

Element Materials Technology Denver-Longmont A.K.A. NTS Labs, LLC

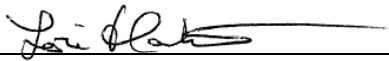
Test Report for Environmental Testing of the Impulse LoRa Modem

Prepared For

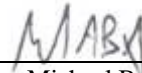
KS Technologies, LLC | 11580 Black Forest Road, Suite 60 | Colorado Springs, CO 80908

Prepared By

Element Materials Technology Denver-Longmont | 1601 Dry Creek Drive, Suite 2000 | Longmont, CO 80503 | 303-776-7249 | www.element.com



Lori Hartman
Preparer



Michael Bosica
Program Manager

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Revision History

Rev.	Description	Issue Date
0	Initial Release	07/22/2025

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1.0 Introduction

This document presents the test procedures used and the results obtained during the performance of an Environmental test program at Element Materials Technology Denver-Longmont (hereafter referred to as “Element”). The test program was conducted to assess the ability of the specified Equipment Under Test (EUT) to successfully satisfy the requirements defined in the test specification.

2.0 References

The following references listed below form a part of this document to the extent specified herein.

- Test Specification: IEC 60529 Edition 2.2 2013-08
- KS Technologies, LLC Purchase Order OP0675581-0 dated 06/24/2025
- Element Quotation OP0675581 dated 06/24/2025
- ISO/IEC 17025:2017(E) *General Requirements for the Competence of Testing and Calibration Laboratories*, dated 11/2017

3.0 Product Selection and Description

KS Technologies, LLC selected and provided the following test sample(s) to be used as the Equipment Under Test.

Table 3.0-1: Product Identification – Equipment Under Test (EUT)

Item	Qty.	Name/Description	Part Number	Serial Number
1	2	Impulse LoRa Modem	KST5421-US915	000010, 000011

3.1 Security Classification

Non-classified

4.0 General Test Requirements

4.1 Test Equipment

The instrumentation used in the performance of these tests is periodically calibrated and standardized within manufacturer's rated accuracies and are traceable to the National Institute of Standards and Technology. The calibration procedures and practices are in accordance with ISO 17025:2017. Certification of calibration is on file subject to inspection by authorized personnel.

5.0 Test Description and Results

Table 5.0-1: Summary of Test Information & Results

Section	Test	Specification	Test Facility	Test Date	Part #	Serial #	Test Result
5.1	IP6X	IEC 60529 Edition 2.2 2013-08	Longmont	07/18/2025 - 07/21/2025	KST5421- US915	000010, 000011	No dust ingress noted
5.2	IPX7	IEC 60529 Edition 2.2 2013-08	Longmont	07/17/2025	KST5421- US915	000010, 000011	No water ingress noted

5.1 IP6X

5.1.1 Test Procedure

IEC 60529 Edition 2.2 2013-08

5.1.2 Test Result

The EUT showed no dust ingress noted after the test was completed.

5.1.3 Test Datasheets

CLIMATICS TEST LOG					
Start Date:	7/18/2025	End Date:	7/21/2025	Job No:	PR191937
Customer:	KS Technologies, LLC		Test Engineer:	Cam Storey	
Customer Witness:	N/A		Lab Temp:	71F	Lab Humidity: 59%
Part Name:	Impulse LoRa Modem (Qty: 2)		Part Number:	KST5421-US915	
Test Specification:	IEC 60529 Edition 2.2 2013-08		Serial number:	000010	
Test Performed:	IP-6x		Lot:	000011	
Date	Time	Remarks			Initials
		IP Designation: IP-6x Enclosure Category: 1 – Air pressure reduced within the enclosure			CS
		Dust: 2 kg of talcum powder per cubic meter of the test chamber volume			CS
7/18/2025	900	Samples (2) were affixed with a hose fitting to allow for pulling a vacuum on the internal cavity of each sample. Each sample was torqued to 8in lbs.			CS
7/18/2025	915	Samples were set up within the dust chamber			CS
7/18/2025	915	The customer provided details that the sample internal volume = 560 cm ³			CS
7/18/2025	915	Per the IEC specification, the target flow for the test shall be 373.30 to 559.95 CC per minute			CS
7/18/2025	920	The chamber was sealed. A vacuum of 2kPA within the sample was achieved without reaching the target flow. Additionally, no measurable flow was achieved, therefore the test duration was set at 8 hours			CS
7/18/2025	920	Began the 8-hour exposure			CS
7/21/2025	900	The 8-hour exposure was completed. Opened the chamber, cleared away all the dust from the sample, and removed it from the chamber			CS
		Test Results = Both samples were opened and inspected for signs of dust ingress. No signs of dust ingress was observed within each sample			CS
		Test complete			CS

5.1.4 Test Photographs



Pre-Exposure



Pre-Exposure



Pre-Exposure



Post Exposure



Post Exposure



Post Exposure



Post Exposure



Post Exposure



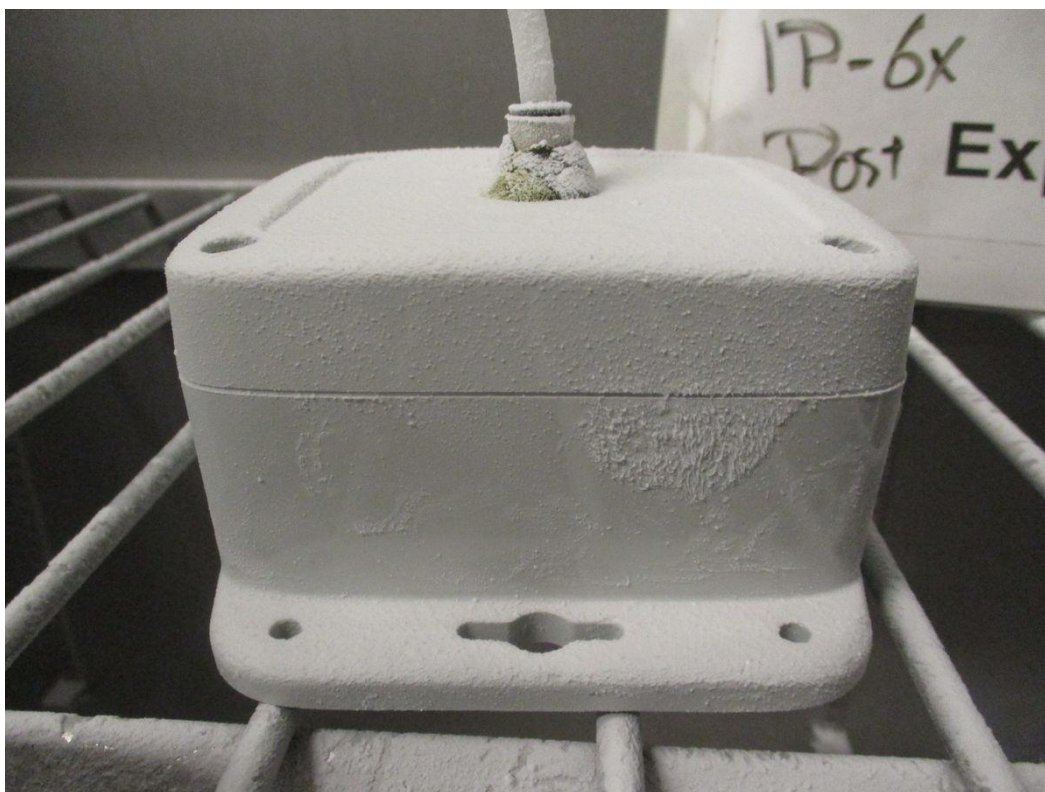
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Post Exposure



Post Exposure



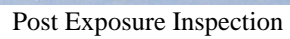
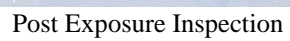
Post Exposure



Post Exposure



Post Exposure





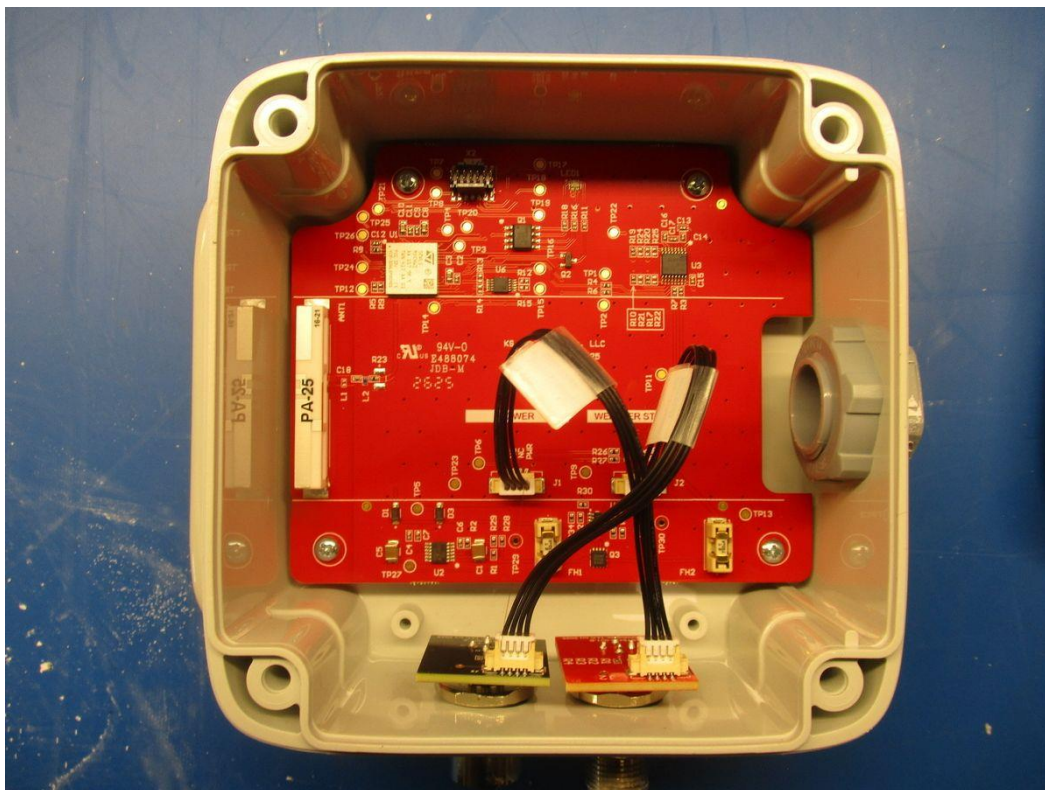
Post Exposure Inspection



Post Exposure Inspection



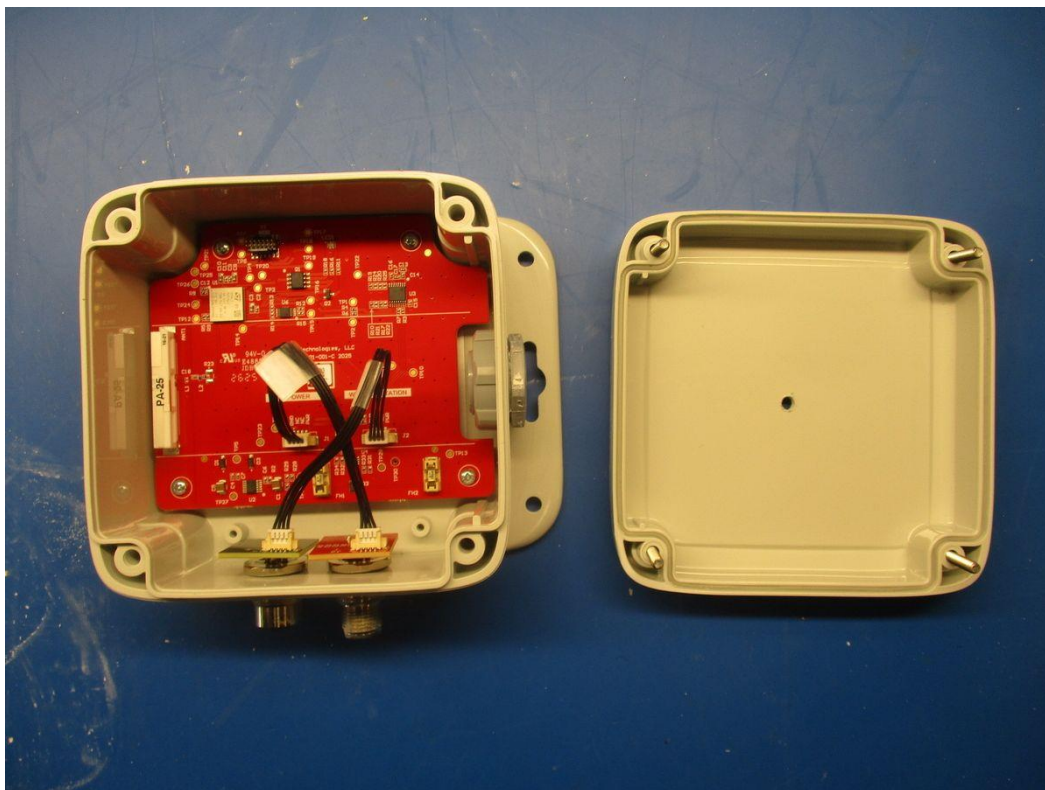
Post Exposure Inspection



Post Exposure Inspection



Post Exposure Inspection



Post Exposure Inspection



Post Exposure Inspection



Post Exposure Inspection



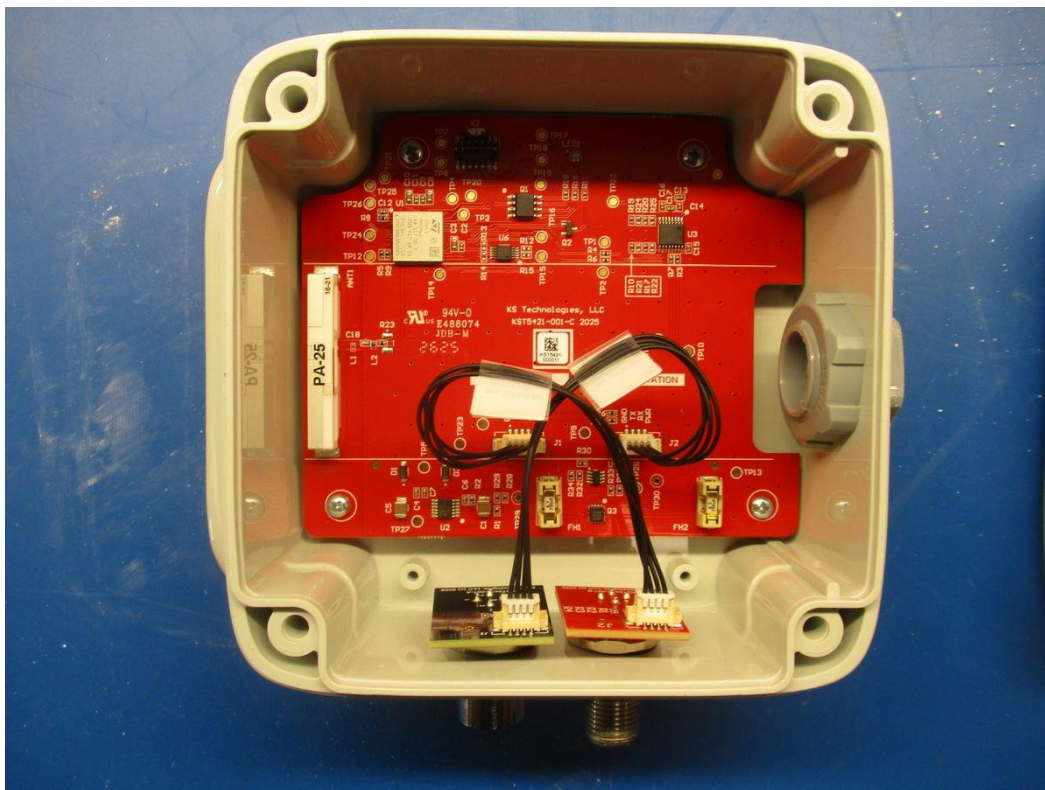
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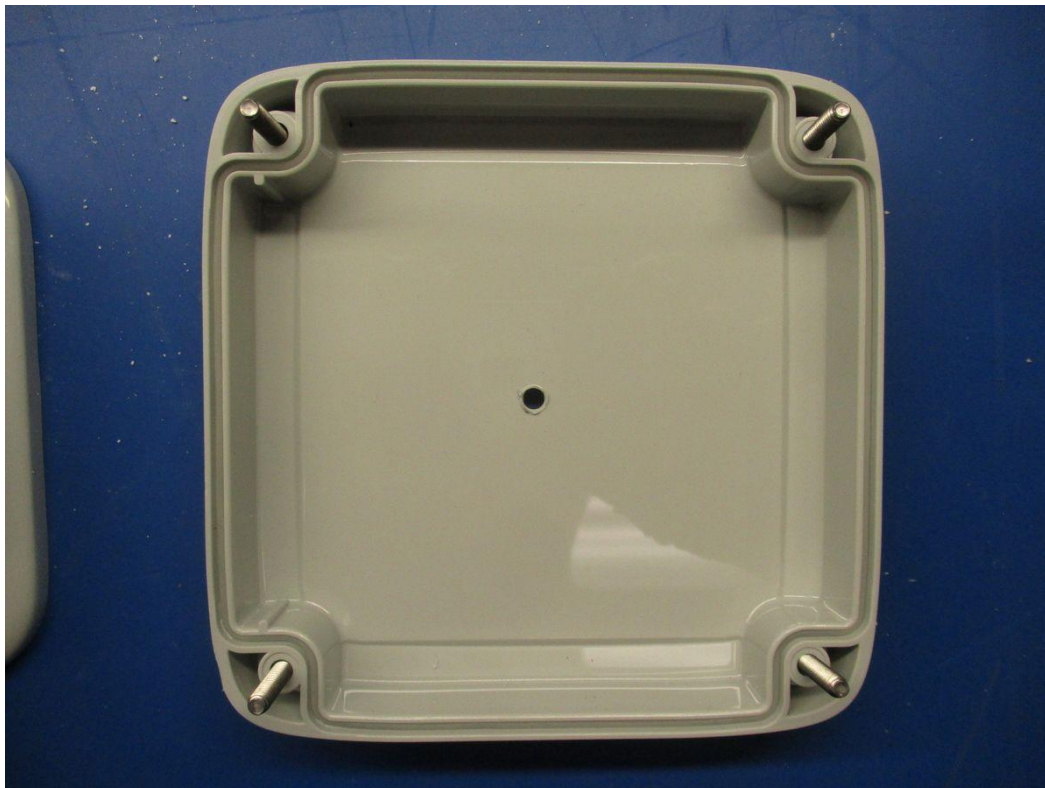
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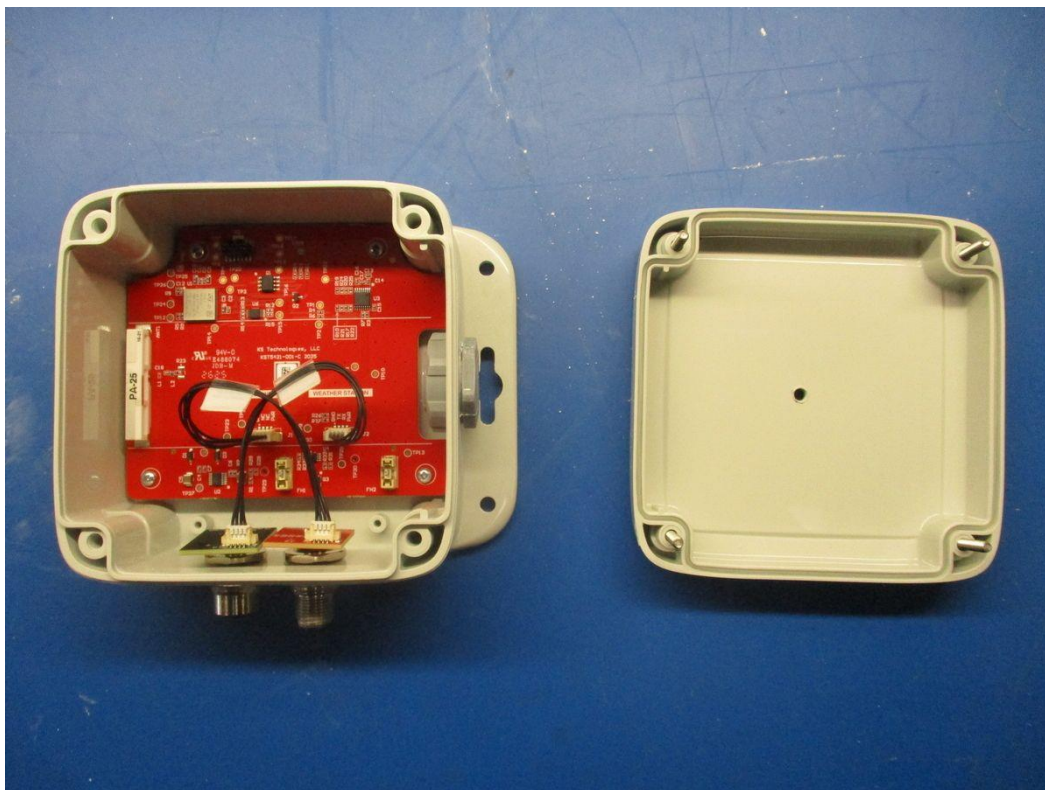
Post Exposure Inspection



Post Exposure Inspection



Post Exposure Inspection



Post Exposure Inspection



Post Exposure

5.1.5 Test Equipment List

Table 5.1-1: IP6X Test Equipment List

Asset Number	Asset Type	Manufacturer	Model	Calibrated	Due
WC080871	Chamber (Dust, Settling)	Thermotron	D27	NCR	NCR
WC070466	Meter (Hygrometer)	Fluke	971	07/09/2025	07/09/2026
WC080896	Wrench (Torque)	Proto Tool	J6169NMF	02/12/2025	02/12/2026
WC084344	Scale (Digital)	Mettler Toledo	PBA655-BC120	02/25/2025	02/25/2026
WC084362	Gauge (Vacuum)	Dwyer Instruments	2000-10KPA	06/18/2025	06/18/2026
WC084369	IP Test Dust	Powder Technology Inc	TALC (#399)	NCR	NCR
WC084448	Meter (Flow)	Dwyer Instruments	RMA-13_TMV	NCR	NCR

Calibration Abbreviations

CAL: Calibration

NCR: No Calibration Required

5.2 IPX7

5.2.1 Test Procedure

IEC 60529 Edition 2.2 2013-08

5.2.2 Test Result

The EUT showed no water ingress noted after the test was completed.

5.2.3 Test Datasheets

CLIMATICS TEST LOG					
Start Date:	7/17/2025	End Date:	7/17/2025	Job No:	PR191937
Customer:	KS Technology, LLC		Test Engineer:	Cam Storey	
Customer Witness:	N/A		Lab Temp:	73F	Lab Humidity: 60%
Part Name:	Impulse LoRa Modem (Qty: 2)		Part Number:	KST5421-US915 KST5421-US915	
Test Specification:	IEC 60529 Edition 2.2 2013-08			Serial number:	000010 000011
Test Performed:	IP-x7			Lot:	N/A
Date	Time	Remarks			Initials
		IP Designation: IP-x7			CS
		Test Means: Immersion tank water-level on enclosure 0.15 m above top, 1 m above bottom			CS
		Water Temperature: The water temperature does not differ from that of the specimen by more than 5 K			CS
		Test Duration: 30 minutes			CS
7/17/2025	1115	Samples were placed in a cage with a rope that measures out to 1 meter			CS
7/17/2025	1124	Samples were then placed in a chamber to condition so the samples temperature is within 5 K of the water temperature. Water temperature = +23C			CS
7/17/2025	1431	Samples were then exposed to water immersion at 1 meter for a duration of 30 minutes			CS
7/17/2025	1501	Samples have completed the exposure and were removed from the tank			CS
		Test Results = Both samples were opened and inspected for signs of water intrusion. No signs of water intrusion were found within either sample			CS
		Test complete			CS

5.2.4 Test Photographs



Pre-Exposure



Pre-Exposure



Pre-Exposure



Pre-Exposure



Pre-Exposure



Pre-Exposure



Pre-Exposure



Pre-Exposure



Pre-Exposure



Pre-Exposure



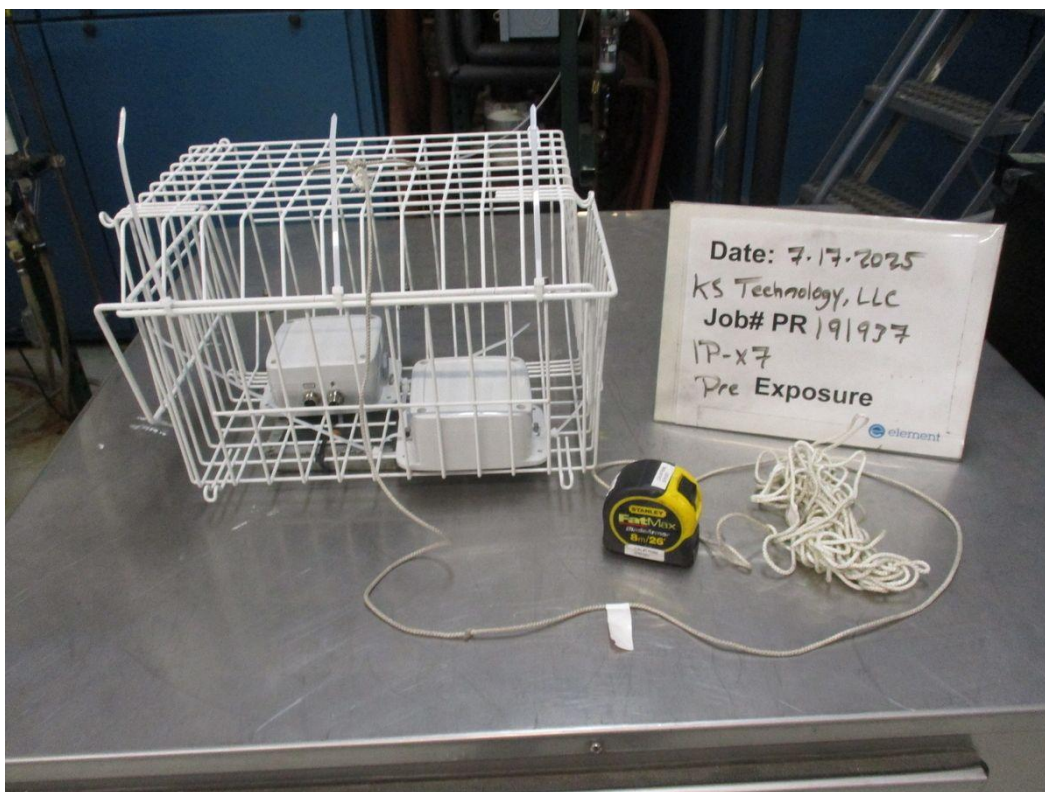
Pre-Exposure



Pre-Exposure



Setup



Setup



Conditioning



Exposure



Exposure



Exposure



Timer



Post Exposure



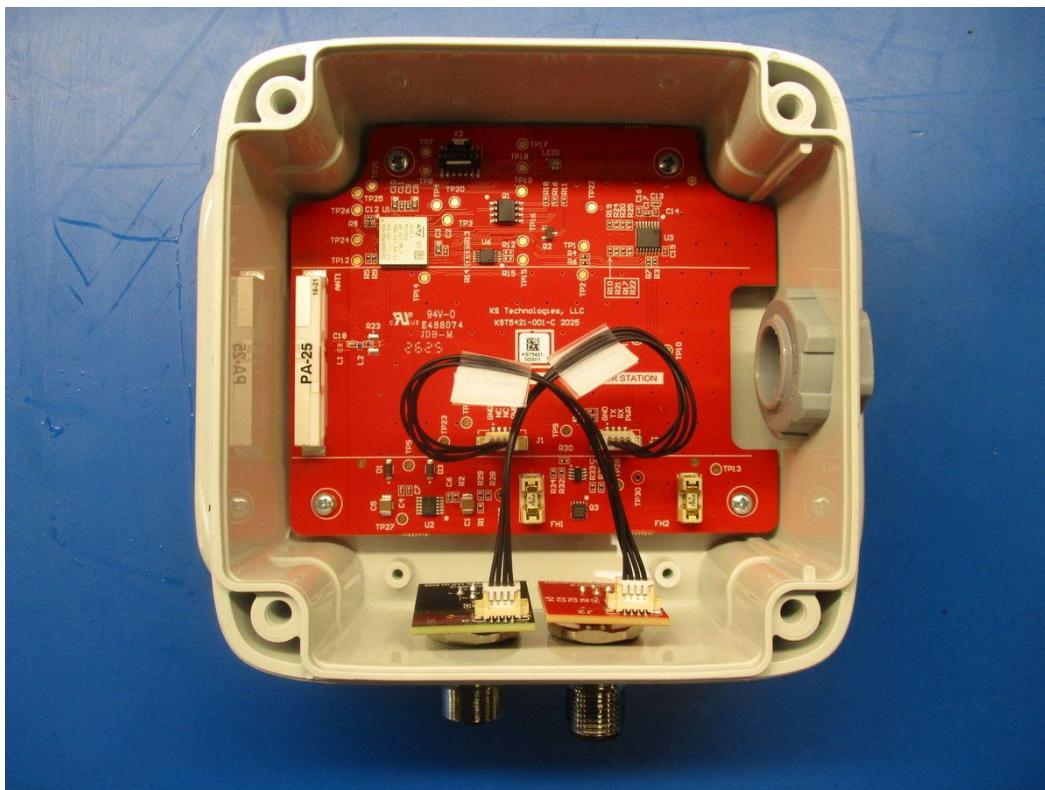
Post Exposure



Post Exposure



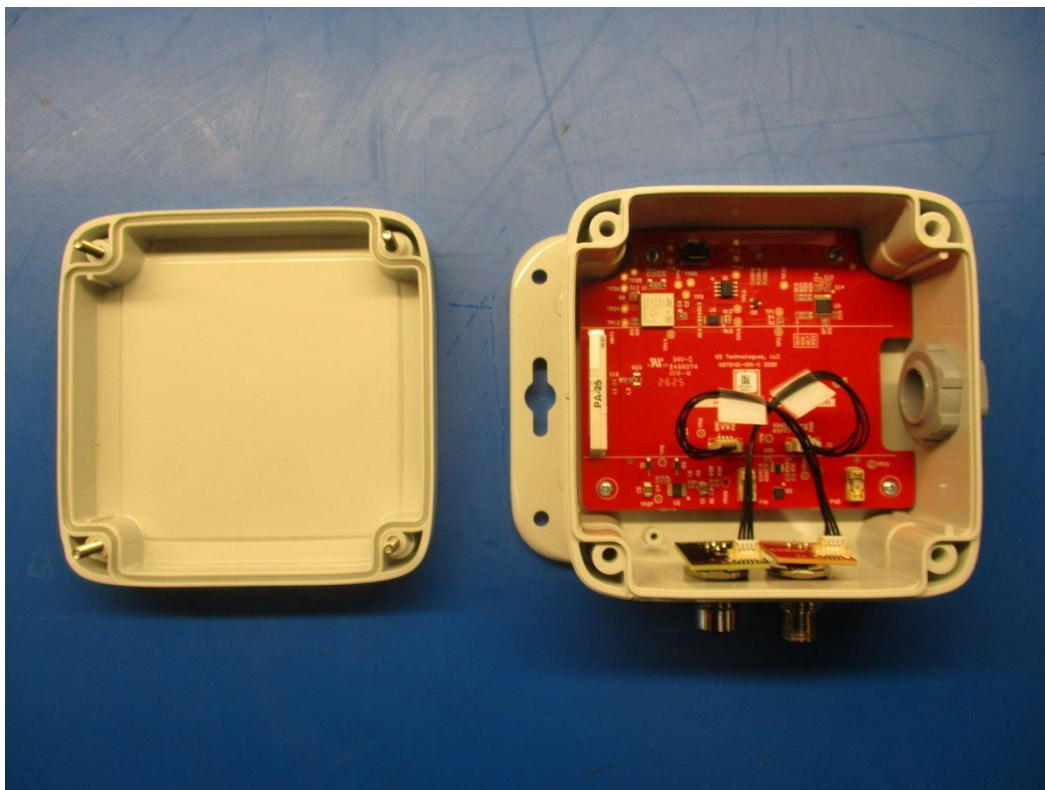
Post Exposure Inspection



Post Exposure Inspection



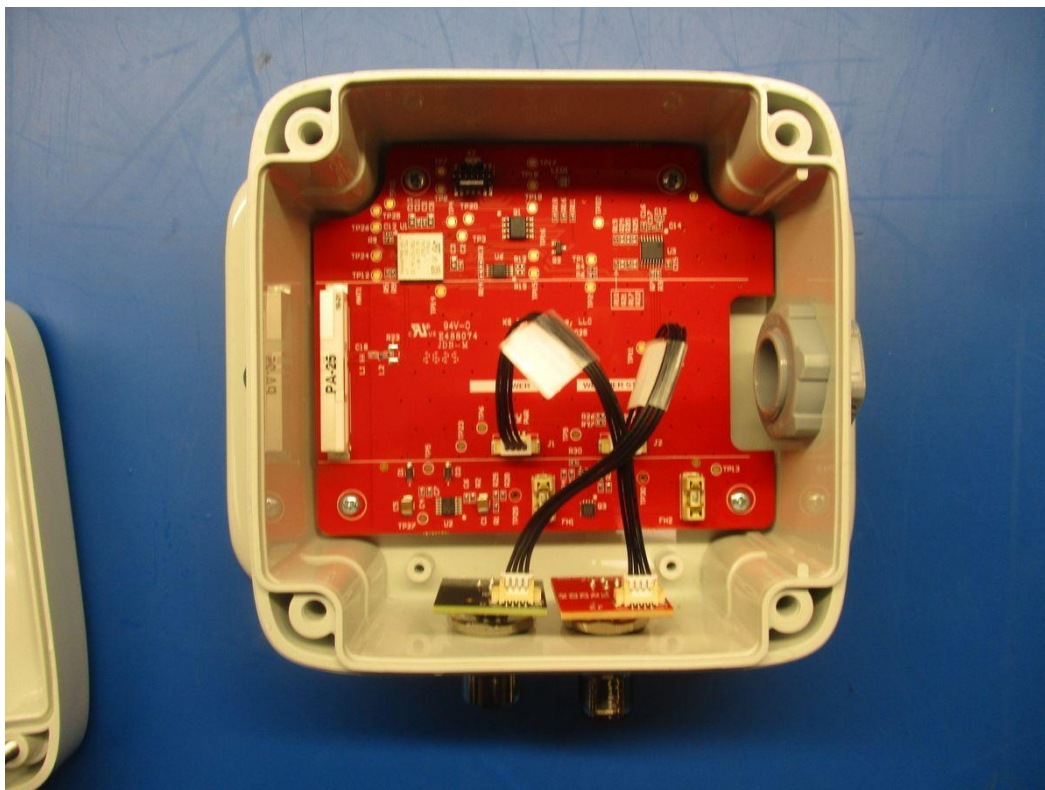
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Post Exposure Inspection



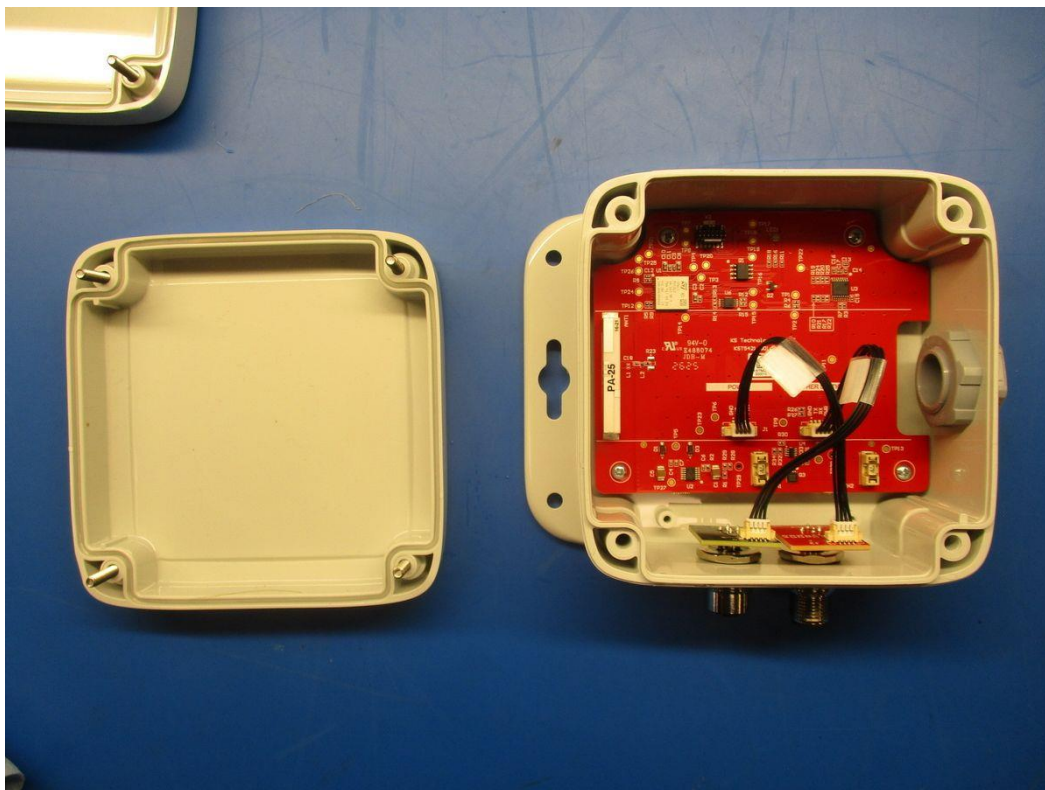
Post Exposure Inspection



Post Exposure Inspection



Post Exposure Inspection

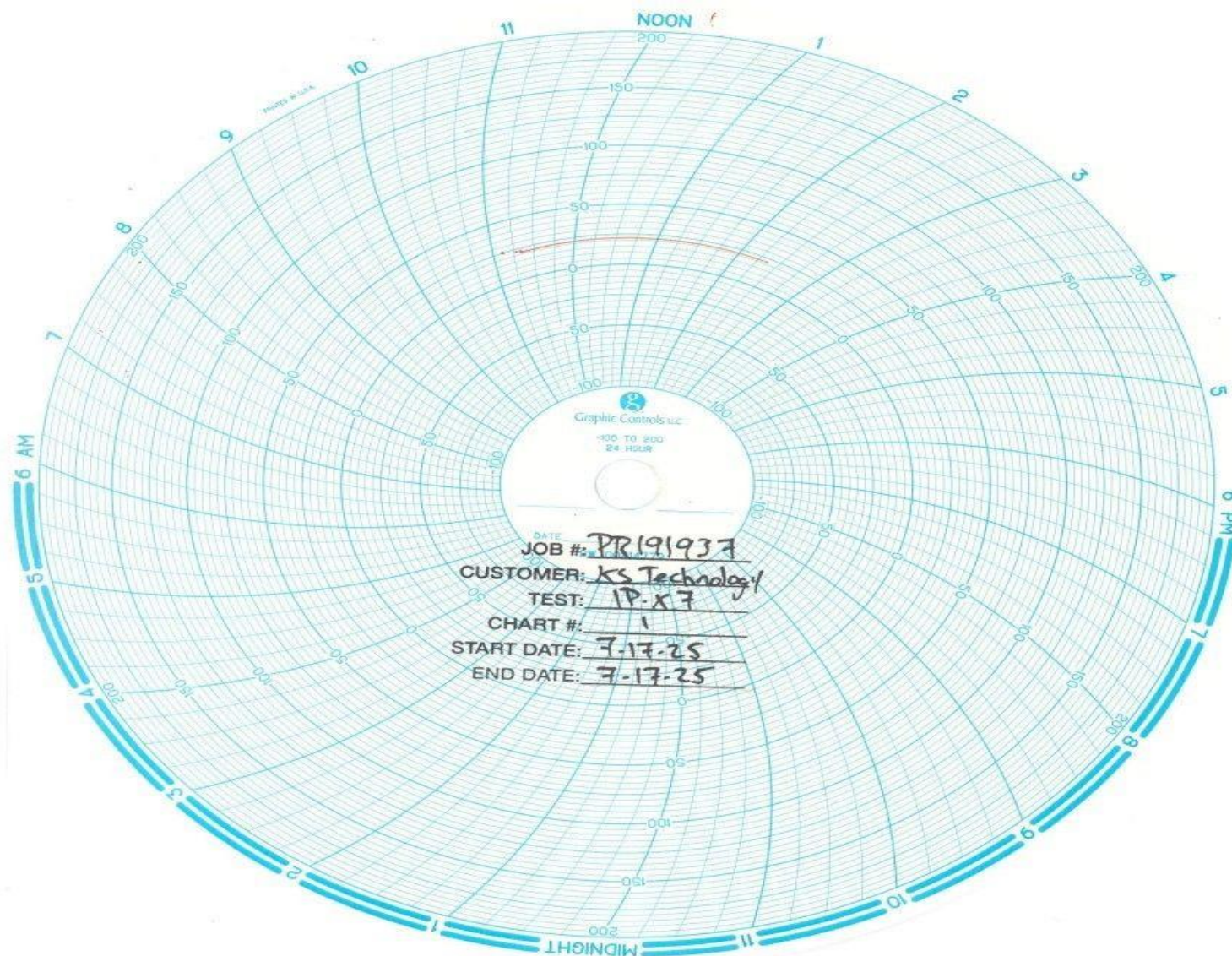


Post Exposure Inspection



Post Exposure

5.2.5 Test Data



5.2.6 Test Equipment List

Table 5.2-1: IPX7 Test Equipment List

Asset Number	Asset Type	Manufacturer	Model	Calibrated	Due
WC084345	Chamber (Temperature)	Cincinnati Sub-Zero (CSZ)	Z-32-2-2-H/WC	11/08/2024	11/08/2025
WC061417	Calibrator (Thermocouple)	Omega Engineering	CL27	11/21/2024	11/21/2025
WC070466	Meter (Hygrometer)	Fluke	971	07/09/2025	07/09/2026
WC080932	Stopwatch (Digital)	Digi	94460-28	03/21/2024	03/21/2026
WC084240	Measurement Tools (Tape Measure)	Stanley	33-726	07/03/2025	07/03/2026
WC084400	Tank (Immersion)	Element	01	NCR	NCR

Calibration Abbreviations

CAL: Calibration

NCR: No Calibration Required

End of Test Report