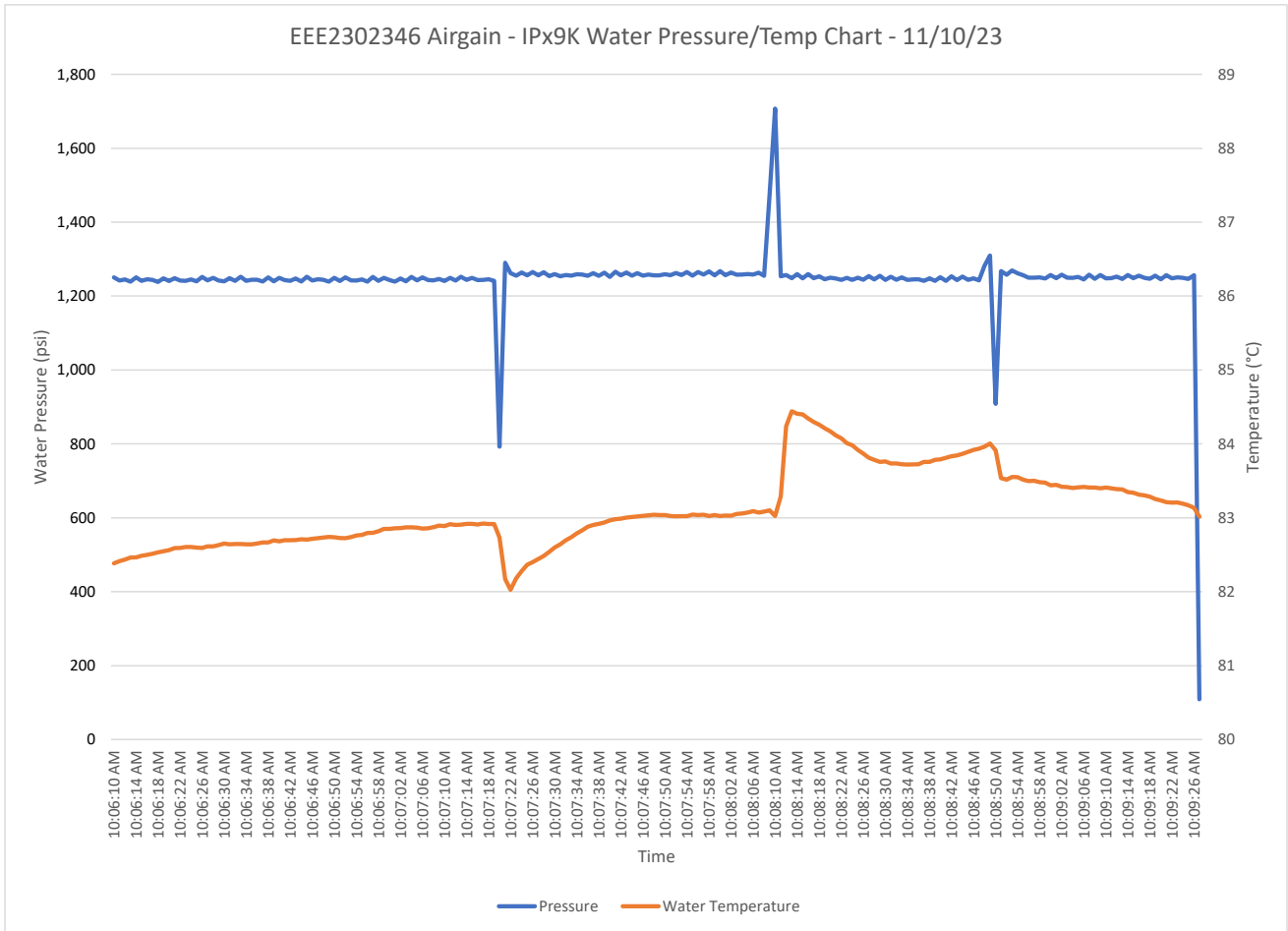
11.3.3. Description of Test Apparatus:

Eq ID	Equipment Description	Manufacturer	Model No.	Serial No.	Frequency Range	Cal Date	Due Date
EHW0	HOT WATER HEATER	CHROMALOX	MICROTHERM CMX SERIES	PC03804	20-100C	NOTE 1	
EPW0	POWER WASHER	ALL PRESSURE WASHERS	5000	F0910016462	5000psi @ 4.5 GPM	NOTE 1	
EST0	STAINLESS STEEL IMMERSION TANK	LOMAX	ST500	2293	6FT DEPTH/44 INCH DIAMETER	NOTE 1	
EWT0	WATER TURNTABLE	ELITE	WT-001	001	1RPM-5RPM	10/10/2022	10/10/2024
MDR20	DATA ACQUISTION SYSTEM	KEYSIGHT	DAQ970A	MY58018694	---	8/28/2023	8/28/2024
MTS28	MEASURING TAPE (5M)	KESON	PGPRO18M16V	---	5M/16FT	5/6/2022	5/6/2024
MZD0	TIMER/STOPWATCH	OAKTON	220	001	0.01% ACCURACY	3/25/2023	3/25/2025
XFG11	FLOW GAUGE	HEDLAND	H705B-010	102715	.5-10GPM	3/9/2023	3/9/2025
XXN2	PROTRACTOR ANGLE LOCATOR	JOHNSON	700	---	360 DEGREES	4/19/2023	4/19/2024

CNR: Calibration Not Required CBU: Calibrate Before Use I/O: Initial Only N/A: Not Applicable
 Note 1: For the purpose of this test, the equipment was calibrated prior to the test or monitored by a calibrated instrument.

11.3.4. Test Results:

The DUTs were subjected to and completed the Pressure Spray testing per Airgain RECON13 SOW_09-25-2023 with reference to ISO 20653 Edition 2.2 (2013-08) IPX9K. Following the test, the DUTs were visually inspected for physical damage or water intrusion. The DUTs had no evidence of physical damage or water intrusion. The DUTs were then returned to the customer for further evaluation.



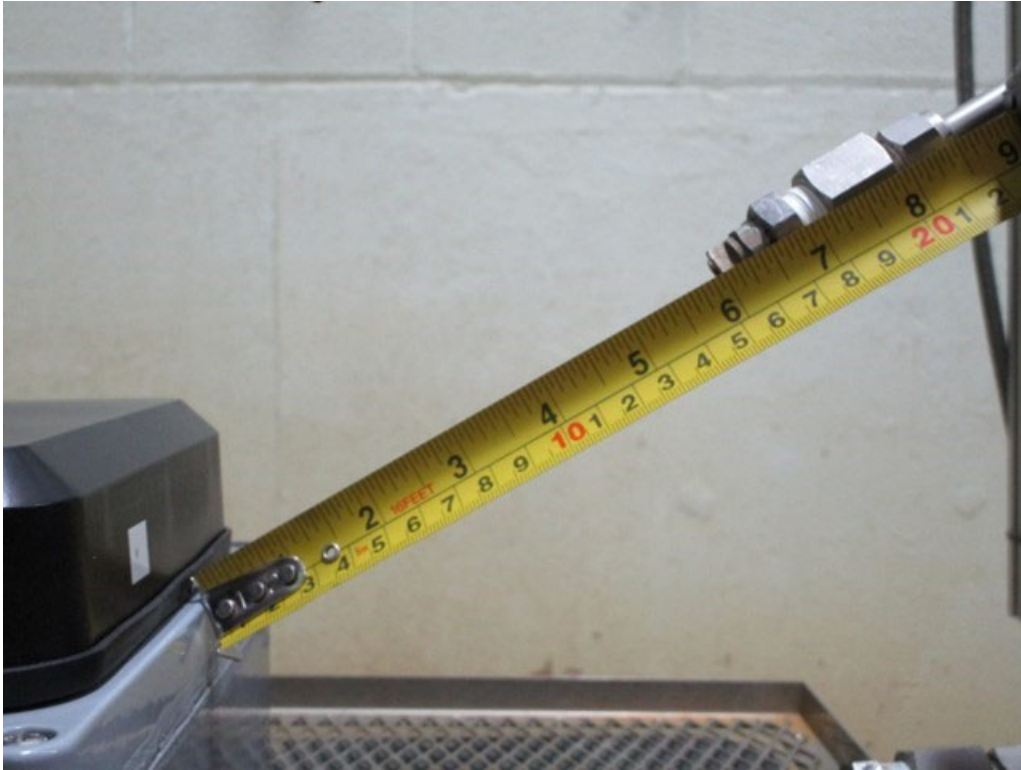
Typical Pressure/Temperature Plot



Test Setup Photograph (Flow)



Test Setup Photograph (Distance - 0°)



Test Setup Photograph (Distance - 30°)



Test Setup Photograph (Distance - 60°)



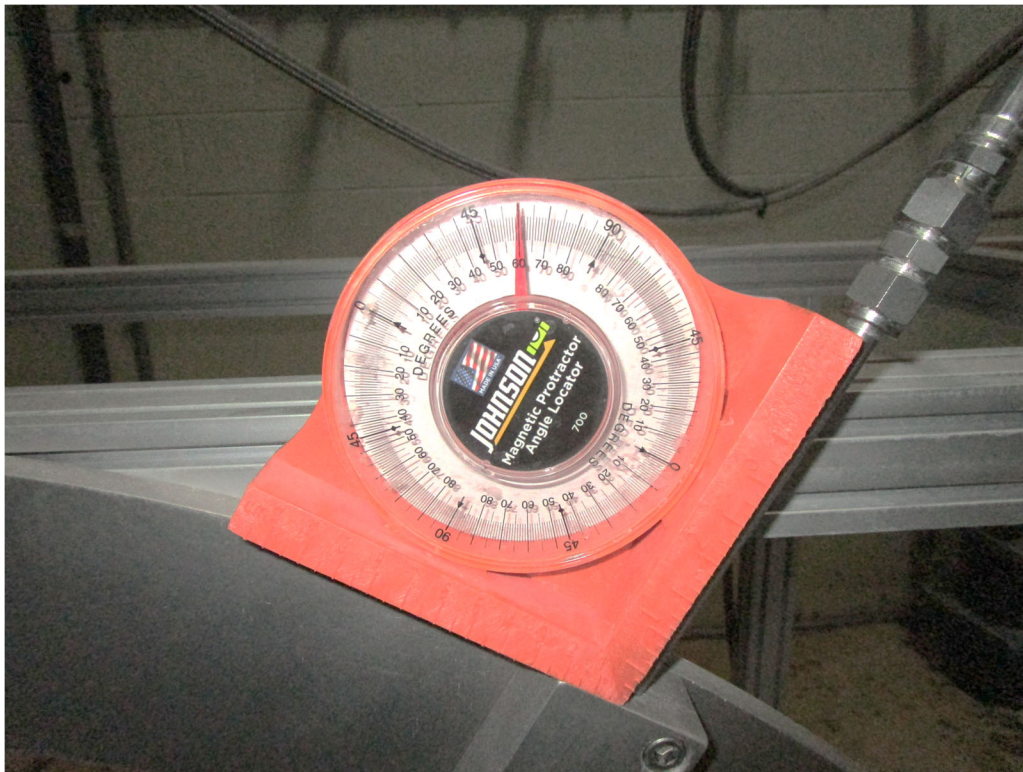
Test Setup Photograph (Distance - 90°)



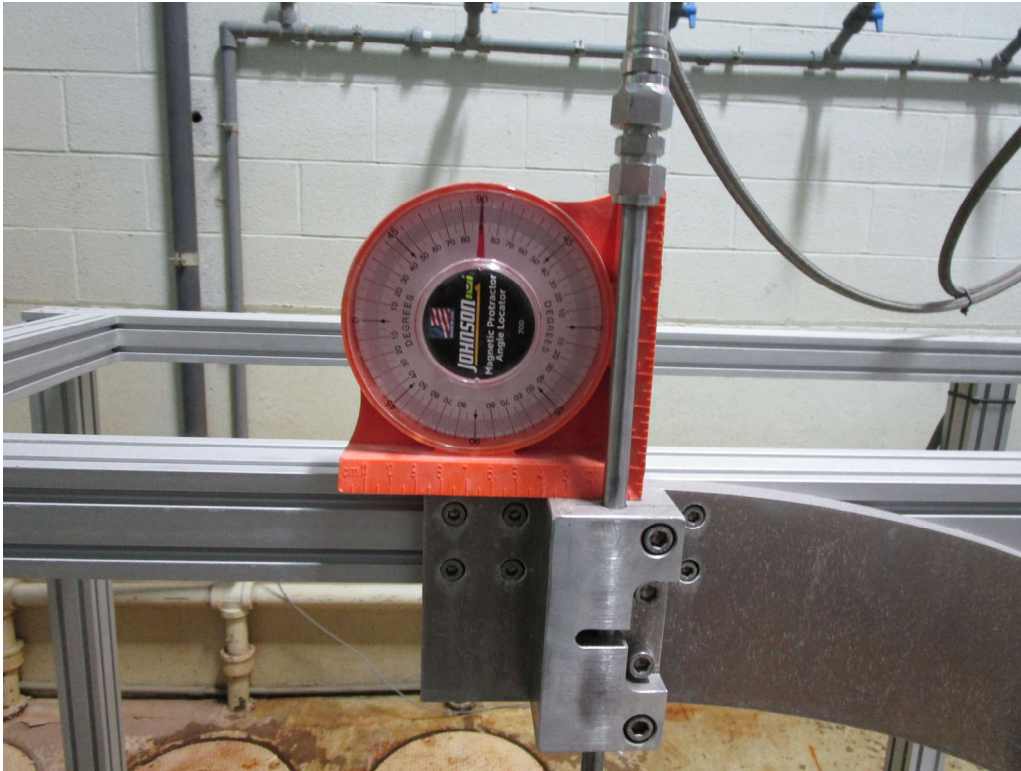
Test Setup Photograph (Angle - 0°)



Test Setup Photograph (Angle - 30°)



Test Setup Photograph (Angle - 60°)



Test Setup Photograph (Angle - 90°)



Test in Progress Photograph (0°)



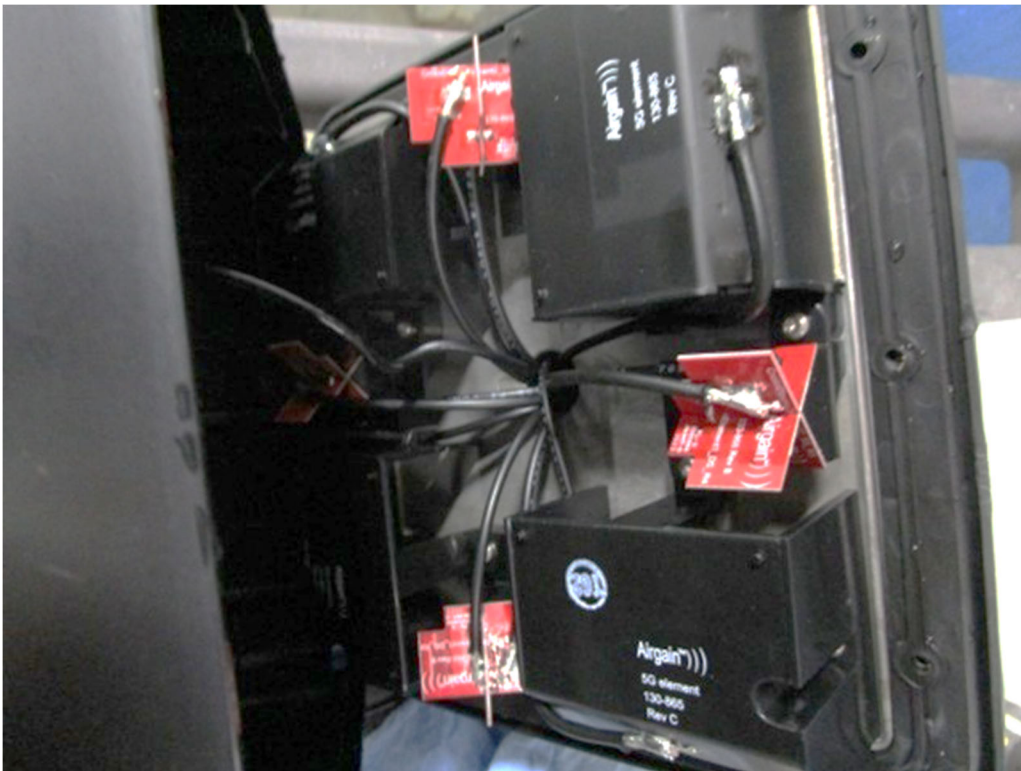
Test in Progress Photograph (30°)



Test in Progress Photograph (60°)



Test in Progress Photograph (90°)



DUT 2 Post-Test Photograph



DUT 2 Post-Test Photograph



DUT 6 Post-Test Photograph



DUT 6 Post-Test Photograph