



Environmental Tests on Multimax 5g Antennas

For	Airgain Inc 3611 Valley Centre Dr Ste 150 San Diego, CA 92130
P.O. Number	4000078529
Date Tested	December 15, 2022 to December 22, 2022
Test Personnel	Kyle Hewitt
Test Documents	ISO 20653 (2013-02-15) Customer Provided Document "SOW Multimax 5G IP67 & IP69K rev. 1.1"

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1. REPORT REVISION HISTORY

Revision	Date	Description
-	December 29, 2022	Initial release

2. INTRODUCTION

This document presents the results of a series of environmental (ENV) tests that were performed on (9) Multimax 5g Antennas (hereinafter referred to as the Device Under Test (DUT)). The DUTs were identified as follows:

Part ID: AP-MF5G-C2W4G-Q-B-XX	S/N 1
Part ID: AP-MF5G-C2W4G-Q-B-XX	S/N 2
Part ID: AP-MF5G-C2W4G-Q-B-XX	S/N 3
Part ID: AP-MF5G-C2W4G-Q-B-XX	S/N 4
Part ID: AP-MF5G-C2W4G-Q-B-XX	S/N 5
Part ID: AP-MF5G-C2W4G-Q-B-XX	S/N 6
Part ID: AP-MF5G-C2W4G-Q-B-XX	S/N 7
Part ID: AP-MF5G-C2W4G-Q-B-XX	S/N 8
Part ID: AP-MF5G-C2W4G-Q-B-XX	S/N 9

3. TEST DOCUMENTS

The tests were performed in accordance with ISO 20653 (2013-02-15) and Customer Provided Document "SOW Multimax 5G IP67 and IP69K rev. 1.1".

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	ISO 20653 (2013-02-15), IP6K and Customer Provided Document "SOW Multimax 5G IP67 & IP69K rev. 1.1"	Compliant	1, 2, 3	12/15/22 – 12/16/22
Immersion IPX7	ISO 20653 (2013-02-15), IPX7 and Customer Provided Document "SOW Multimax 5G IP67 & IP69K rev. 1.1"	Compliant	4, 5, 6	12/16/22
Pressure Spray IPX9K	ISO 20653 (2013-02-15), IPx9K and Customer Provided Document "SOW Multimax 5G IP67 & IP69K rev. 1.1"	Compliant	7, 8, 9	12/22/22

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 not powered during the testing.

7. PERFORMANCE MONITORING

The DUTs were not monitored during the tests.

8. ACCEPTANCE CRITERIA

The DUTs must meet the requirements of test 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 at the test date as operated and monitored if required. 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



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 and the test probe may penetrate completely but shall maintain a sufficient distance from hazardous parts.

11.1.2. Test Procedure:

The test was conducted in accordance with ISO 20653 (2013-02-15) IP6K, and Customer Provided Document "SOW Multimax 5G IP67 and IP69K rev. 1.1". 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

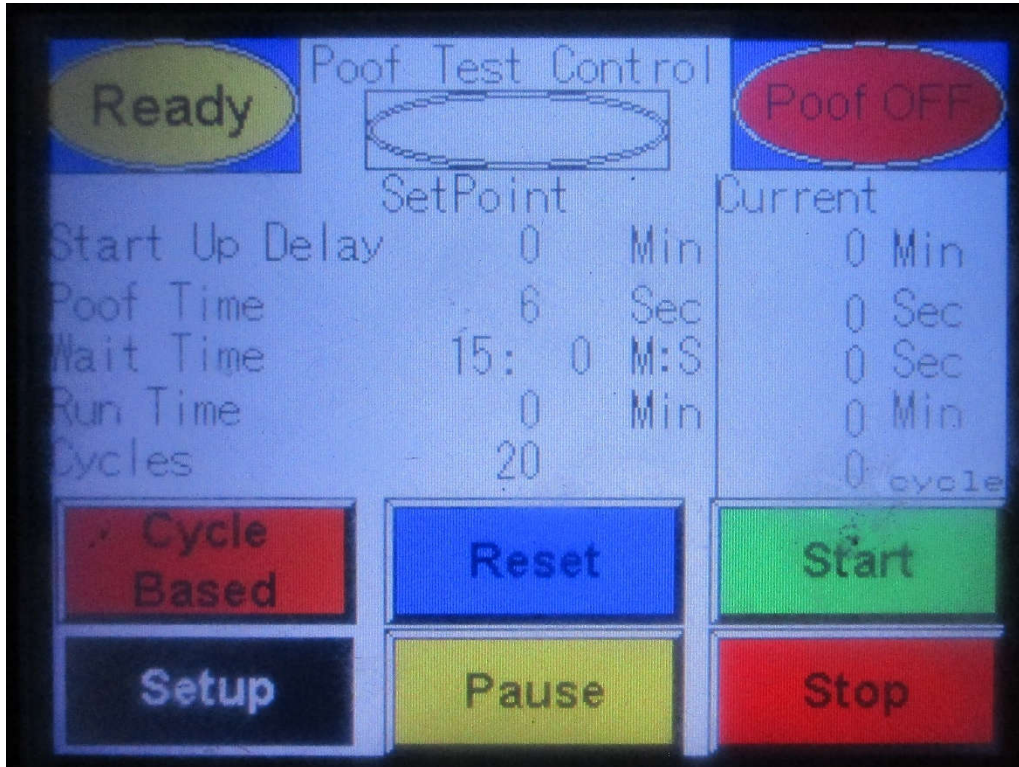
The dust used was A2 Arizona dust. A 1mm diameter wire, 100mm long, was then used to probe all openings or seams on each DUT.

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	---	7/8/2022	7/8/2023
MQIE	TEST ROD PROBE	ED&D	TRP-02	L04461664	---	2/11/2022	2/11/2024

11.1.4. Test Results:

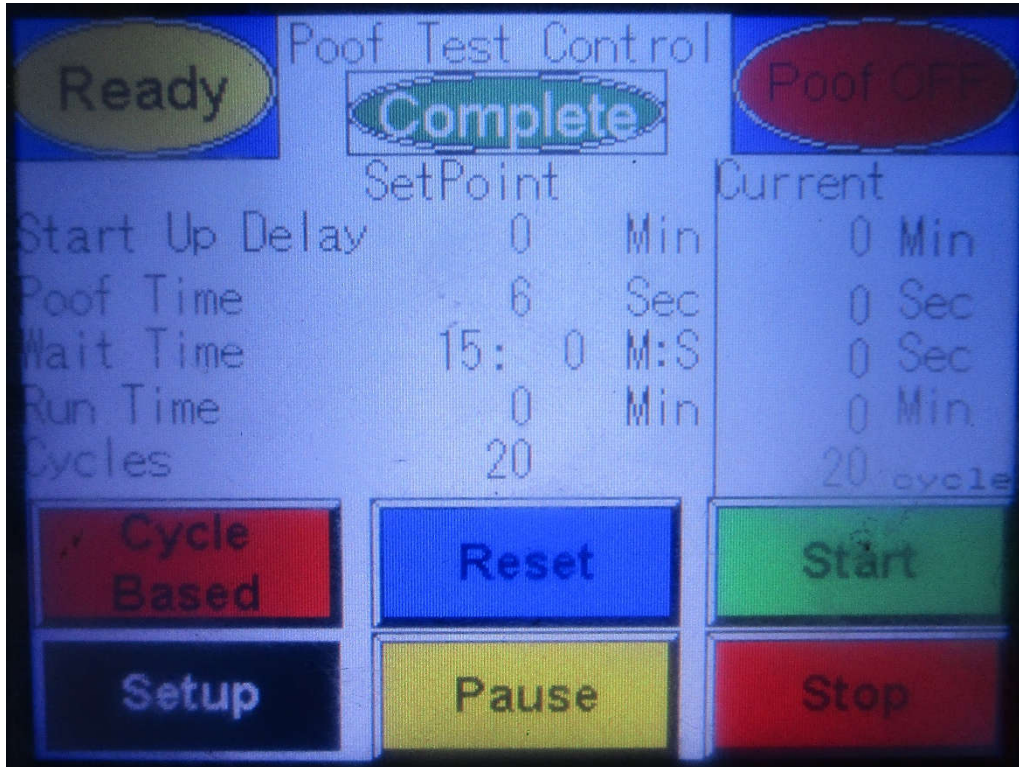
The DUTs completed the Dust testing per ISO 20653 (2013-02-15) IP6K, and Customer Provided Document "SOW Multimax 5G IP67 and IP69K rev. 1.1". Following the test, the DUTs were visually inspected for physical damage and dust intrusion. The DUTs had no evidence of physical damage or dust intrusion and were not penetrated by the wire probe. The DUTs were then returned to the customer for further evaluation.



Test Profile



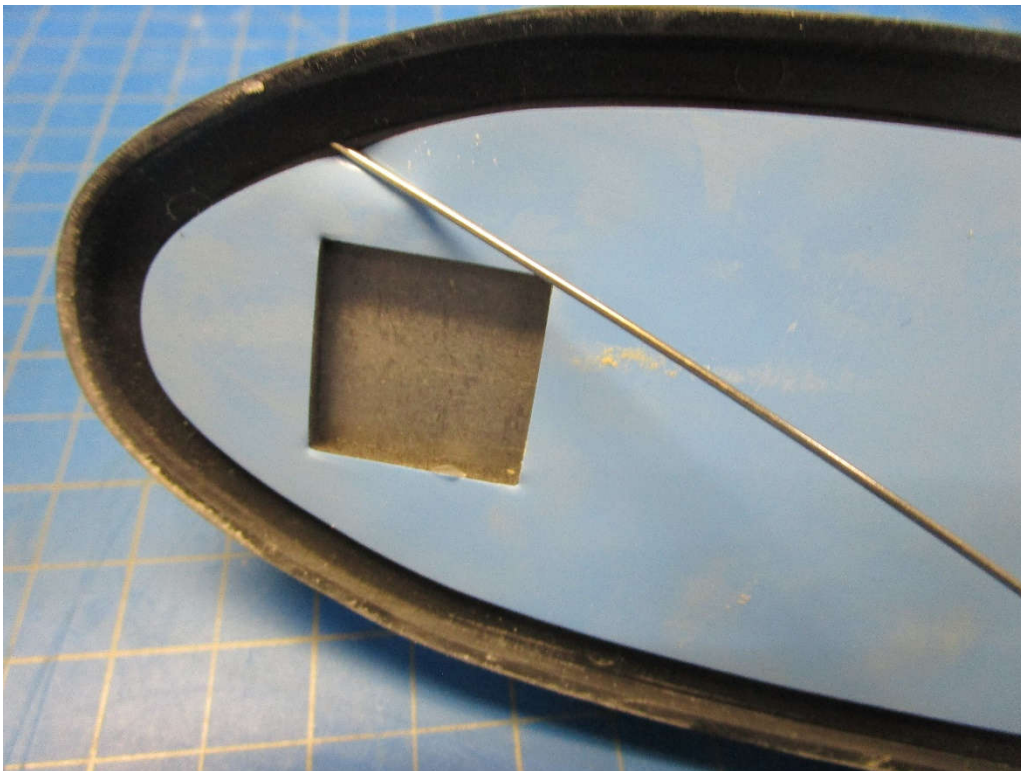
Test Setup Photograph



Completed Profile



Post-Test Photograph



Test In Progress Photographs– 1mm Probe



Typical Post-Test Photograph – DUT Interior



Typical Post-Test Photograph – DUT Base

11.2. Immersion IPX7

11.2.1. Requirements:

The DUTs shall satisfactorily withstand exposure to water immersion without physical damage and if water has entered, it shall not be sufficient to interfere with operation of the equipment or impair safety.

11.2.2. Test Procedure:

The test was conducted in accordance with ISO 20653 (2013-02-15) IPX7, and Customer Provided Document "SOW Multimax 5G IP67 & IP69K rev. 1.1". 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.

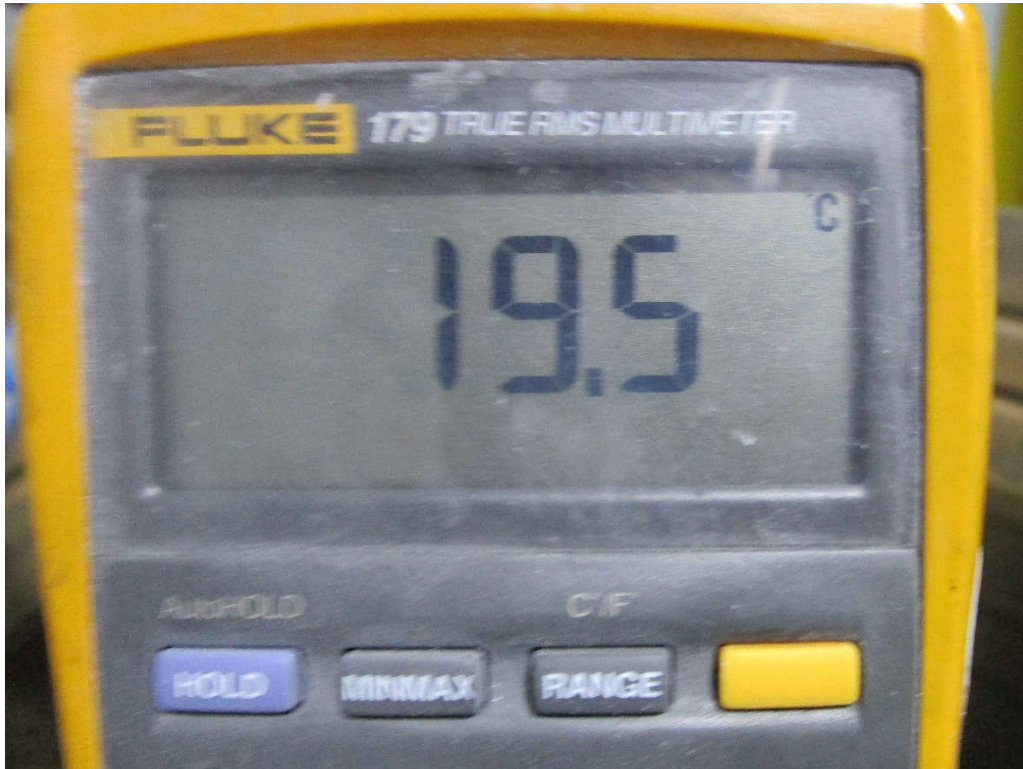
11.2.3. Description of Test Apparatus:

Eq ID	Equipment Description	Manufacturer	Model No.	Serial No.	Frequency Range	Cal Date	Due Date
EMS0	MEASURING STICK	ELITE ELECTRONIC ENG	EEE-MS-1-1.2	0001	---	3/8/2022	3/8/2025
EST0	STAINLESS STEEL IMMERSION TANK	LOMAX	ST500	2293	---	N/A	
MDC40	MULTIMETER	FLUKE	179	20730155	I;VDC;VAC;R	8/22/2022	8/22/2023
MZD6	STOPWATCH/TIMER	EXTECH	365510	---	---	8/27/2022	8/27/2023

I/O: Initial Only N/A: Not Applicable

11.2.4. Test Results:

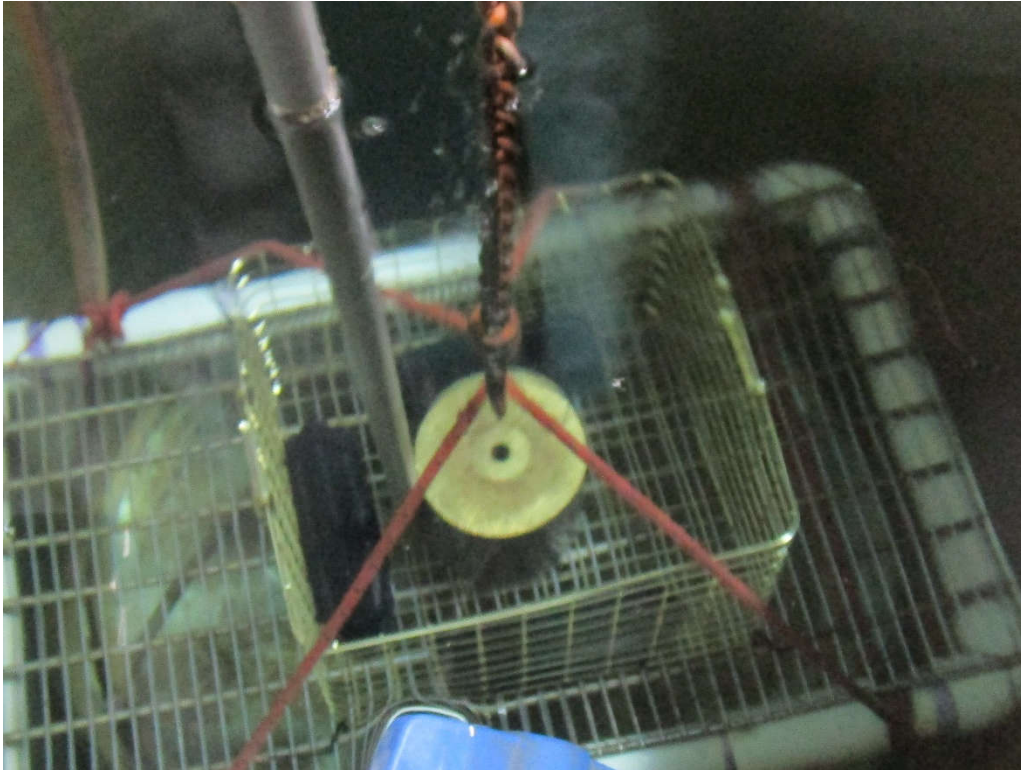
The DUTs were subjected to and completed the Immersion testing per ISO 20653 (2013-02-15) IPX7, and Customer Provided Document "SOW Multimax 5G IP67 and IP69K rev. 1.1". There was no evidence of water intrusion after the thirty (30) minutes of immersion. Following the test, the DUTs were returned to the customer for further inspection.



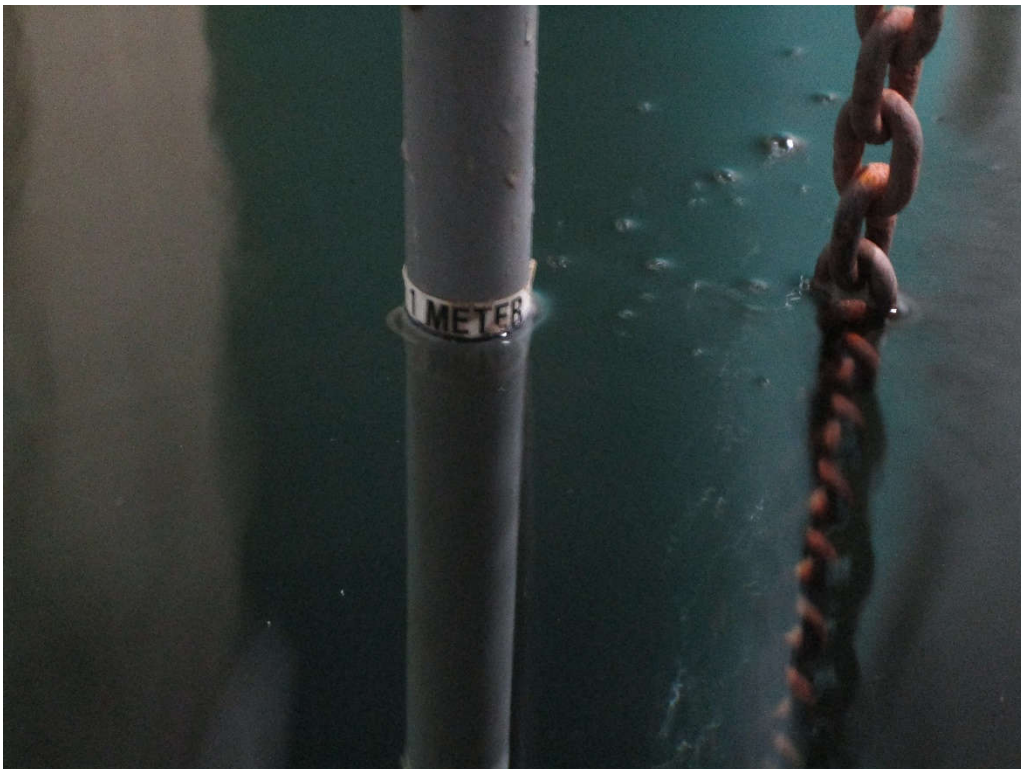
Test Setup Photograph – Water Temperature



Test Setup Photograph – DUT Temperature



Test In Progress Photograph



Test In Progress Photograph – Depth Measurement



Typical Post-Test Photograph – DUT Interior



Typical Post-Test Photograph – DUT Base

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 ISO 20653 (2013-02-15) IPx9K, and Customer Provided Document "SOW Multimax 5G IP67 and IP69K rev. 1.1". 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 (13.9 Liters/Minute to 15.9 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.

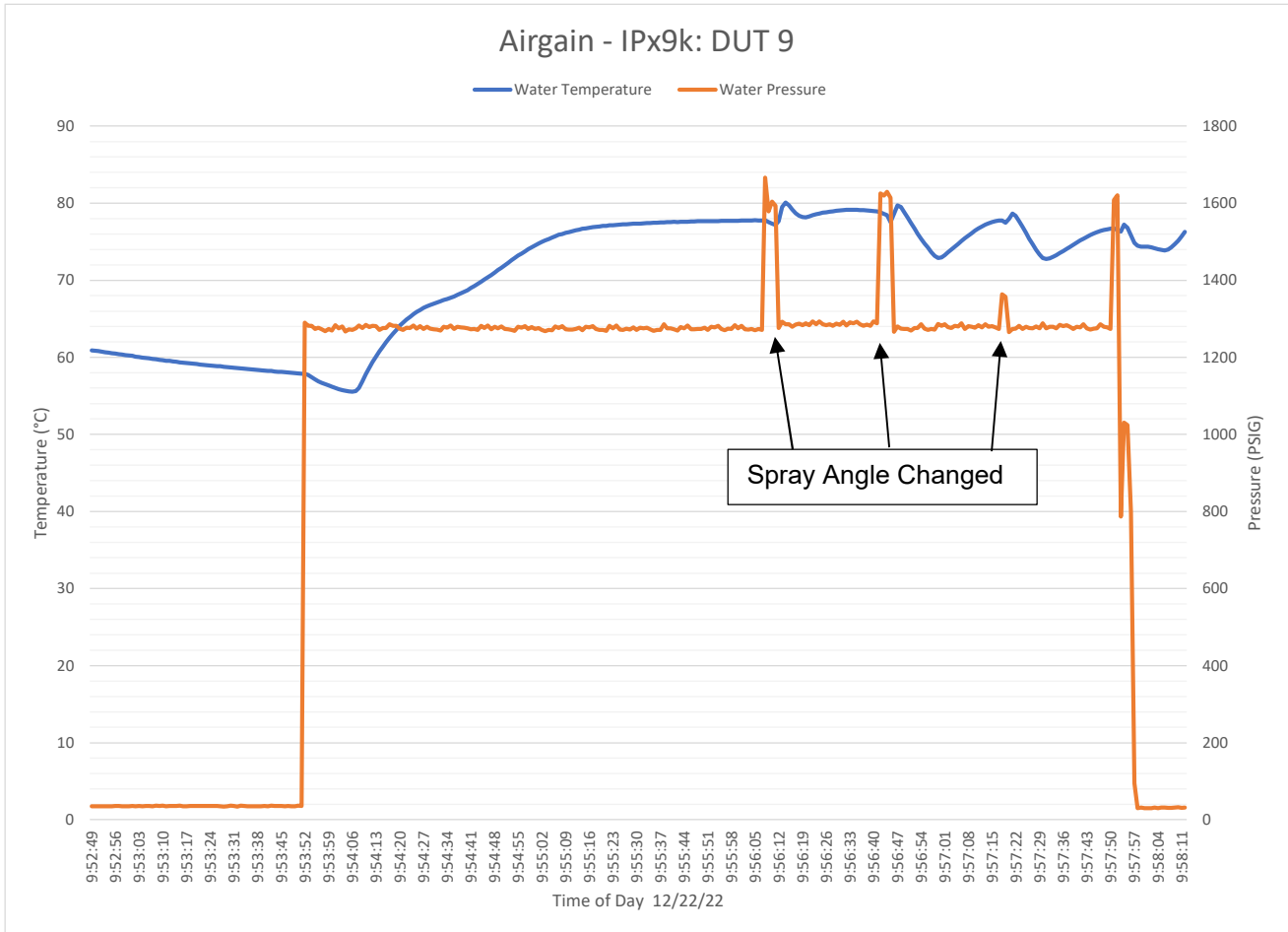
11.3.3. Description of Test Apparatus:

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	
EPT16	PRESSURE TRANSDUCER	GP:50	211CRX7FJGS	188375	0-7500 PSIG	4/5/2022	4/5/2023
EPW0	POWER WASHER	ALL PRESSURE WASHERS	5000	F0910016462	5000psi @ 4.5 GPM	NOTE 1	
EST0	STAINLESS STEEL IMMERSION TANK	LOMAX	ST500	2293	---	N/A	
EWT0	WATER TURNTABLE	ELITE	WT-001	001	1RPM-5RPM	10/10/2022	10/10/2024
EWT1	IPX9K TEST SET UP	ELITE	IPX9K FIXTURE	001	IPX9K	NOTE 1	
MDP3	20 CHANNEL MULTIPLEXER (2/4 WIRE)	KEYSIGHT	DAQM901A	MY58033128	---	9/15/2022	9/15/2023
MDR9	DATA ACQUISTION SYSTEM	KEYSIGHT	DAQ970A	MY58018784	---	6/1/2022	6/1/2023
MTS27	MEASURING TAPE (5M)	KESON	PGPRO18M16V	---	5M/16FT	5/6/2022	5/6/2024
MZD6	STOPWATCH/TIMER	EXTECH	365510	---	---	8/27/2022	8/27/2023
XFGT	FLOW GAUGE	HEDLAND	H605S-005	111315	.5 GPM - 5 GPM (6k PSI)	4/4/2022	4/4/2023

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:

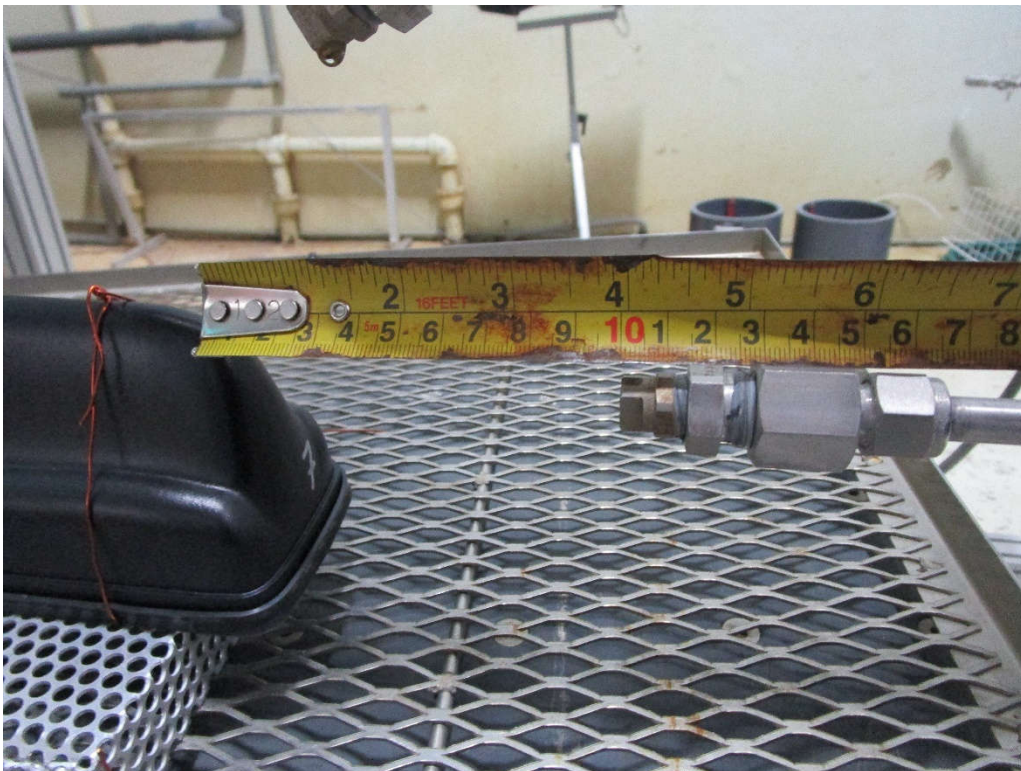
The DUTs were subjected to and completed the Pressure Spray testing per ISO 20653 (2013-02-15) IPx9K, and Customer Provided Document "SOW Multimax 5G IP67 and IP69K rev. 1.1". Following the test, the DUTs were visually inspected for physical damage or water intrusion. The DUTs had no evidence of physical damage or water intrusion. The DUTs were then returned to the customer for further evaluation.



Typical Pressure/Temperature Plot



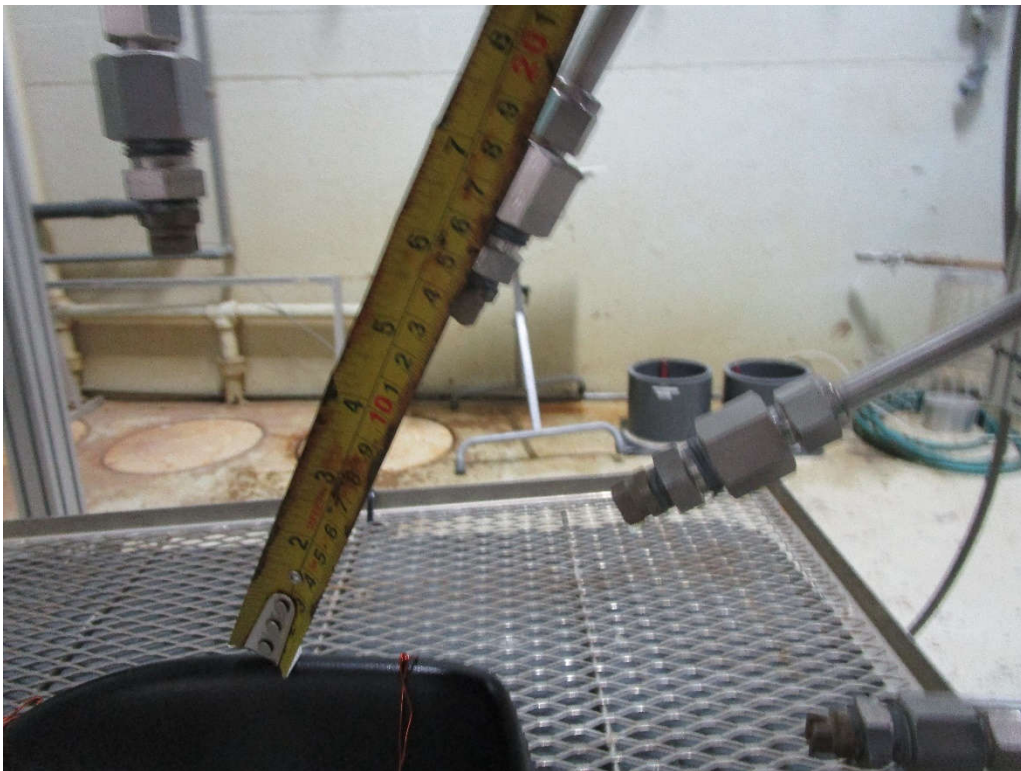
Test Setup Photograph (Flow)



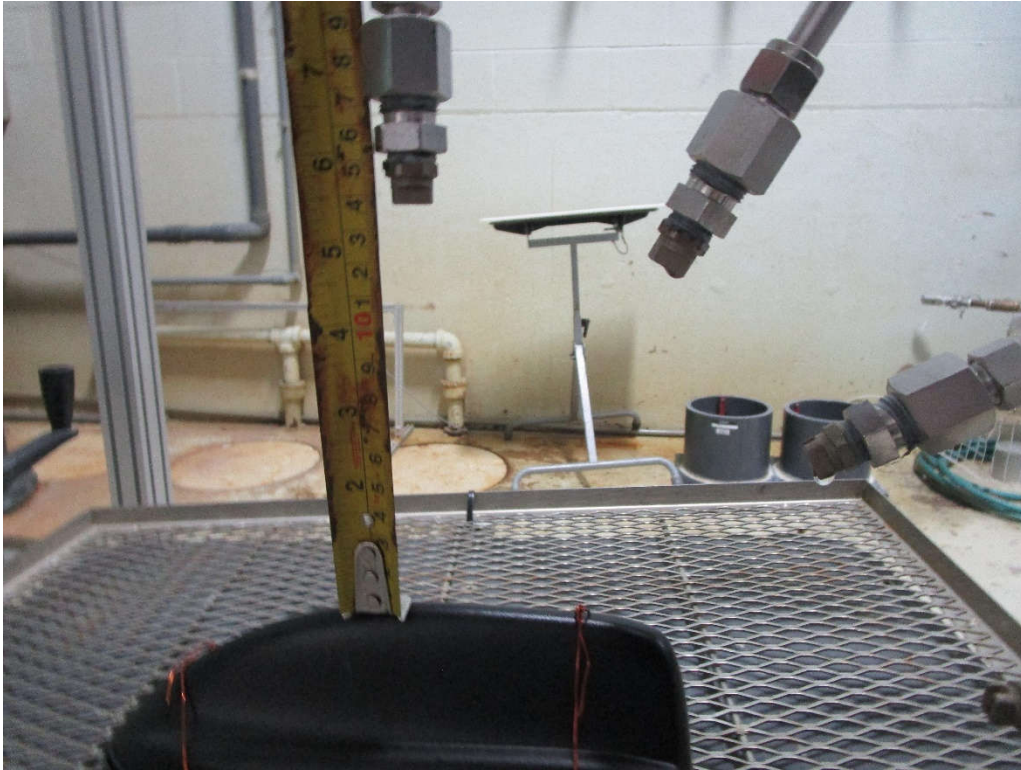
Test Setup Photograph (Distance - 0°)



Test Setup Photograph (Distance - 30°)



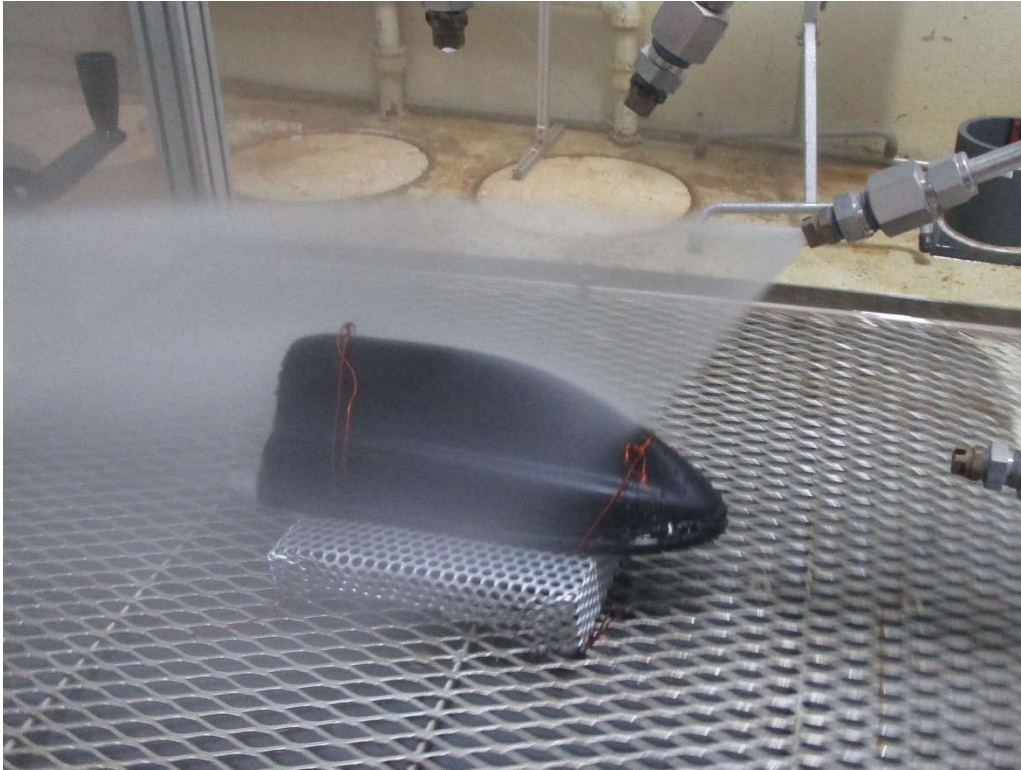
Test Setup Photograph (Distance - 60°)



Test Setup Photograph (Distance - 90°)



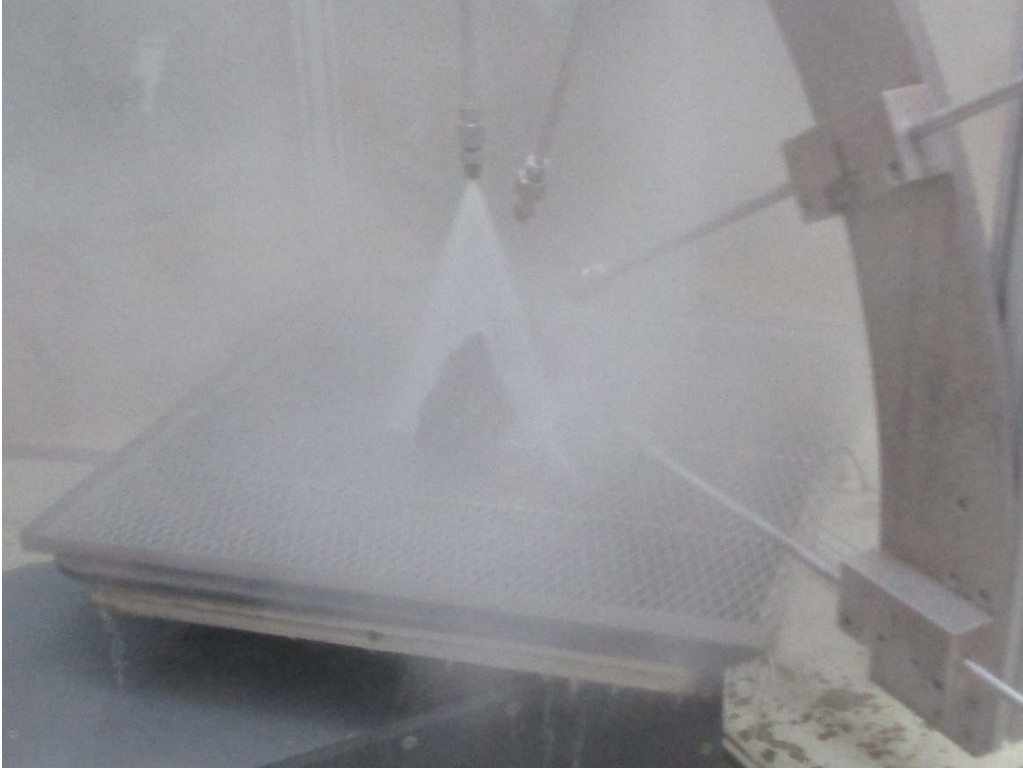
Test in Progress Photograph (0°)



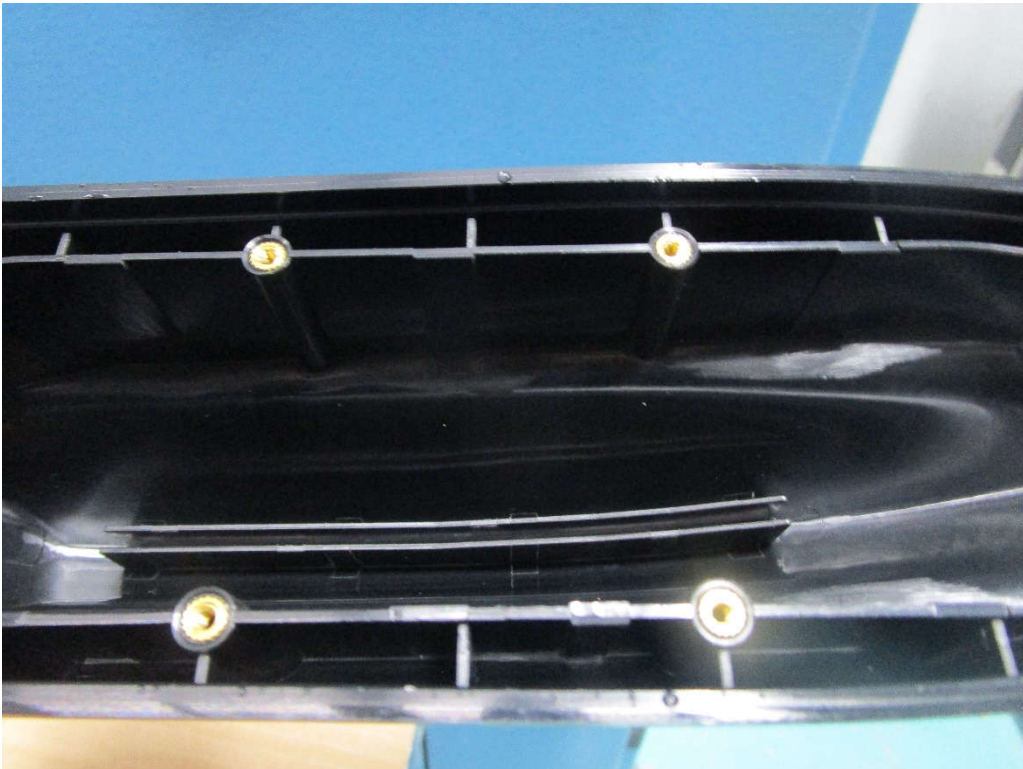
Test in Progress Photograph (30°)



Test in Progress Photograph (60°)



Test in Progress Photograph (90°)



Typical Post-Test Photograph – DUT Interior



Typical Post-Test Photograph – DUT Base