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Eco Electrical Systems

ECC-UHC-FR Cutout Wildlife Protective Covers
IEEE 1656-2010

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REPORT OF PERFORMANCE

CLIENT/MANUFACTURER	Eco Electrical Systems 7635 Rocky Flats Ct. Reno, NV USA 89502
TEST OBJECT	ECC-UHC-FR Cutout Cover System Voltage: 27 kVrms
TESTED BY	Powertech Labs Inc. 12388 - 88th Ave, Surrey, BC Canada V3W 7R7 www.powertechlabs.com
DATE RECEIVED	2020-11-30, 2021-03-17
TEST DATE(S)	2021-01-12 to 2021-04-06
TEST SPECIFICATION	IEEE 1656-2010, Clauses 5.2, 5.3, 5.4, 5.9.3
TEST RESULT	PASS

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1 INTRODUCTION

At the request of Eco Electrical Systems, ECC-UHC-FR cutout wildlife protective covers, manufactured by Eco Electrical Systems, were subjected to wet withstand, wet power-frequency flashover, lightning impulse, and high-current (power arc) tests in accordance with IEEE 1656-2010 and the customer's specifications. This report summarizes the results of the tests performed.

2 TEST OBJECT INFORMATION

The test object was identified based on the nameplate information as follows:

Manufacturer:	Eco Electrical Systems
Type:	ECC-UHC-FR Cutout Wildlife Protective Cover
PAT No.:	10679815
Test fixture:	Hubbell 27 kV, 150 kV BIL Fuse Cutout
Condition:	New

3 GENERAL INFORMATION

3.1 Purpose

The purpose of the test was to verify if the test object complies with the requirements of the standard.

3.2 Witnesses

None.

3.3 Tests Performed

Test Standards/Specifications

IEEE 1656-2010	Clause 5.2 – Wet withstand Clause 5.3 – Wet power frequency flashover Clause 5.4 – Lightning impulse withstand Clause 5.9.3 – High current (power arc) tests

4 WET WITHSTAND

General Information:

Standard	IEEE 1656-2010, Clause 5.2
Test Date	2021-01-12 to 2021-01-14
Test Leader	Alex Webb

Environmental Conditions:

Ambient temperature	16.6 °C
Barometric Pressure	770 mmHg

Precipitation Conditions:

Vertical rain rate	1.4 mm/min
Horizontal rain rate	1.6 mm/min
Conductivity	101.5 µS/cm

Test Conditions:

Test voltage	18.7 kV
Frequency	60 Hz

An ECC-UHC-FR cutout wildlife protective cover was installed on a Hubbell 27 kV, 150 kV BIL polymer fuse cutout with the fuse in the closed position. The cutout was mounted on a crossarm and fitted with bare #6 AWG conductor and energized to 120% of rated line-to-ground voltage.

The wildlife protective cover was then subjected to a wet withstand test using Option 1 – Moving electrode. A live-line tool with a grounded probe was brought in contact with and moved across the entire surface of the guard to within 5 cm of the bare energized conductor. The test was repeated on 3 samples of wildlife protective covers.

The test was then repeated on all 3 covers with an alternate design of ribbed locking pins and on all 3 samples without the front extension in place. At the request of the customer, the test was repeated on all three wildlife protective covers using insulated #6 AWG conductor. In this case, the grounded electrode was moved across the entire surface of the guard. This test was performed using the normal locking pins without the front extension in place.

Photographs of the test setup can be found in Appendix D.

Requirements:
The wildlife guard passes the test if all three samples do not puncture or flash over.

Evaluation:
No punctures or flashovers occurred as the grounded probe was brought in contact with and moved across the entire surface of the guard to within 5 cm of the bare energized conductor in any of the sample configurations, or when the grounded probe was swept over the entire surface of the guards with insulated conductor installed.

Extension	Pins	Conductor	Surfaces Touched	Result
In Place	Regular	Bare #6 AWG	Up to 5 cm	PASS
Removed	Regular	Bare #6 AWG	Up to 5 cm	PASS
Removed	Ribbed	Bare #6 AWG	Up to 5 cm	PASS
Removed	Regular	Insulated #6 AWG	All	PASS

Result
PASS

5 WET POWER FREQUENCY FLASHOVER

General Information:

Standard	IEEE 1656-2010, Clause 5.3
Test Date	2021-01-27
Test Leader	Alex Webb

Environmental Conditions:

Ambient temperature	17.6 °C
Barometric Pressure	748 mmHg

Precipitation Conditions:

Vertical rain rate	1.8 mm/min
Horizontal rain rate	1.6 mm/min
Conductivity	95.2 µS/cm

Test Conditions:
A Hubbell 27 kV, 150 kV BIL polymer fuse cutout was subjected to 5 power-frequency flashovers in accordance with ANSI C29.1-1988 with the fuse in the closed position. The cutout was then fitted with an ECC-UHC wildlife protective cover and the power-frequency flashover test was repeated. The test was performed on 3 samples of wildlife protective covers.

Photographs of the test setup can be found in Appendix B.

Requirements:
The wildlife protective covers pass the test if the average flashover value of all three samples is not less than 90% of the value obtained on the fuse cutout alone.

Evaluation:

Sample	Individual Uncorrected Flashover values (kV)					Average uncorrected flashover (kV)	Average corrected flashover (kV)
Cutout only	64.9	61.8	65.1	64.5	63.0	63.9	64.1
Cover #1	66.4	66.6	63.9	66.2	69.8	66.6	66.8
Cover #2	65.7	62.7	58.7	67.3	66.0	64.1	64.3
Cover #3	58.0	66.5	65.6	67.8	58.3	63.2	63.4

The average flashover value of each device exceeded 90% of the fuse cutout alone.

Result
PASS

6 LIGHTNING IMPULSE WITHSTAND

General Information:

Standard	IEEE 1656-2010, Clause 5.4
Test Date	2021-02-03
Test Leader	Alex Webb

Environmental Conditions:

Ambient temperature	16.7 °C
Relative Humidity	43.2 %
Barometric Pressure	761 mmHg

Test Conditions:

Specified test voltage:	150 kV_{peak}
Corrected test voltage:	151.9 kV_{peak}
Waveform:	1.2/50 µs

Three ECC-UHC wildlife protective covers were mounted, one at a time, on to a Hubbell 27 kV, 150 kV BIL polymer fuse cutout. The fuse cutout and cover were then subjected to 3 positive and 3 negative lightning impulses with the fuse cutout in each of the following configurations:

Configuration	Fuse position	HV Applied	Grounded
Terminal-to-ground	Closed	Upper Terminal	Bracket
Terminal-to-terminal	Open	Upper Terminal	Lower Terminal

Example waveforms are provided in Appendix A, and photographs of the test setup in Appendix D.

Requirements:
If no disruptive discharge occurs during any of the three consecutive impulses, then the device has passed the test. If more than one disruptive discharge occurs, then the device has failed the test. If one disruptive discharge occurs, then nine additional impulses of the test voltage specified are applied, and if no disruptive discharge occurs, then the device has passed the test. If failure occurs in a non-self-restoring part of the insulation, then the device has failed the test

Evaluation:
A single flashover was observed during the 3 negative impulses on the first and second samples in the terminal-to-ground configuration. In each case, the samples withstood the additional 9 impulses without any additional flashovers. No flashovers were observed during either series of 3 impulses on the third sample.

Result
PASS

7 HIGH CURRENT (POWER ARC) TESTS

General Information:

Test Standard	IEEE Standard 1656-2010, Clause 5.9.3
Test Date	2021-04-06
Test Leader	Eric Li

Environmental Conditions:

Ambient temperature	8-15 °C
Relative Humidity	48-65 %

Test Conditions:

High current (power arc) tests were performed at 60 Hz using the single-phase circuit shown in Figure 1. The tests were performed at 15.7 kV phase-to-ground for a 27 kV system. Three samples were tested with the same Hubbell 27 kV fuse cutout.

In each test, the source side terminal of the cutout was connected to lab power source with #6 AWG bare copper wire; the mounting bracket was connected to lab ground; the load side terminal of the cutout was not connected. A #24 AWG copper fuse wire was installed across the surface of the wildlife guard sample, between the source side terminal of the cutout and the mounting bracket bolt. Pictures of the test setup are provided in Figures 7 and 8.

The test values measured during testing are given below:

Test No.	Sample No.	Source Voltage [kV_{rms}]	Current		Waveform
			Symmetrical [kA_{rms}]	Duration [ms]	
#1	2276-4A	15.9	10.4	175	Figure 4
#2	2276-5A	15.7	10.2	175	Figure 5
#3	2276-6A	15.8	10.3	175	Figure 6

Requirements:
The wildlife guard passes the test if all samples self-extinguish without signs of melting.

Evaluation:
The three samples completed the tests with no flames or signs of melting. A picture of the samples after tests is provided in Figure 12

Result
PASS

APPENDIX A – LIGHTNING IMPULSE WAVEFORMS

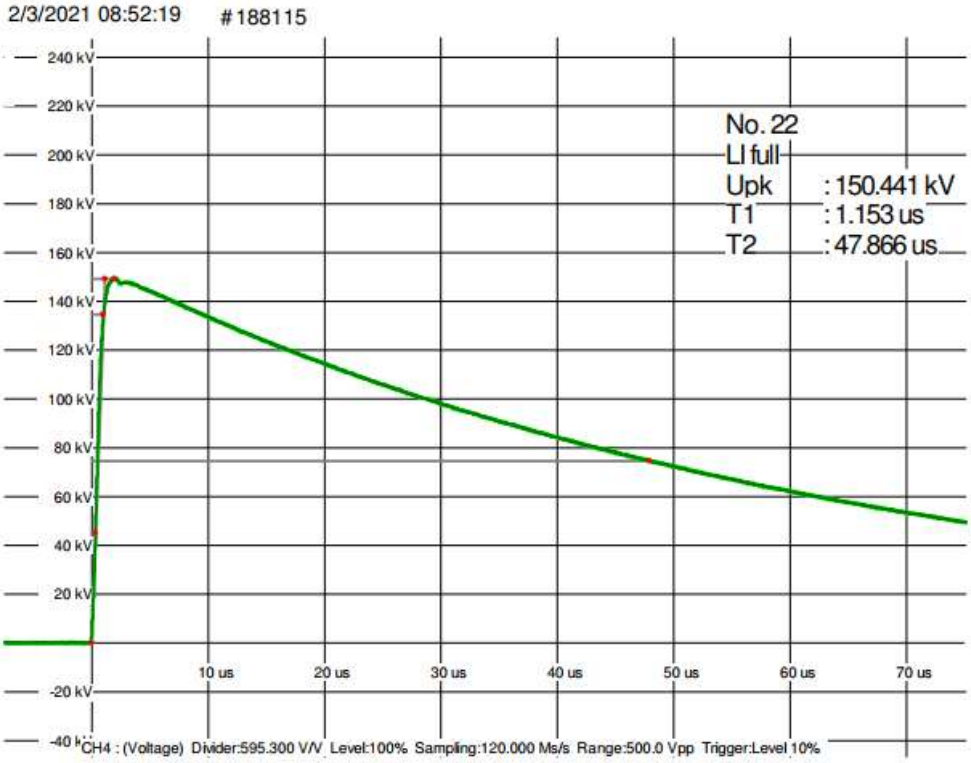

Figure 1. Example positive lightning impulse waveform

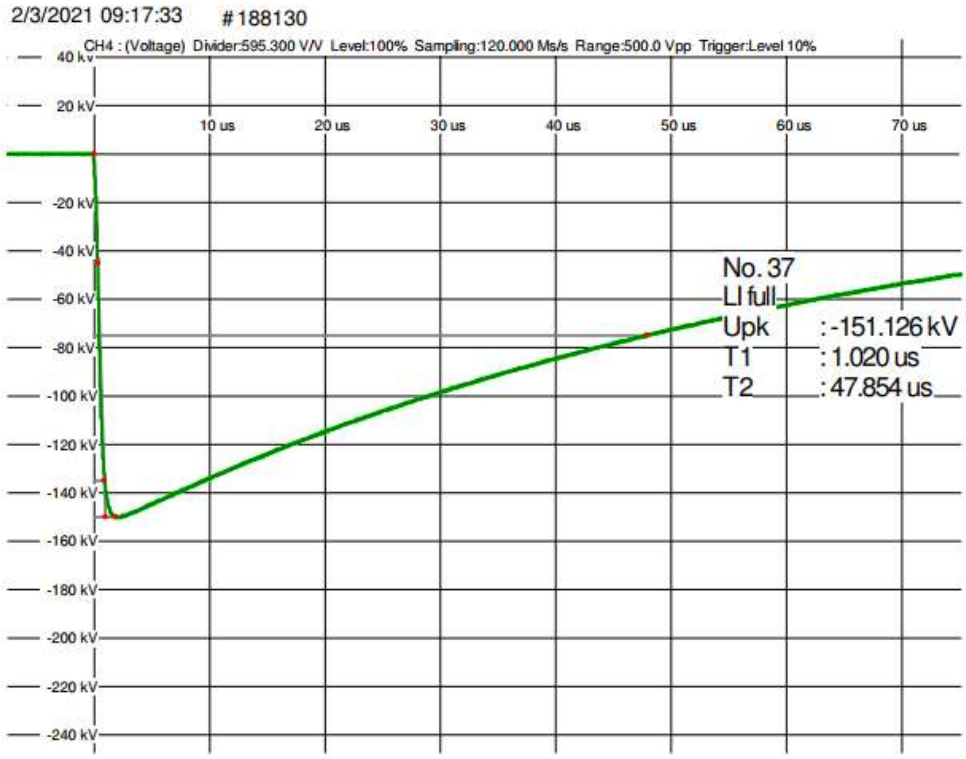

Figure 2. Example negative lightning impulse waveform

APPENDIX B – HIGH-CURRENT (POWER ARC) SCHEMATIC AND WAVEFORMS

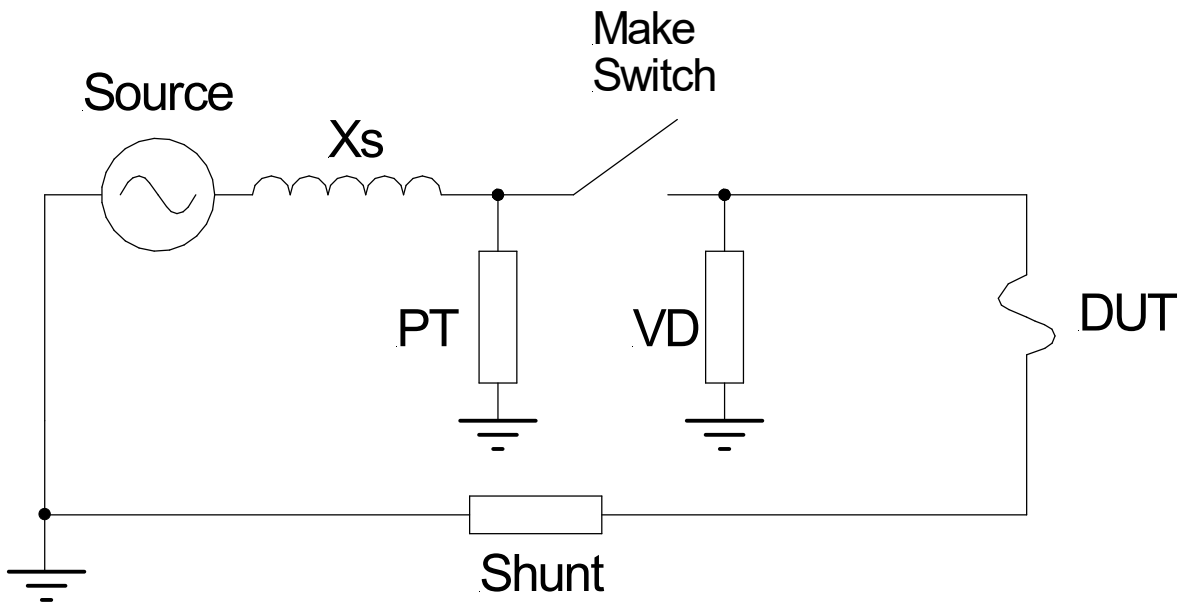

Figure 3. Test circuit schematic

Notes:

1. *Xs – Source current limiting reactance*
2. *PT, VD – Source voltage measurements*
3. *DUT – Device under test*
4. *Shunt – Current measurements*

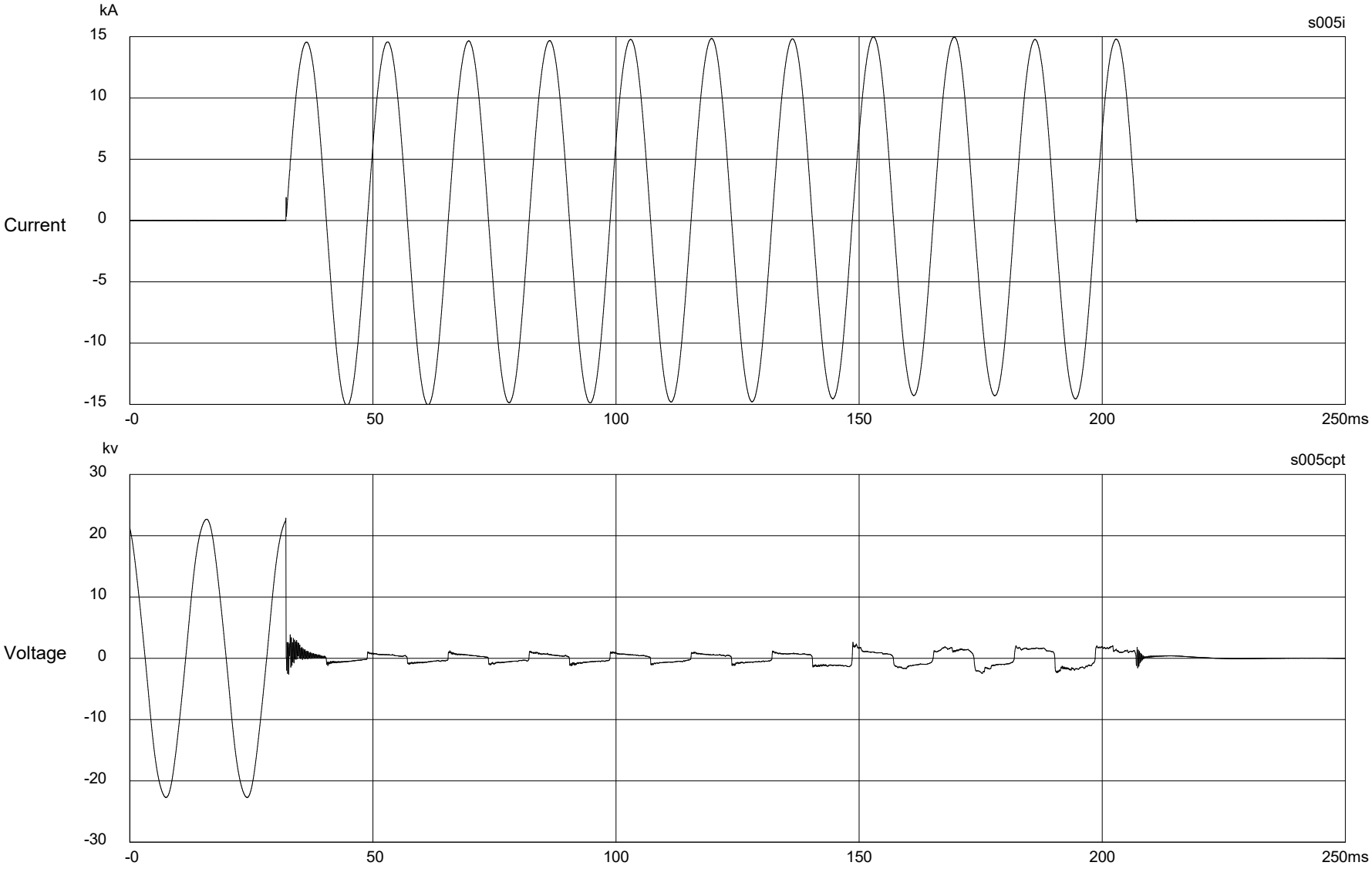

Figure 4. Waveforms for Test #1 on sample #2276-4A.

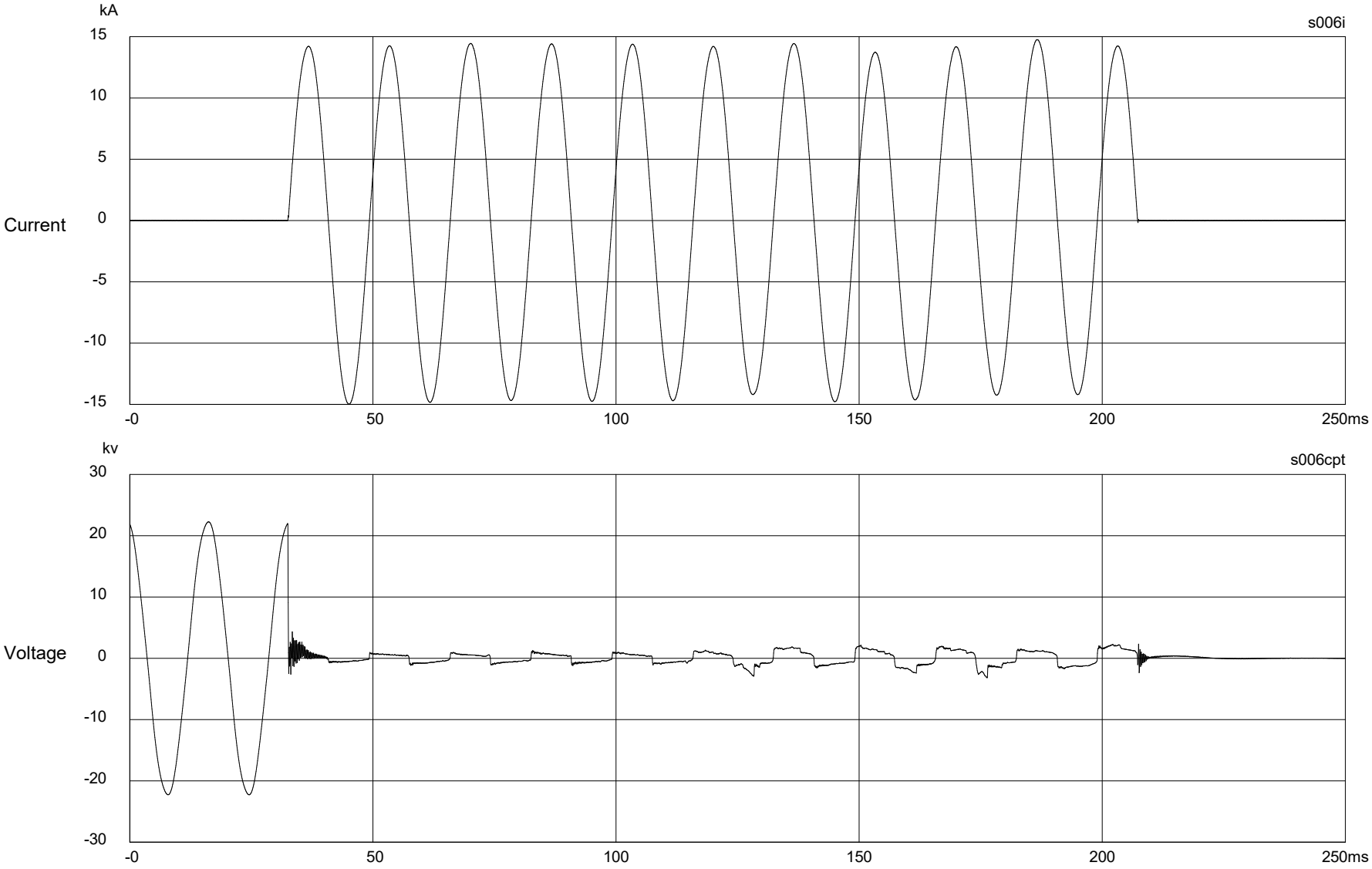

Figure 5: Waveforms for Test #2 on sample #2276-5A.

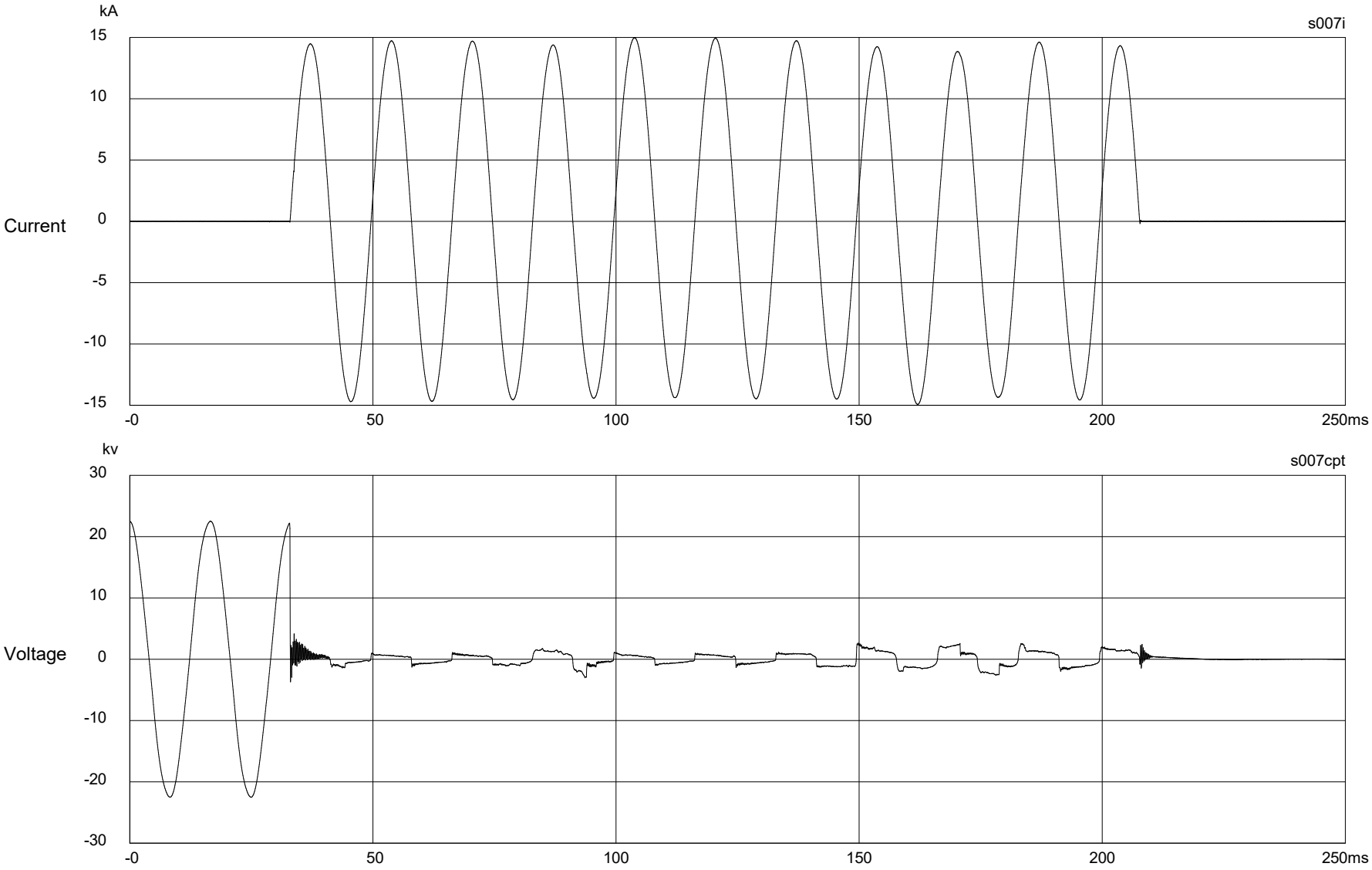

Figure 6: Waveforms for Test #3 on sample #2276-6A.

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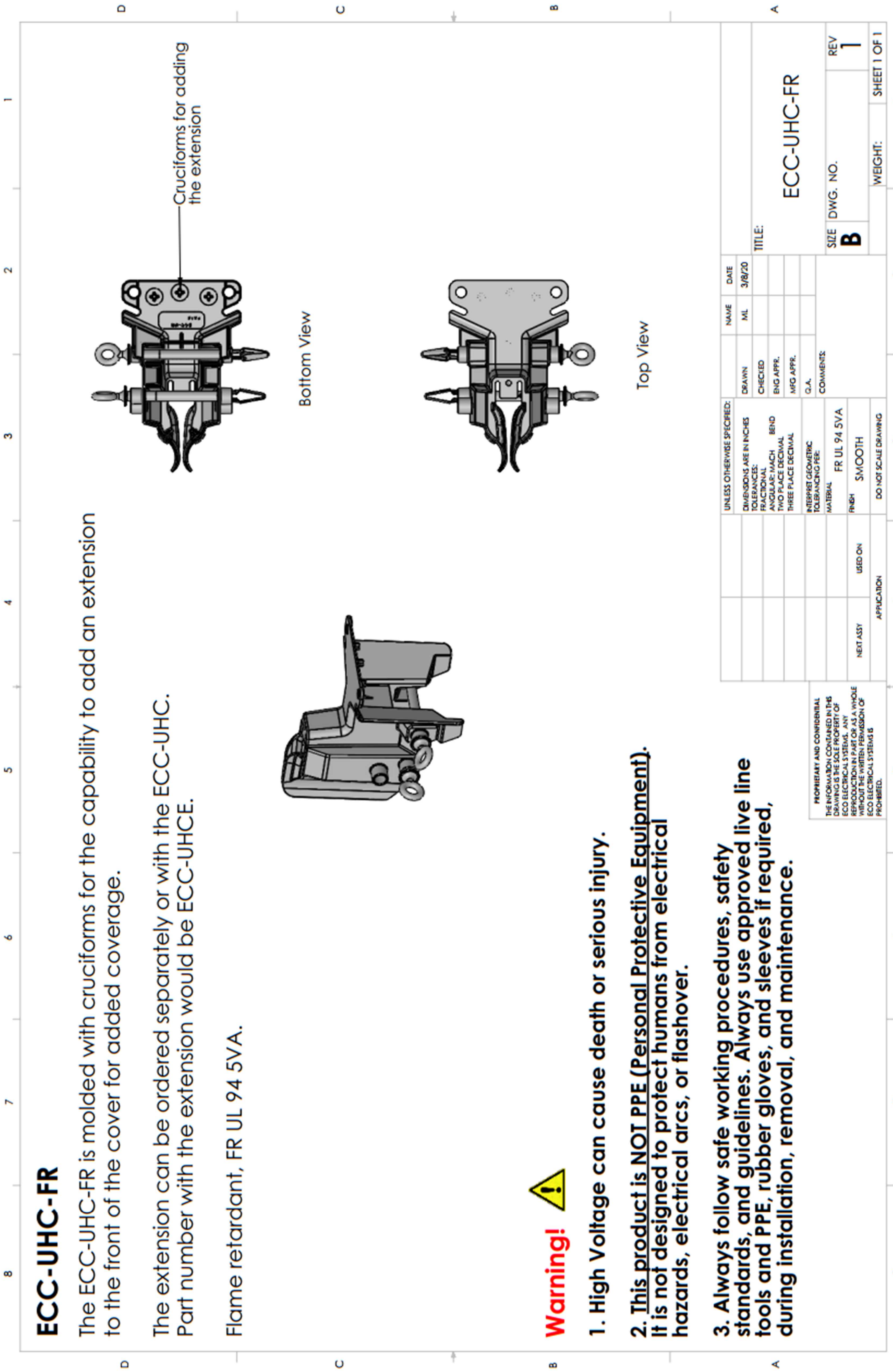
APPENDIX C – MANUFACTURER'S DRAWING



APPENDIX D – PHOTOGRAPHS OF THE TEST OBJECT

Figure 7. Lightning impulse withstand test setup

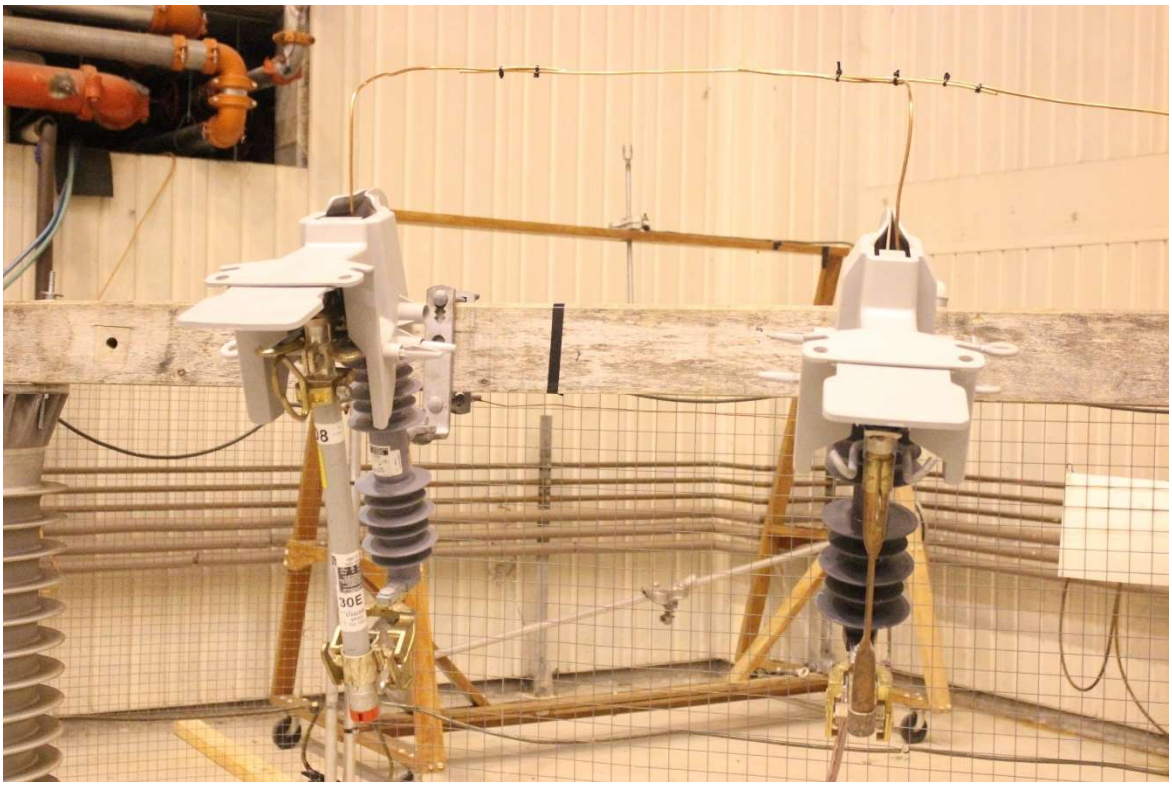


Figure 8. Wet withstand and wet power-frequency flashover test setup (ECC-UHC-FR shown on right)

Figure 9: Setup for the high current (power arc) tests.

Figure 10. Setup for the high current (power arc) tests.

Figure 11. Setup for the high current (power arc) tests, fuse wire.

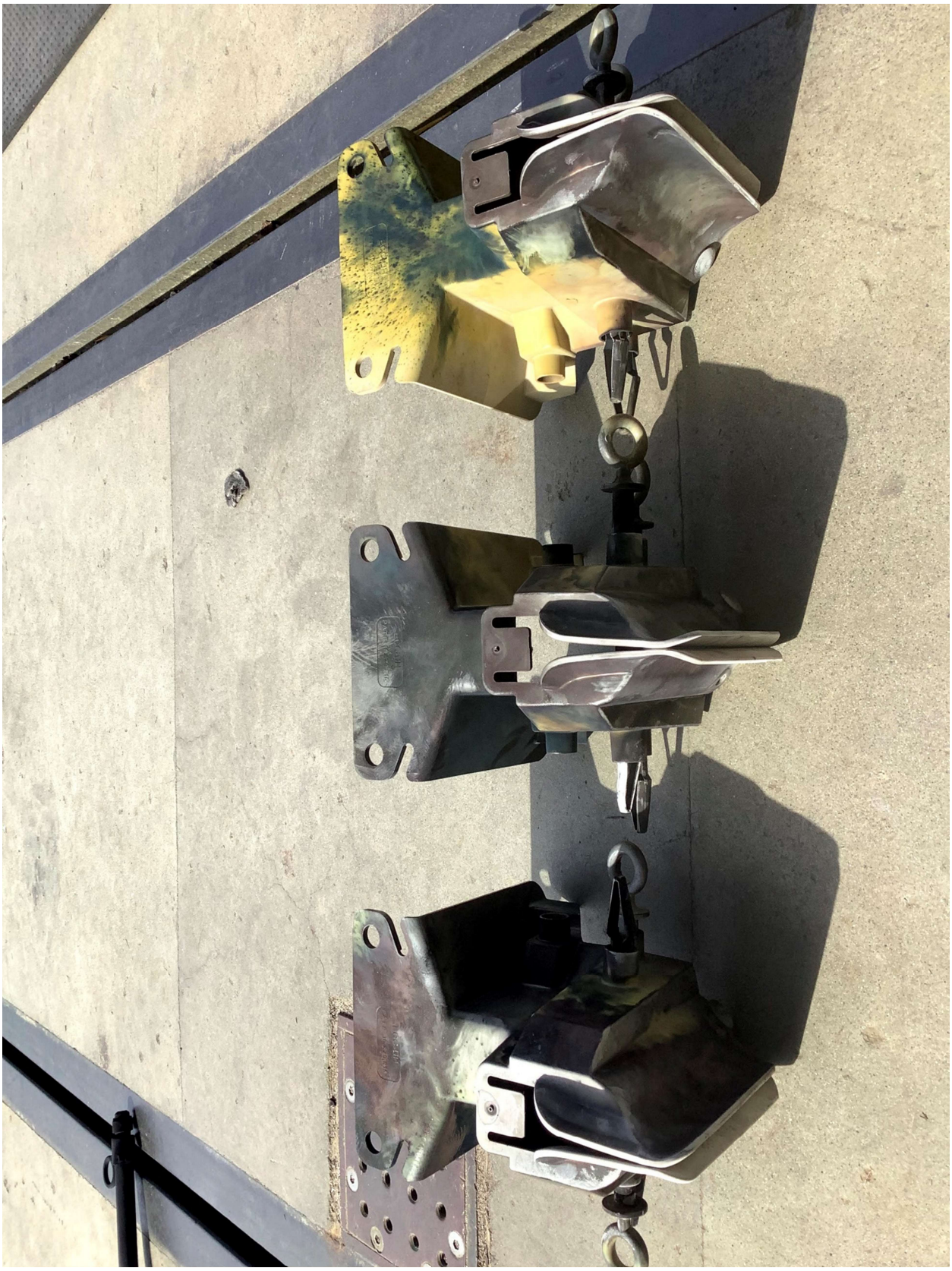


Figure 12. Samples after the high current (power arc) tests.

APPENDIX D – EQUIPMENT CALIBRATION

Description	Manufacturer	Model	Powertech ID	Calibration Due
AC voltage divider	Phenix	DVD200X	10348	June 12, 2021
Multimeter	Fluke	289	34066	April 30, 2021
HV impulse analyzer	Haefely	HiAS 743	HV031107	March 29, 2021
Ratio meter	Haefely	RM430	HV031146	August 20, 2021
Conductivity meter	Oakton	CON150	34601	Feb. 24, 2021
Weather station	Control Company	76047-584	34193	July 25, 2021

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APPENDIX F – REVISION HISTORY

Revision	Document Date	Description of Change
0	2021-05-12	New document.
1	2021-07-19	• Client address corrected