TEST REPORT

2023US0048

DATE OF RECEPTION
Date Format: dd/MM/yyyy 15/02/2023

DATE TESTS
Starting: 20/02/2023
Ending: 21/03/2023

APPLICANT

Flamesafe Workwear USA Ltd
1820 Avenue M, Suite 1086
US-11230 NEW YORK
United States

Att. Peter Bloom

IDENTIFICATION AND DESCRIPTION OF SAMPLES

Reference by AITEX	Reference by customer	AITEX sample description
2023US0048-S01	KFMOD026	Knitted fabric

TESTS CARRIED OUT

- PRE-TREATMENT FOR DOMESTIC WASHING AND DRYING PROCEDURES FOR TEXTILE TESTING.
- MASS PER UNIT AREA.
- ELECTRIC ARC EXPOSURE TEST: DETERMINATION OF THE ARC RATING (ATPV OR E_{BT50}) OF FLAME RESISTANT MATERIALS FOR CLOTHING

Tests marked with * are not included within the scope of the ENAC accreditation

DESCRIPTION OF SAMPLES

Reference by AITEX: 2023US0048-S01

Reference by customer:

KFMOD026

Information supplied by the customer

Information suministred by client:
Style KFMOD026 Colour hi-vis yellow

Manufacturer FLAMESAFE WORKWEAR USA,LTD Woven fabric 0; Knitted fabric 1; Non-woven 0 Fabric structure Jacquard eyelet fabric Fiber content and percentages 60%MODACRYLIC,40% COTTON
Weight 220g/m2 or 6.5oz/yd2

AITEX Subsamples	Subsample Description
2023US0048-S01.1	KFMOD026 AFTER WASH 3 CYCLES

EXECUTIVE SUMMARY

	Reference	Test/Standard	Result
ASTM F1506:22	2023US0048-S01.1	ELECTRIC ARC TEST (OPEN ARC) **ASTM F 1959 / F1959M:2022**	ATPV = 5,4 CAL/CM^2

REQUIREMENT SUMMARY

ELECTRIC ARC TEST (OPEN ARC)

REQUIREMENT ACCORDING ASTM F1959/F1959M−22

Arc rating values below 10 cal/cm^2 shall be reported to the nearest 0.1 cal/cm^2, and arc rating values above 10 cal/cm^2 shall be reported to the nearest 1 cal/cm^2.

Arc Flash PPE category according to standard NFPA70E Edition 2021 Table 130.7 (C) (16) - Personal Protective Equipment (PPE)

PPE Category	Minimum Arc Rating (cal/cm^2)
1	4
2	8
3	25
4	40

RESULTS

PRE-TREATMENT FOR DOMESTIC WASHING AND DRYING PROCEDURES FOR TEXTILE TESTING

Standard

AATCC TM 135:2018

Test date

Start date 20/02/2023 **End date** 21/02/2023

Washing procedure

IV

Washing temperature

49ºC

Washing cycles

3

Drying procedure

(Aiii) Tumble Dry Permanent Press

Washing powder

AATTC 1993 WOB

Reference
2023US0048-S01

Units	Dry mass of the samples(Kg)	Counterweight mass Kg *Kg*	Counterweight type	Equipment
1	2.7	0.9	---	WHIRLPOOL 13107I12

RESULTS

MASS PER UNIT AREA

Standard
ASTM D3776/3776M-20 (R2020) Option C

Conditioning date	20/02/2023	**Test date**	21/03/2023

Atmosphere for conditioning testing

Temperature	(21±1) ºC	**Relative humidity**	(65±2) %

Type of fabric
Knitting fabric

Number of specimens
1

Dimensions of specimens
500 cm^2

Reference	Mass per unit area (oz/yd^2)	Mass per unit area (g/m^2)
2023US0048-S01	6,42	218
2023US0048-S01.1	#NoNum#	#NoNum#

RESULTS

ELECTRIC ARC EXPOSURE TEST: DETERMINATION OF THE ARC RATING (ATPV or E_{BT50}) OF FLAME RESISTANT MATERIALS FOR CLOTHING

Standard

ASTM F1959/F1959M−22

Reference

2023US0048-S01.1

Test results

The test program includes minimum of twenty individual panel arc trials.

The following test data was recorded for each trial:

Arc exposure electrical conditions: arc trial number, RMS arc current, peak arc current, arc voltage, arc duration, energy dissipated in arc, plots of arc current and arc voltage.
Temperature rise response from two monitor sensors for each panel in each trial, plot of average responses from two monitor sensors.
Pictures after arc exposure.
Video

Essential test data and test results are presented in the following pages as follows:

Arc rating: ATPV or E_{BT50} or both and plots of the burn injury probability (ATPV) or break open probability (E_{BT50}) or both versus Ei.
Heat attenuation factor (HAF) and plot of HAF on Ei.
Test specimen description and order of layer.
Distance from an arc center line to the panel surface.
Subjective evaluation.
Pictures after arc exposure.
Ignition probability value (if determined during testing).

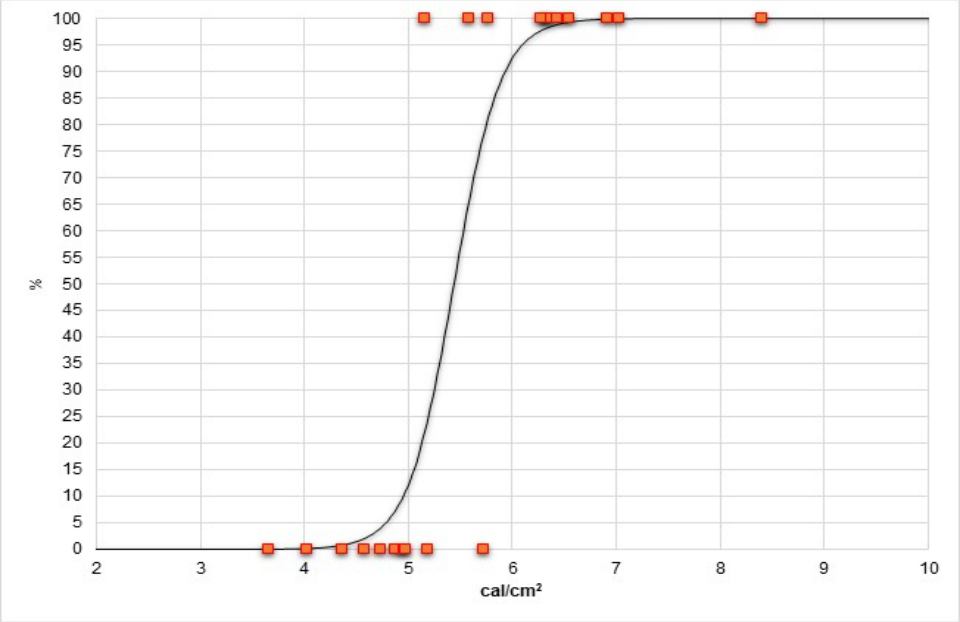
Test conditions	
Date test	06/03/2023 - 06/03/2023
Arc current	(8 ± 1) kA
Stainless steel electrodes, gap of the electrodes	(300 ± 5) mm
Distance between the electrodes and sample	(300 ± 5) mm
Fuse wire	0.5 mm
Number of samples tested	21
Starting and ending conditioning date	03/03/2023 - 06/03/2023
Conditioning	24 h; 21 ± 2ºC, 65 ± 5% HR.

Measurement uncertainty

±10%

Determination of ATPV, 50% of Probability of 2nd degree burn

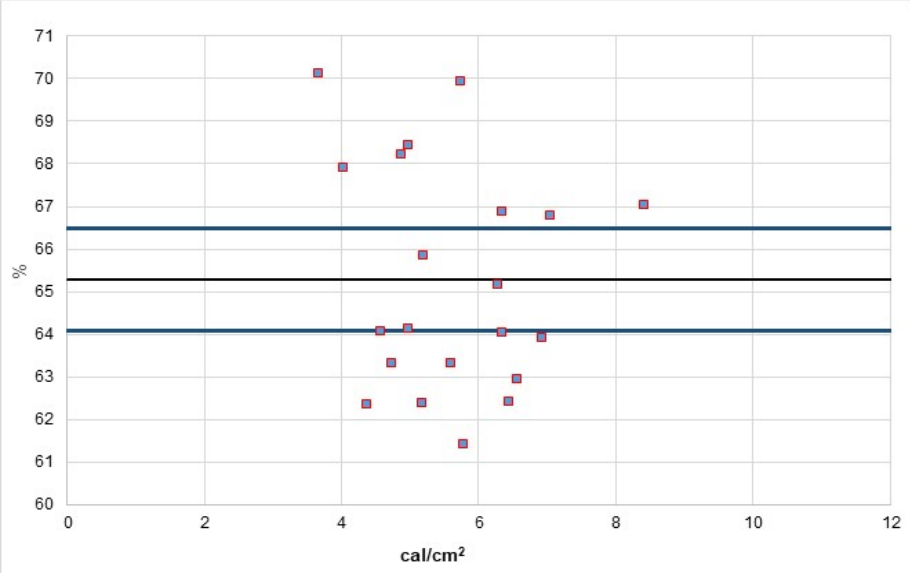
ATPV	5,4 cal/cm²



ATPV points above	9
ATPV points 20%	15
ATPV points below	8
ATPV points mix zone	4

Determination of HAF, confidence Intervals 95%

HAF	65,3 %



% HAF value :	65,3
Upper Confidence Level %:	66,5
Lower Confidence Level %:	64,1
Points above:	8
Points below:	10
Points between:	3
Total Points:	21

Summary of measured energy and subjective evaluation:

Test	Time (ms)	Cycles 50Hz	Ei cal/cm²	SCD cal/cm²	HAF %	Burn	Break Open
1-A	83,4	4,17	4,0	-0,4	67,9	N	N
1-B	83,4	4,17	4,6	-0,19	64,1	N	N
1-C	83,4	4,17	3,6	-0,54	70,2	N	N
2-A	133,4	6,67	6,6	0,45	63,0	Y	N
2-B	133,4	6,67	6,3	0,23	64,1	Y	N
2-C	133,4	6,67	4,9	-0,22	68,2	N	N
3-A	115,6	5,78	5,8	0,21	61,4	Y	N
3-B	115,6	5,78	5,0	-0,06	64,1	N	N
3-C	115,6	5,78	4,4	-0,22	62,4	N	N
4-A	113	5,65	5,6	0,08	63,3	Y	N
4-B	113	5,65	5,7	-0,14	70,0	N	N
4-C	113	5,65	5,2	-0,14	65,8	N	N
5-A	134	6,7	6,9	0,42	63,9	Y	N
5-B	134	6,7	8,4	0,7	67,0	Y	Y
5-C	134	6,7	6,4	0,39	62,4	Y	N
6-A	113,8	5,69	5,2	0,02	62,4	Y	N
6-B	113,8	5,69	4,7	-0,19	63,3	N	N
6-C	113,8	5,69	7,0	0,34	66,8	Y	N
7-A	124,2	6,21	6,3	0,12	66,9	Y	N
7-B	124,2	6,21	6,3	0,22	65,2	Y	N
7-C	124,2	6,21	5,0	-0,22	68,4	N	N

Summary of measured energy and subjective evaluation:

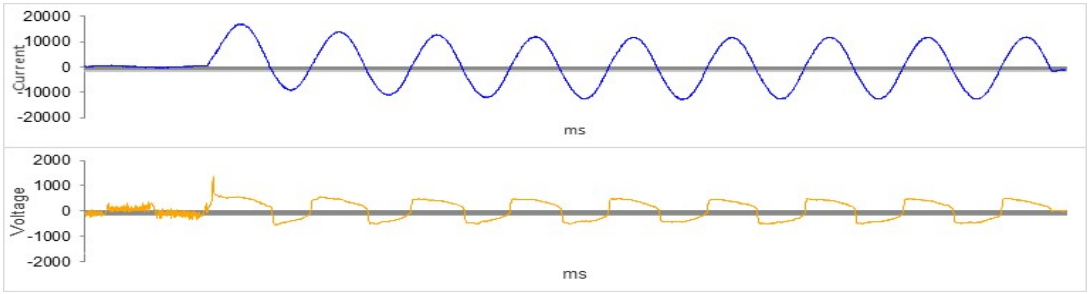
Test	After flame (s)	Ablation	Melting	Dripping	Charring	Embrittlement
1-A	0	N	N	N	Y	Y
1-B	0	N	N	N	Y	Y
1-C	0	N	N	N	Y	Y
2-A	0	N	N	N	Y	Y
2-B	0	N	N	N	Y	Y
2-C	0	N	N	N	Y	Y
3-A	0	N	N	N	Y	Y
3-B	0	N	N	N	Y	Y
3-C	0	N	N	N	Y	Y
4-A	0	N	N	N	Y	Y
4-B	0	N	N	N	Y	Y
4-C	0	N	N	N	Y	Y
5-A	0	N	N	N	Y	Y
5-B	0	Y	N	N	Y	Y
5-C	0	N	N	N	Y	Y
6-A	0	N	N	N	Y	Y
6-B	0	N	N	N	Y	Y
6-C	0	N	N	N	Y	Y
7-A	0	N	N	N	Y	Y
7-B	0	N	N	N	Y	Y
7-C	0	N	N	N	Y	Y

Y: Yes N: No

Electrical current and response sensor response:

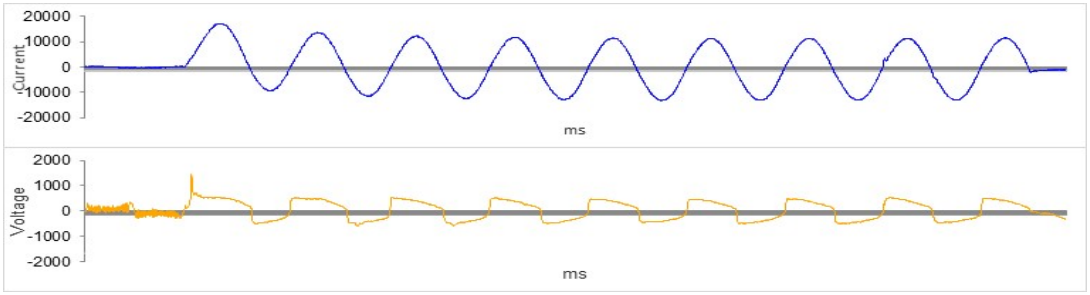
Calibration shot

INITIAL CALIBRATION



Ei Panel A	7,5 cal/cm²	**Ei Panel B**	8,1 cal/cm²	**Ei Panel C**	7,0 cal/cm²

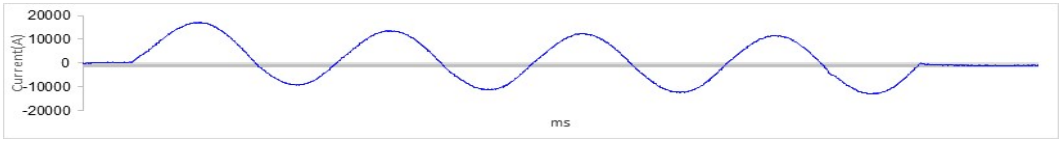
FINAL CALIBRATION



Ei Panel A	7,9 cal/cm²	**Ei Panel B**	7,3 cal/cm²	**Ei Panel C**	7,2 cal/cm²

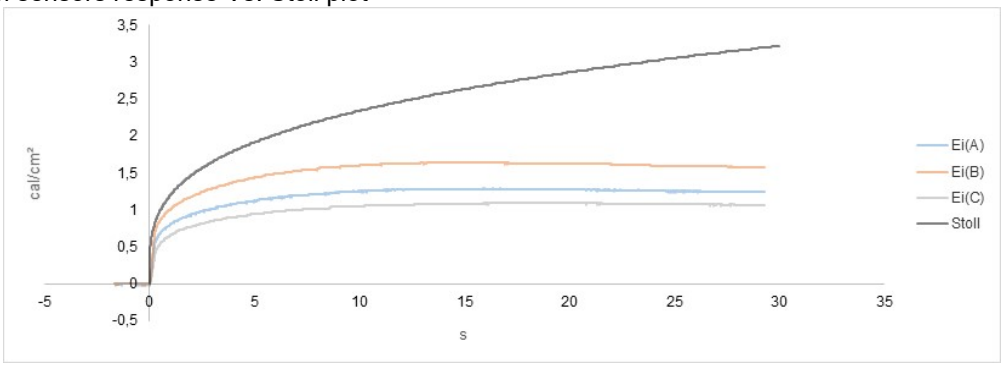
Shot 1

Current Plot

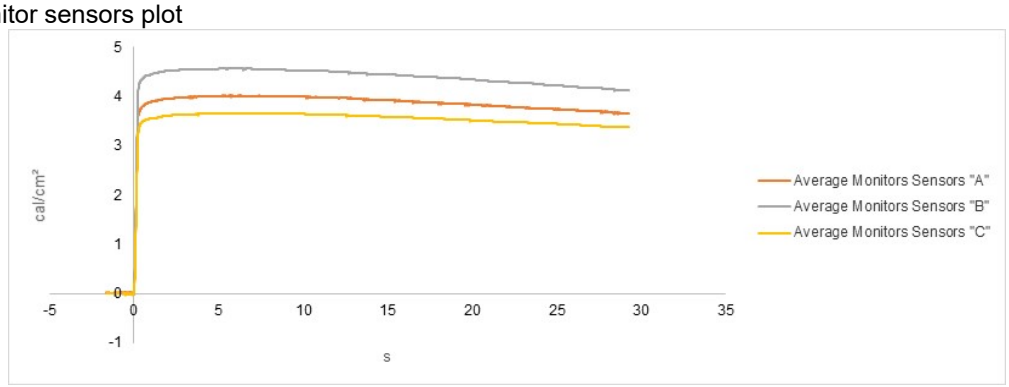


Voltage Plot

Average panel sensors response Vs. Stoll plot

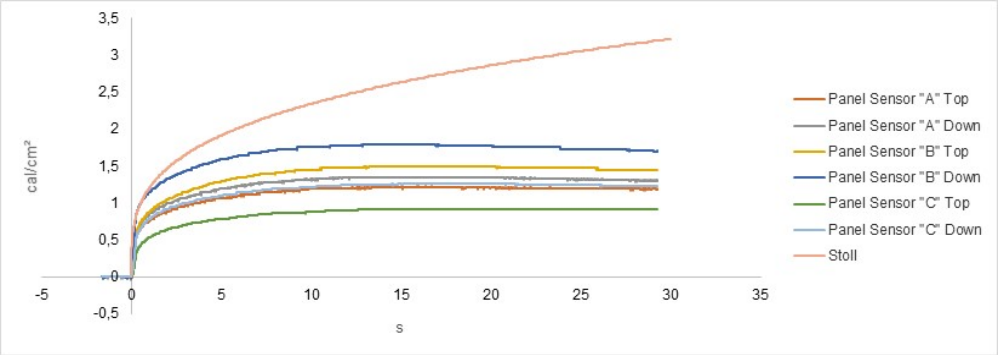


Average monitor sensors plot

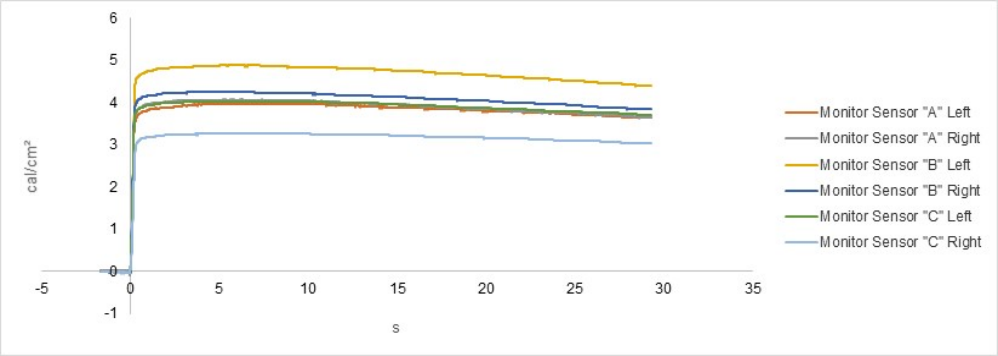


Shot 1

Panel sensors Vs. Stoll plot



Monitor sensors plot

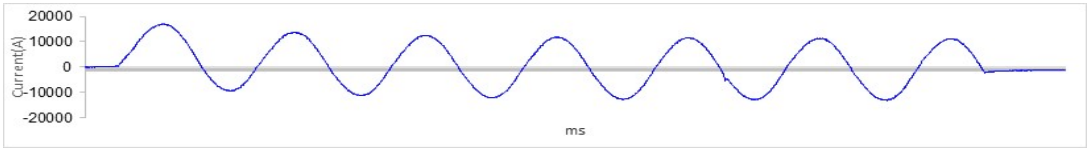


Current Total RMS (kA)	8,5	**Current Peak (kA)**	17,1	**Arc Voltage Peak(V)**	1443, 0
Duration (cycles nº)	4,2	**Duration (ms)**	83,3	**Arc Energy (kJ)**	277,4
Arc Voltage (V)	406,1				

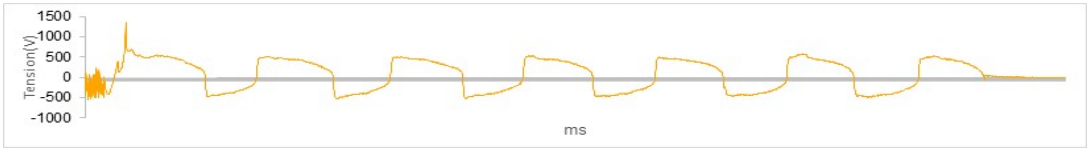
Sensor response	**PANEL A**	**PANEL B**	**PANEL C**
Ei	4,02 cal/cm²	4,57 cal/cm²	3,65 cal/cm²
SCD	-0,40 cal/cm²	-0,19 cal/cm²	-0,54 cal/cm²
HAF	67,93 %	64,08 %	70,15 %

Shot 2

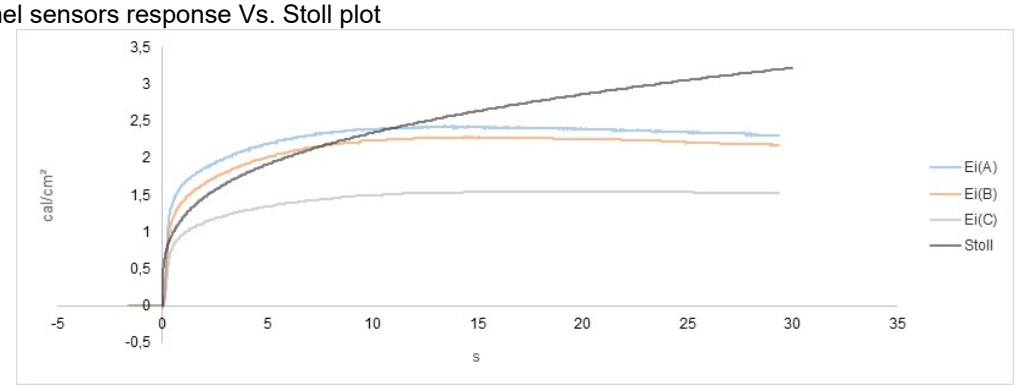
Current Plot



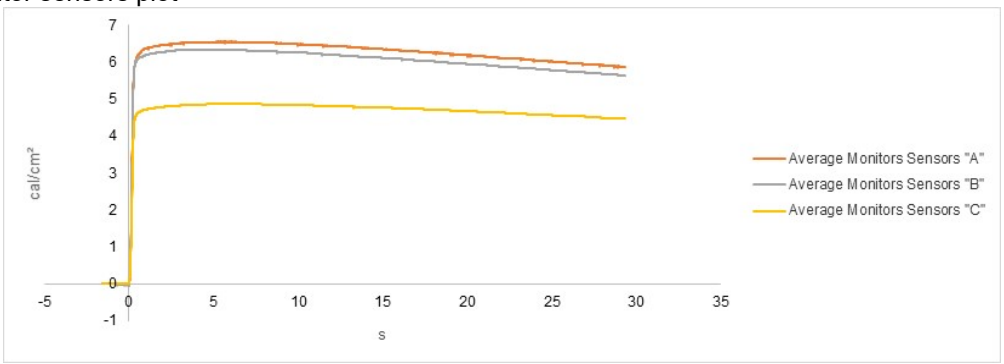
Voltage Plot



Average panel sensors response Vs. Stoll plot

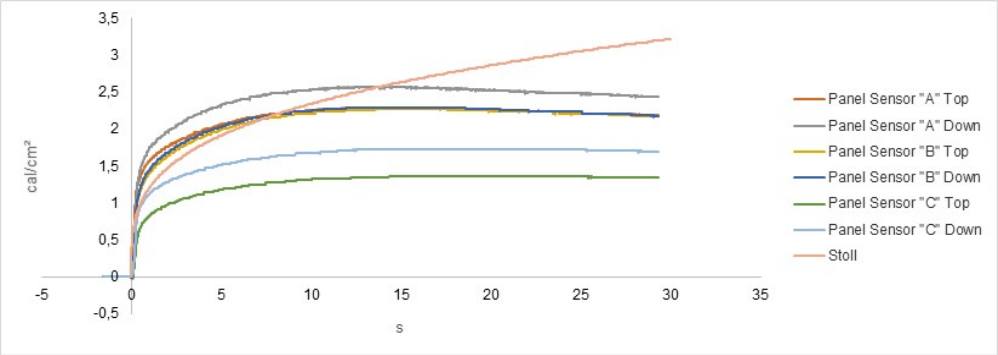


Average monitor sensors plot

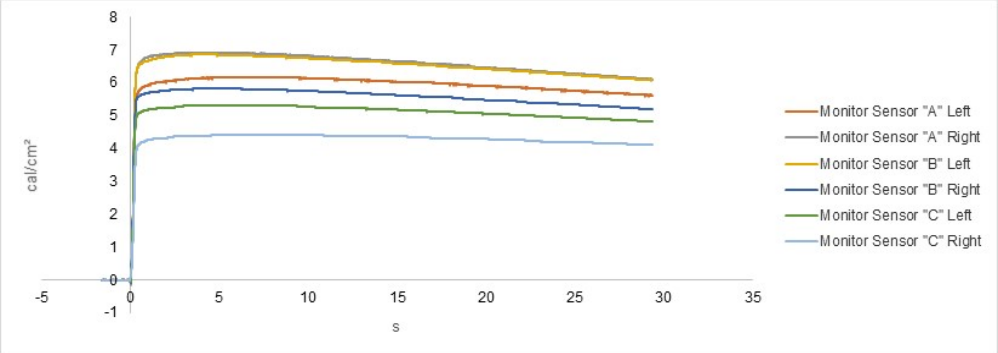


Shot 2

Panel sensors response Vs. Stoll plot



Monitor sensors plot

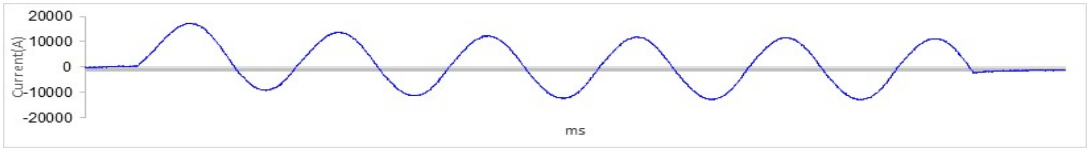


Current Total RMS (kA)	7,8	**Current Peak (kA)**	17,0	**Arc Voltage Peak(V)**	1506, 0
Duration (cycles nº)	6,7	**Duration (ms)**	133,4	**Arc Energy (kJ)**	426,8
Arc Voltage (V)	398,1				

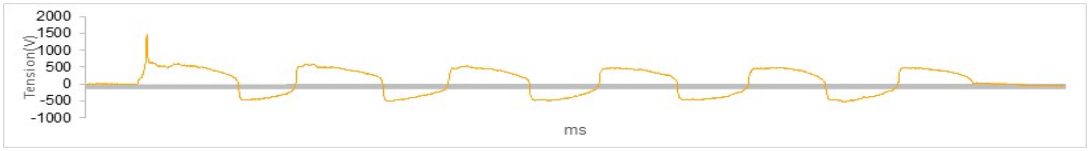
Sensor response	**PANEL A**	**PANEL B**	**PANEL C**
Ei	6,55 cal/cm²	6,34 cal/cm²	4,87 cal/cm²
SCD	0,45 cal/cm²	0,23 cal/cm²	-0,22 cal/cm²
HAF	62,95 %	64,06 %	68,23 %

Shot 3

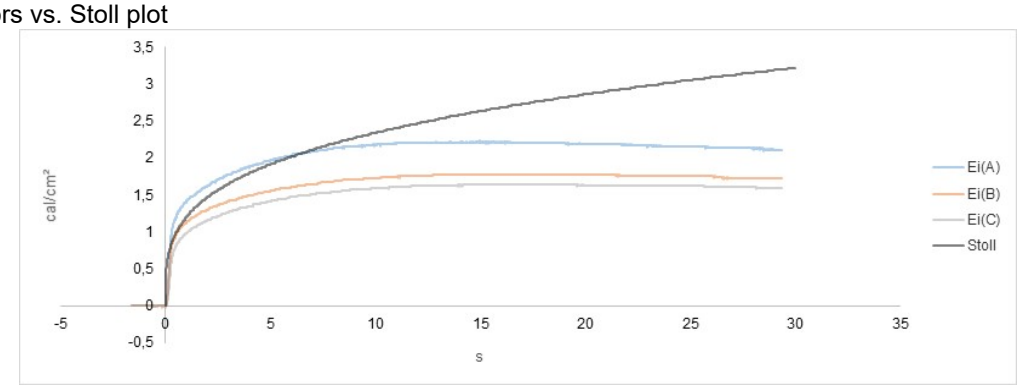
Current Plot



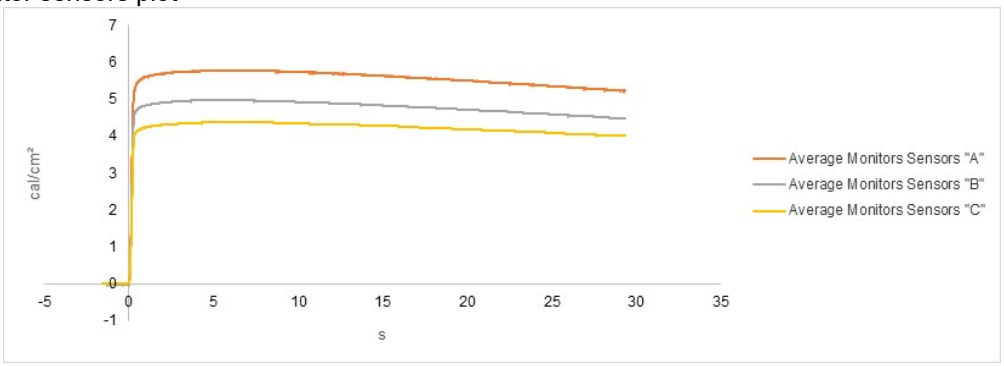
Voltage Plot



Panel sensors vs. Stoll plot

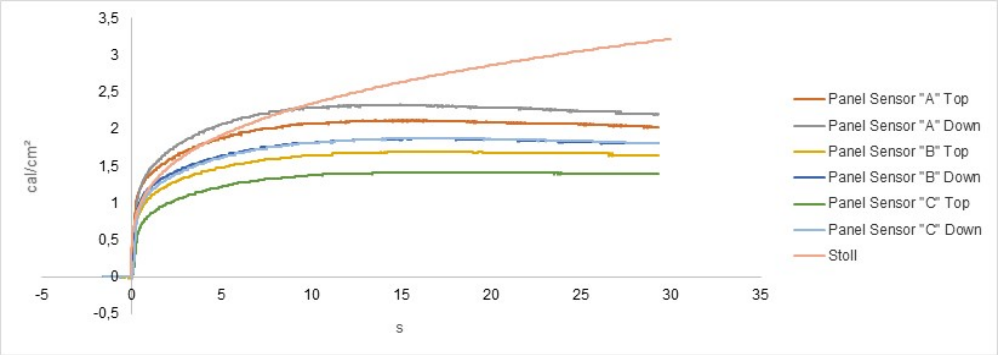


Average monitor sensors plot

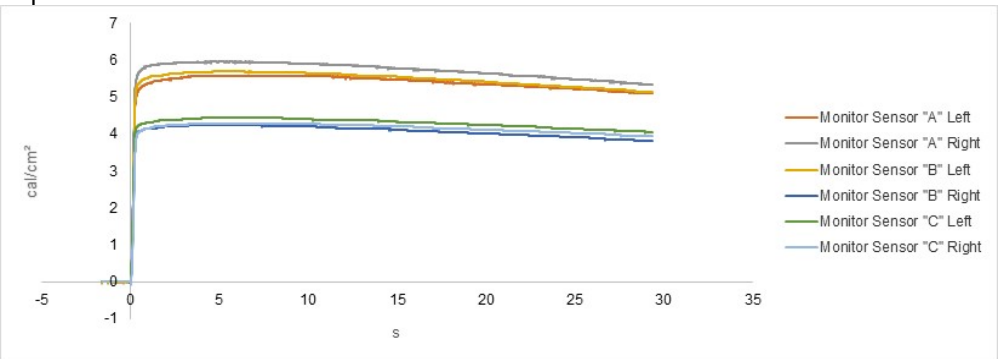


Shot 3

Panel sensors response Vs. Stoll plot



Monitor sensors plot

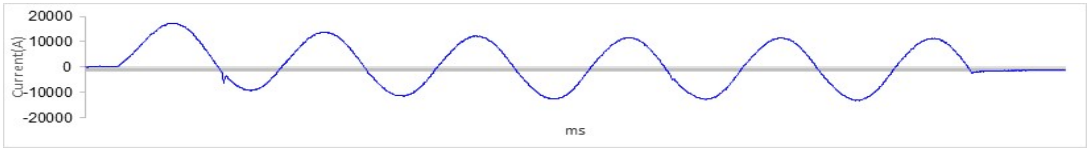


Current Total RMS (kA)	7,2	**Current Peak (kA)**	17,3	**Arc Voltage Peak(V)**	1455, 0
Duration (cycles nº)	5,8	**Duration (ms)**	115,6	**Arc Energy (kJ)**	376,5
Arc Voltage (V)	403,8				

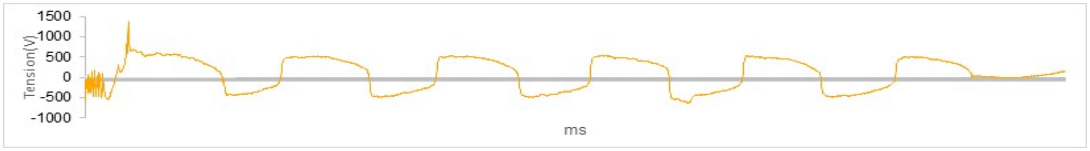
Sensor response	**PANEL A**	**PANEL B**	**PANEL C**
Ei	5,77 cal/cm²	4,96 cal/cm²	4,36 cal/cm²
SCD	0,21 cal/cm²	-0,06 cal/cm²	-0,22 cal/cm²
HAF	61,43 %	64,13 %	62,36 %

Shot 4

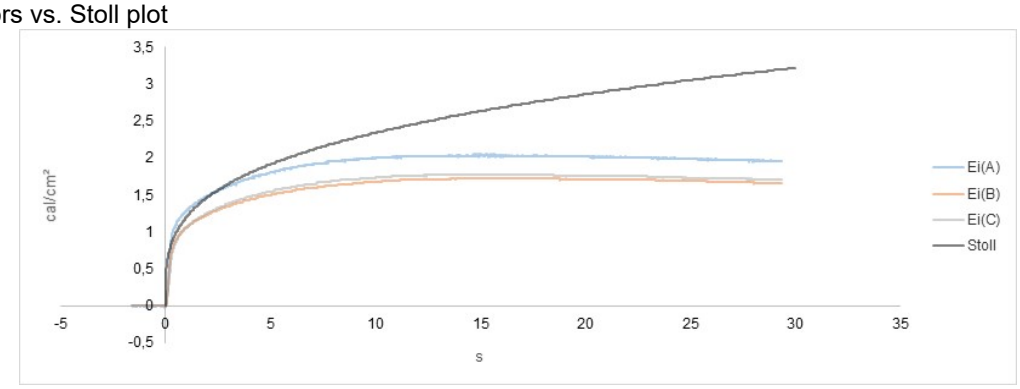
Current Plot



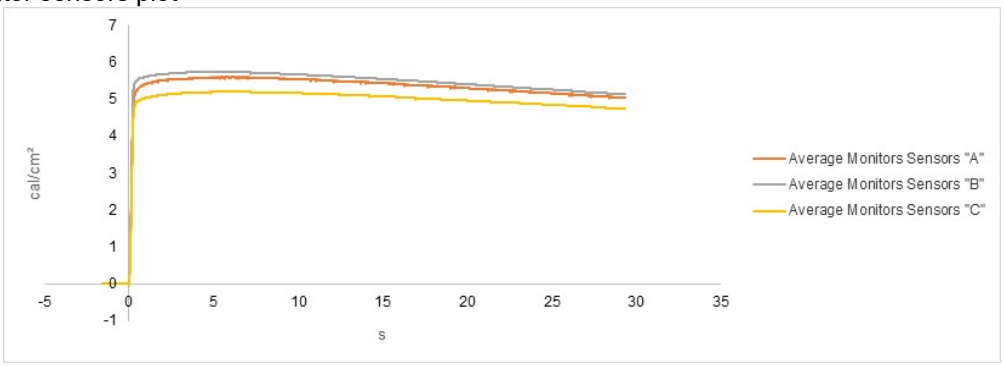
Voltage Plot



Panel sensors vs. Stoll plot

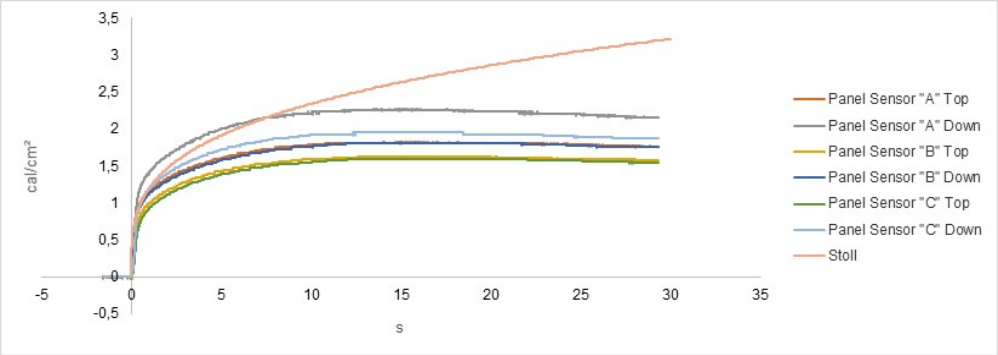


Average monitor sensors plot

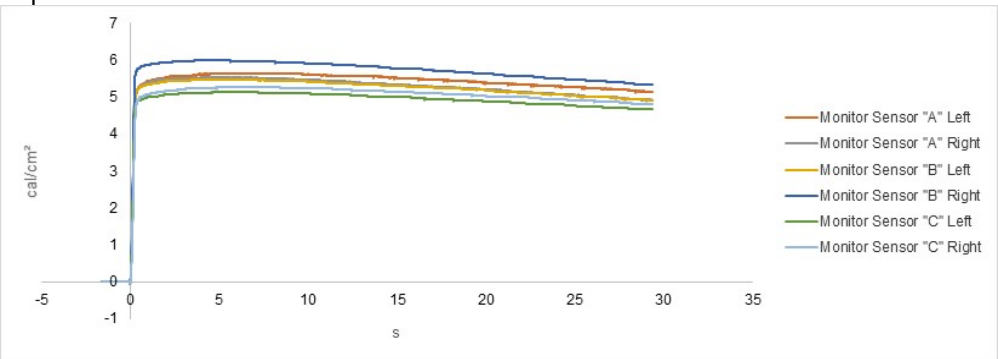


Shot 4

Panel sensors response Vs. Stoll plot



Monitor sensors plot

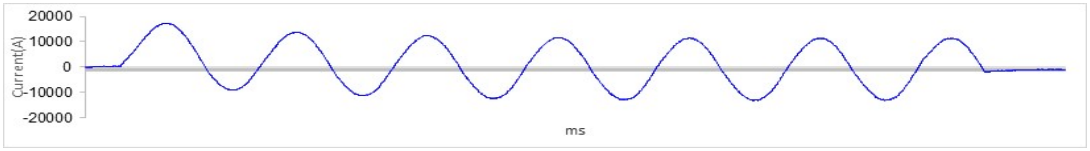


Current Total RMS (kA)	7,5	**Current Peak (kA)**	17,3	**Arc Voltage Peak(V)**	1371, 0
Duration (cycles nº)	5,6	**Duration (ms)**	113,0	**Arc Energy (kJ)**	389,6
Arc Voltage (V)	421,7				

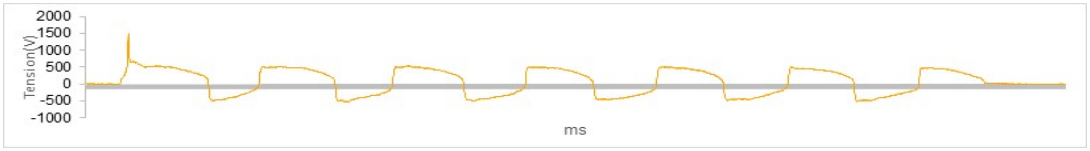
Sensor response	**PANEL A**	**PANEL B**	**PANEL C**
Ei	5,58 cal/cm²	5,73 cal/cm²	5,19 cal/cm²
SCD	0,08 cal/cm²	-0,14 cal/cm²	-0,14 cal/cm²
HAF	63,33 %	69,96 %	65,85 %

Shot 5

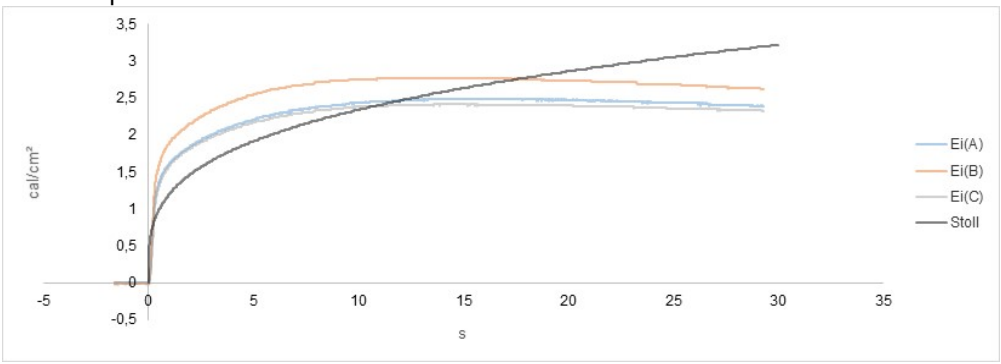
Current Plot



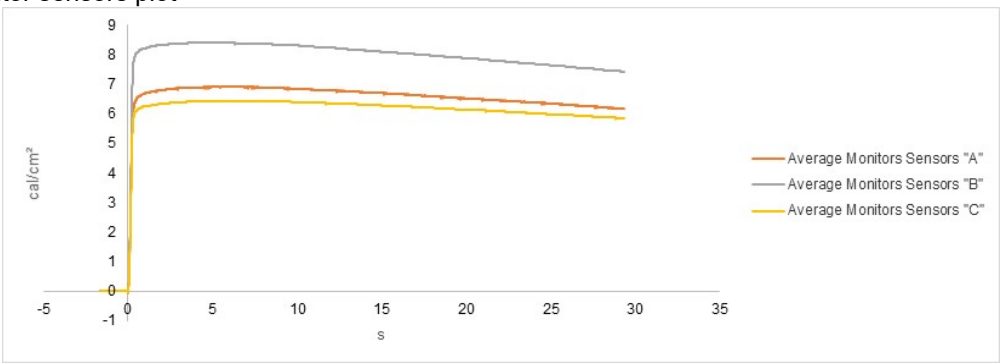
Voltage Plot



Panel sensors vs. Stoll plot

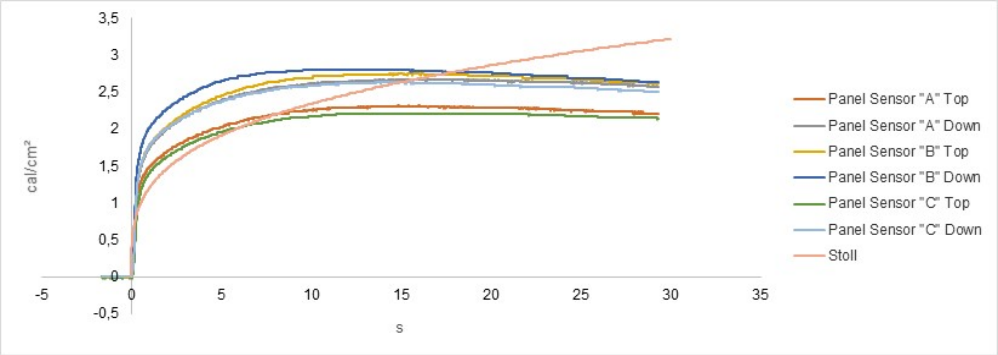


Average monitor sensors plot

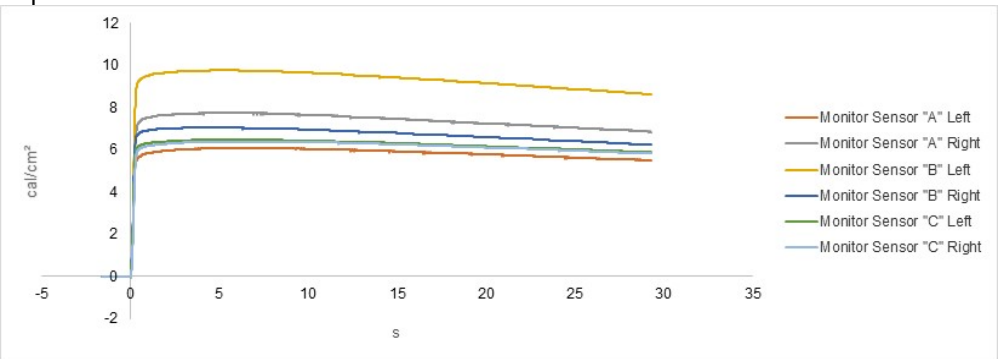


Shot 5

Panel sensors response Vs. Stoll plot



Monitor sensors plot

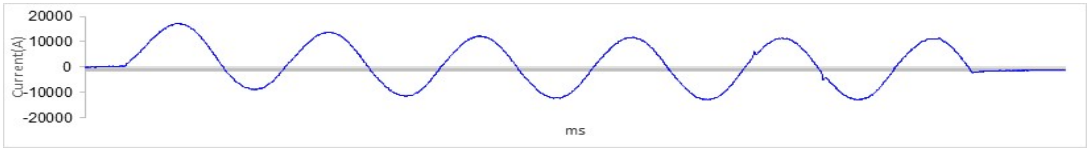


Current Total RMS (kA)	7,8	**Current Peak (kA)**	17,3	**Arc Voltage Peak(V)**	1482, 0
Duration (cycles nº)	6,7	**Duration (ms)**	133,9	**Arc Energy (kJ)**	432,0
Arc Voltage (V)	399,8				

Sensor response	**PANEL A**	**PANEL B**	**PANEL C**
Ei	6,91 cal/cm²	8,41 cal/cm²	6,44 cal/cm²
SCD	0,42 cal/cm²	0,70 cal/cm²	0,39 cal/cm²
HAF	63,92 %	67,04 %	62,42 %

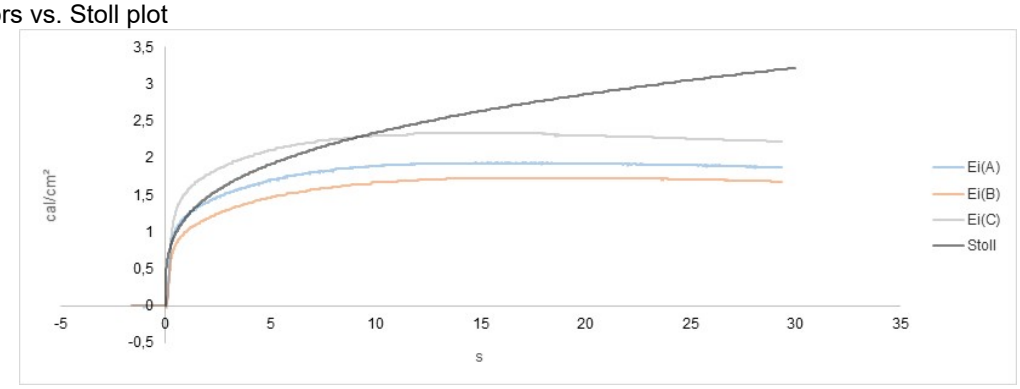
Shot 6

Current Plot

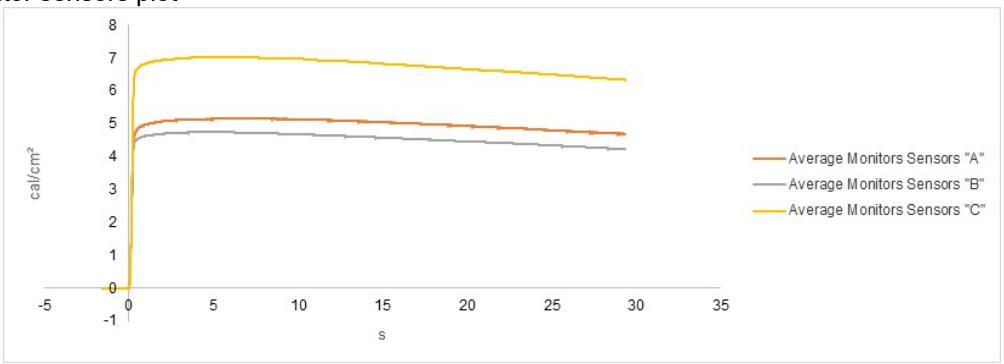


Voltage Plot

Panel sensors vs. Stoll plot

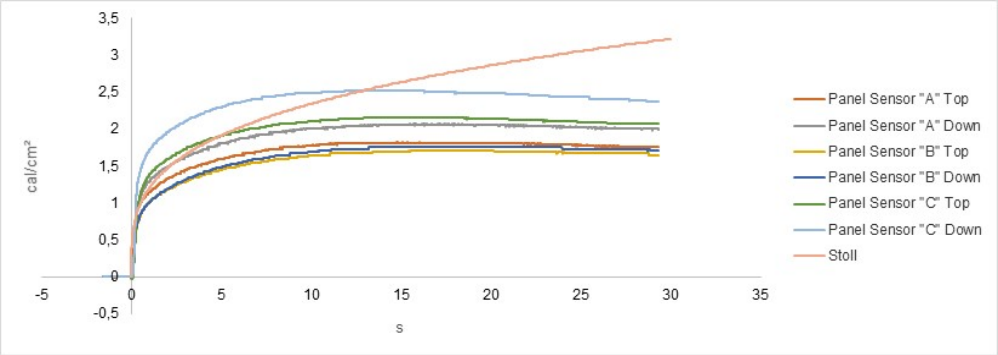


Average monitor sensors plot

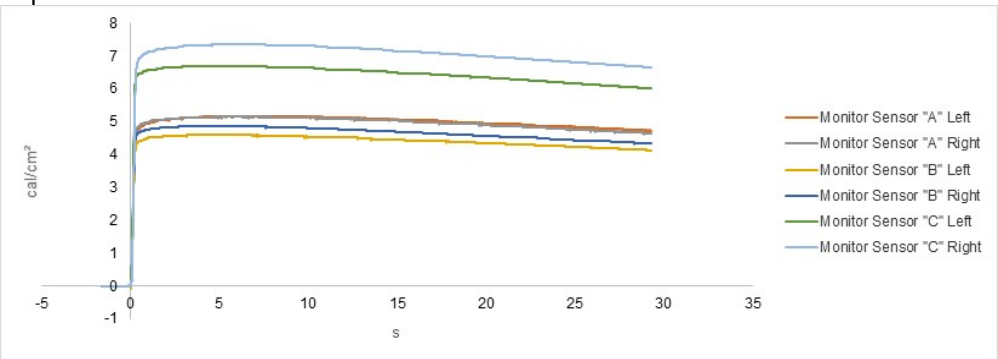


Shot 6

Panel sensors response Vs. Stoll plot



Monitor sensors plot

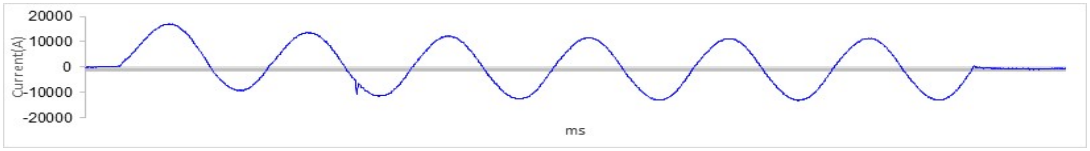


Current Total RMS (kA)	7,4	**Current Peak (kA)**	17,1	**Arc Voltage Peak(V)**	1449,0
Duration (cycles nº)	5,7	**Duration (ms)**	113,9	**Arc Energy (kJ)**	397,6
Arc Voltage (V)	437,1				

Sensor response	**PANEL A**	**PANEL B**	**PANEL C**
Ei	5,16 cal/cm²	4,73 cal/cm²	7,03 cal/cm²
SCD	0,02 cal/cm²	-0,19 cal/cm²	0,34 cal/cm²
HAF	62,39 %	63,34 %	66,80 %

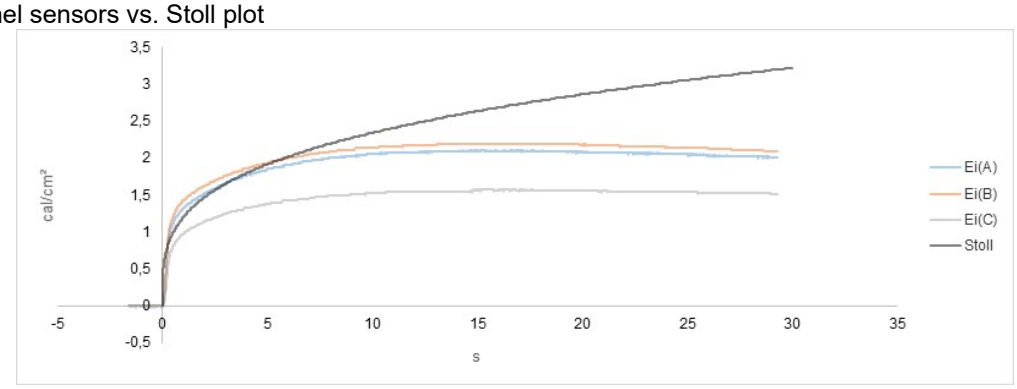
Shot 7

Current Plot

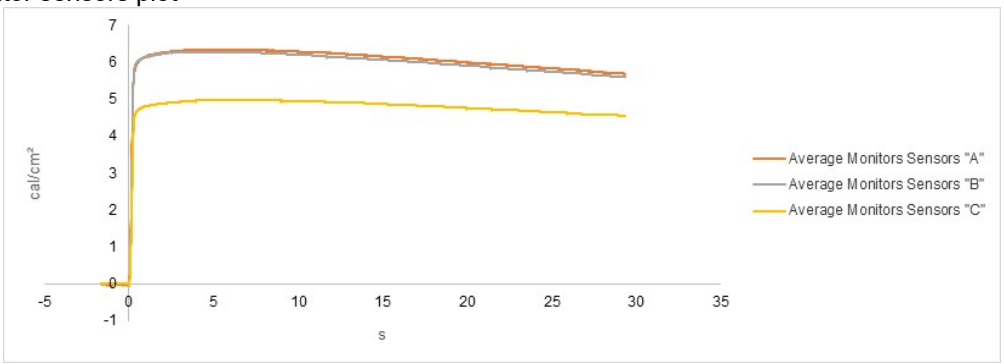


Voltage Plot

Average panel sensors vs. Stoll plot

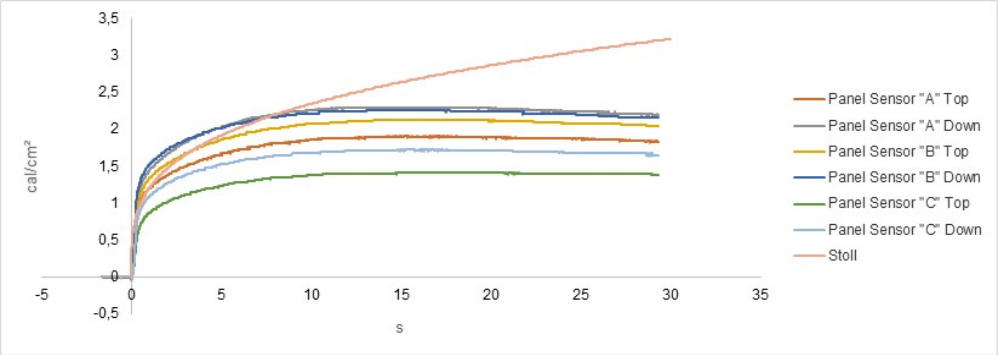


Average monitor sensors plot

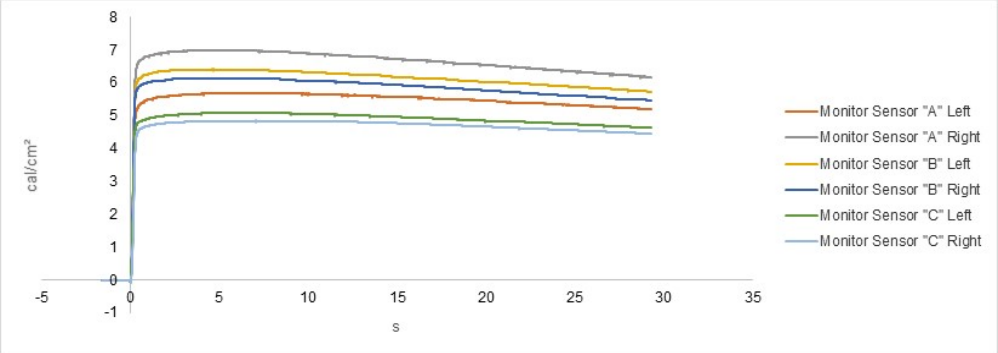


Shot 7

Panel sensors response Vs. Stoll plot



Monitor sensors plot

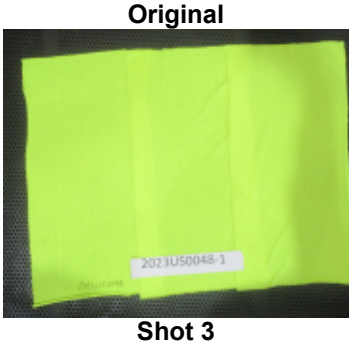


Current Total RMS (kA)	8,3	**Current Peak (kA)**	17,0	**Arc Voltage Peak(V)**	1443, 0
Duration (cycles nº)	6,2	**Duration (ms)**	124,2	**Arc Energy (kJ)**	414,0
Arc Voltage (V)	412,3				

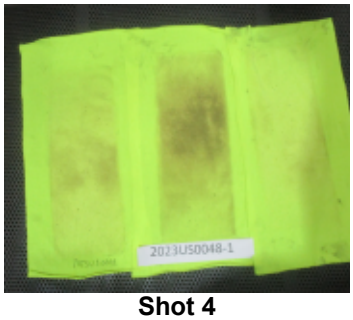
Sensor response	**PANEL A**	**PANEL B**	**PANEL C**
Ei	6,34 cal/cm²	6,28 cal/cm²	4,97 cal/cm²
SCD	0,12 cal/cm²	0,22 cal/cm²	-0,22 cal/cm²
HAF	66,88 %	65,17 %	68,45 %

Tested material pictures:

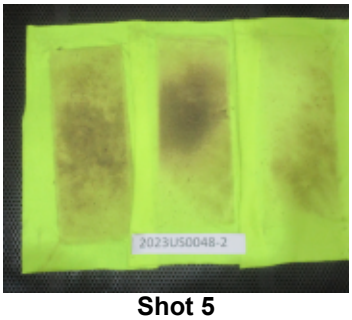
Original



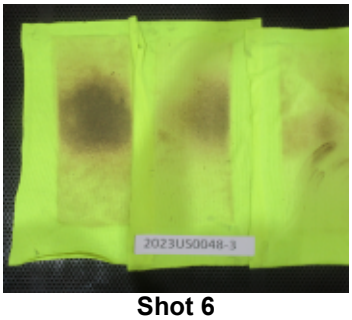
Shot 1



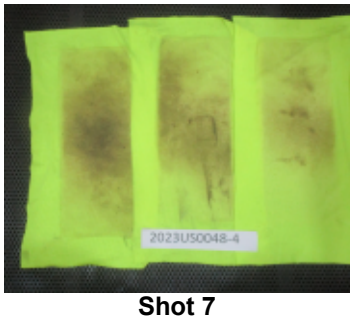
Shot 2



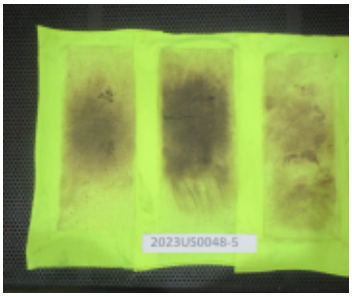
Shot 3



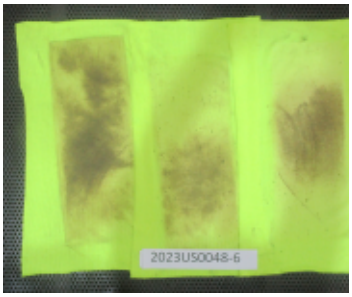
Shot 4



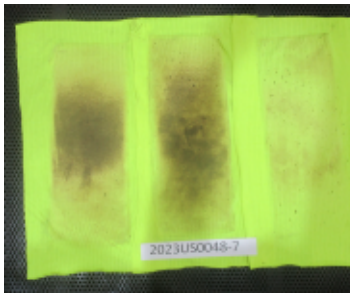
Shot 5



Shot 6



Shot 7



Summary of results:

ATPV	5,4 cal/cm²
HAF	65,3 %

FABRIC TESTED ACCORDING TO THE STANDARD ASTM F1959/F1959M−22
ARC RATING (ATPV)
5,4 cal/cm²

Remark

The test was carried out at: AITEX - Electric open arc laboratory, located at Polígono Industrial Fuente del Jarro. C/ Ciudad de Gibraltar, 5; 46988 – Paterna (Valencia)

Lucia Martinez
Head of PPE and Ballistics department

Date: 07/03/2023 11:03:33
Digitally Signed by:MIGUEL ANGEL PEREZ ESLAVA - NIF:33567494Y

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