

TEST REPORT

2022US0029

DATE OF RECEPTION

08/04/2022

DATE TESTS

Starting: 11/04/2022

Ending: 26/04/2022

APPLICANT

OBERON Company
375 Faunce Corner Road, Unit E
MA-02747 North Dartmouth

Att. ZAC TWIGHT

IDENTIFICATION AND DESCRIPTION OF SAMPLES

REFERENCES

TCG40 (FABRIC)

Pre-treatment according to the information supplied by the customer

Pre-treatment by the customer: 3 washing cycles at 49°C, according to standard AATCC TM135-2018, method 3, IV and type A iii drying

TESTS CARRIED OUT

- SAMPLE IDENTIFICATION.
- MASS PER UNIT AREA.
- ELECTRIC ARC EXPOSURE TEST: DETERMINATION OF THE ARC RATING (ATPV OR EBT50) OF FLAME RESISTANT MATERIALS FOR CLOTHING.

The test was carried out at Polígono Industrial Fuente del Jarro. C/ Ciudad de Gibraltar, 5; 46988 – Paterna (Valencia); which property is shared at 50% between research institutes AITEX and ITE.

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AITEX - Plaza Emilio Sala, 1 - E-03801 ALCOY (Alicante) SPAIN Tel.:+34 96 554 22 00 www.aitex.es info@aitex.es

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



RESULTS

SAMPLE IDENTIFICATION

Reference

TCG40 (FABRIC)



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RESULTS

MASS PER UNIT AREA

Standard

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

Conditioning date

20/04/2022

Test date

25/04/2022

Atmosphere for conditioning testing**Temperature** (21±1) °C**Relative humidity**

(65±2) %

State of the specimens

Original

Number of specimens

1

Dimensions of specimens500 cm²**Reference**

TCG40 (FABRIC) Outer fabric

Mass per unit area (oz/yd ²)	Mass per unit area (g/m ²)
5,24	178

Reference

TCG40 (FABRIC) Inner fabric

Mass per unit area (oz/yd ²)	Mass per unit area (g/m ²)
6,60	224

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RESULTS

MASS PER UNIT AREA

Standard

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

Conditioning date

20/04/2022

Test date

25/04/2022

Atmosphere for conditioning testing**Temperature** (21±1) °C**Relative humidity**

(65±2) %

State of the specimens

Washed

Number of specimens

1

Dimensions of specimens500 cm²**Previous treatment**

Reference

TCG40 (FABRIC) Outer fabric

Mass per unit area (oz/yd ²)	Mass per unit area (g/m ²)
5,23	177

Reference

TCG40 (FABRIC) Innerr fabric

Mass per unit area (oz/yd ²)	Mass per unit area (g/m ²)
6,41	217



RESULTS

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

Standard

ASTM F1959/F1959M-14e1

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 E_i.

Heat attenuation factor (HAF) and plot of HAF on E_i.

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).

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RESULTS

Test conditions	
Date test	11/04/2022
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 pre-treatment date	-
Starting and ending conditioning date	08/04/2022 - 11/04/2022
Conditioning	24 h; 21 ± 2°C, 65 ± 5% Hr.

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RESULTS

Reference

TCG40 (FABRIC)

Sample description according to the information supplied by the customer

Multilayer system:

Layer 1: Black woven fabric style 1016, 99% Aramid, 1% Anti-static, fabric structure Twill, 170 g/m², Oberon company.

Layer 2: Yellow non-woven style 992Q + Yellow woven fabric, 9% Aramid, 1% Anti-static, fabric structure Quilted Twill, 194 g/m², Oberon company.

Deviation from the standard

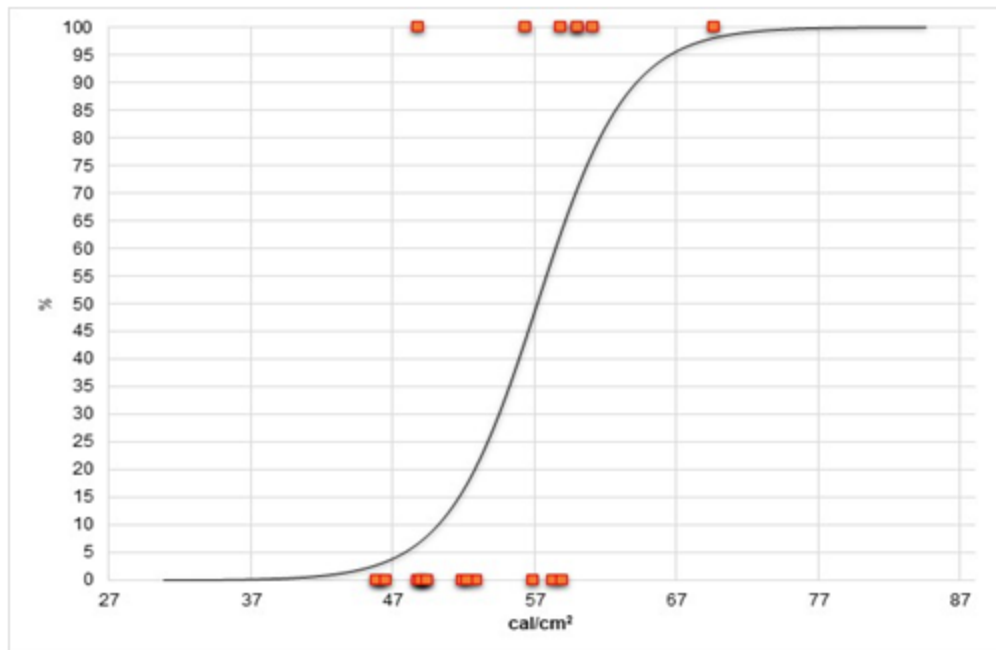
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RESULTS

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

ATPV	57,2 cal/cm ²
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ATPV points above	4
ATPV points 20%	20
ATPV points below	3
ATPV points mix zone	14

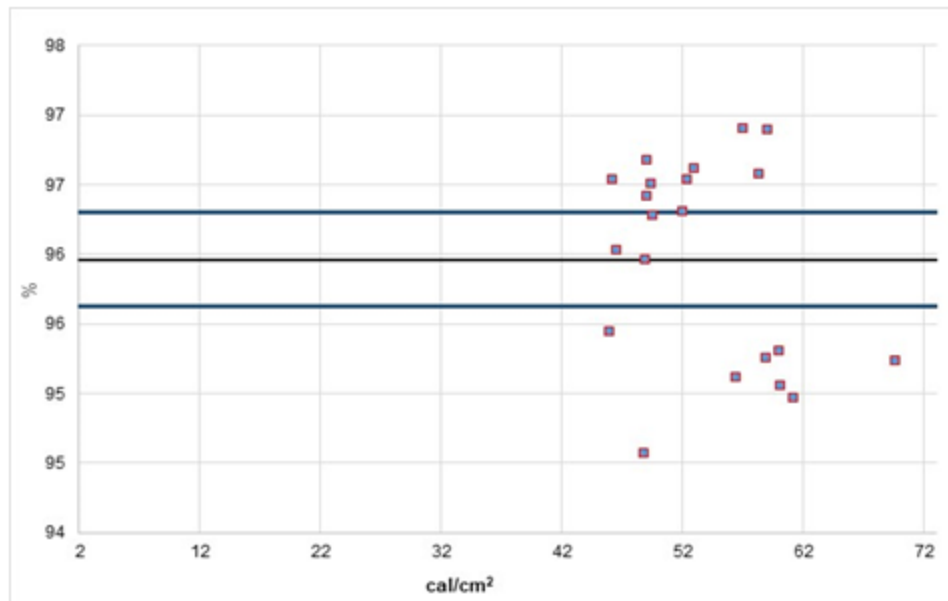
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RESULTS

Determination of HAF, confidence Intervals 95%

HAF	96,0 %
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% HAF value :	96,0
Upper Confidence Level %:	96,3
Lower Confidence Level %:	95,6
Points above:	10
Points below:	8
Points between:	3
Total Points:	21

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RESULTS

Summary of measured energy and subjective evaluation:

Test	Time (ms)	Cycles 50Hz	Ei cal/cm ²	SCD cal/cm ²	HAF %	Burn	Break Open
1-A	1003,8	50,19	69,6	1,06	95,2	Y	N
1-B	1003,8	50,19	56,4	0,52	95,1	Y	N
1-C	1003,8	50,19	52,9	-0,56	96,6	N	N
2-A	964,4	48,22	58,3	-0,28	96,6	N	N
2-B	964,4	48,22	60,1	0,72	95,1	Y	N
2-C	964,4	48,22	60,0	0,66	95,3	Y	N
3-A	844,2	42,21	51,9	-0,39	96,3	N	N
3-B	844,2	42,21	48,8	0,42	94,6	Y	N
3-C	844,2	42,21	52,3	-0,44	96,5	N	N
4-A	783,6	39,18	49,0	-0,83	96,7	N	N
4-B	783,6	39,18	46,1	-0,82	96,5	N	N
4-C	783,6	39,18	48,8	-0,31	96,0	N	N
5-A	824,4	41,22	59,0	-0,4	96,9	N	N
5-B	824,4	41,22	45,9	-0,24	95,4	N	N
5-C	824,4	41,22	49,4	-0,61	96,5	N	N
6-A	863,6	43,18	49,0	-0,67	96,4	N	N
6-B	863,6	43,18	49,5	-0,41	96,3	N	N
6-C	863,6	43,18	46,5	-0,48	96,0	N	N
7-A	984,2	49,21	61,1	0,79	95,0	Y	N
7-B	984,2	49,21	56,9	-0,6	96,9	N	N
7-C	984,2	49,21	58,9	0,53	95,3	Y	N

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RESULTS

Summary of measured energy and subjective evaluation:

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

Y Yes N No

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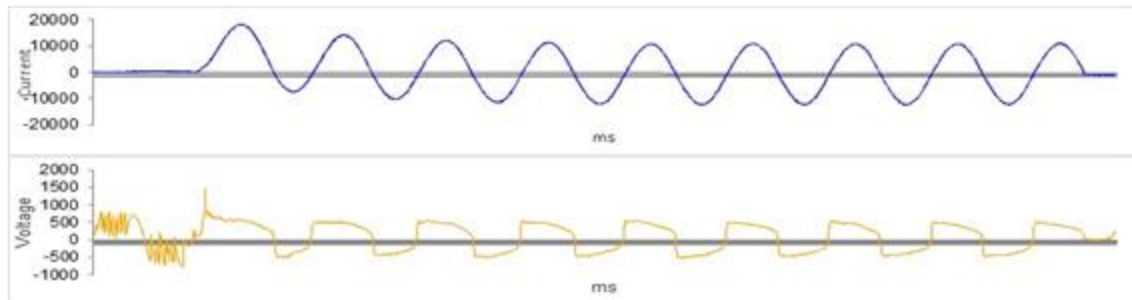


RESULTS

Electrical current and response sensor response:

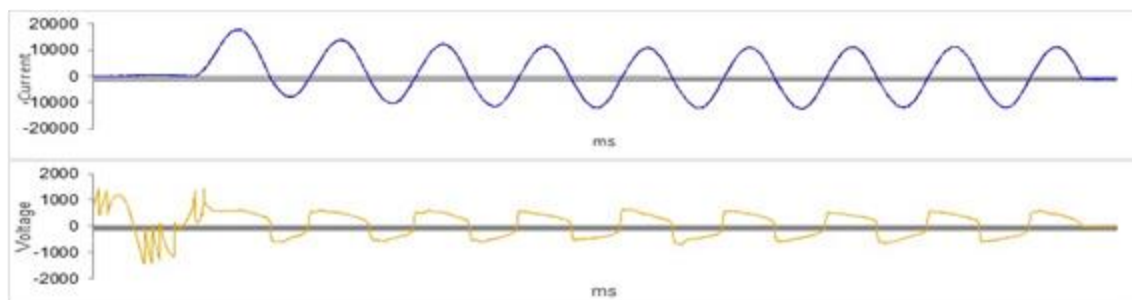
Calibration shot

INITIAL CALIBRATION



Ei Panel A	7,7 cal/cm ²	Ei Panel B	7,5 cal/cm ²	Ei Panel C	5,6 cal/cm ²
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FINAL CALIBRATION



Ei Panel A	7,3 cal/cm ²	Ei Panel B	6,1 cal/cm ²	Ei Panel C	6,1 cal/cm ²
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RESULTS

Electrical current and response sensor response:

Shot 1

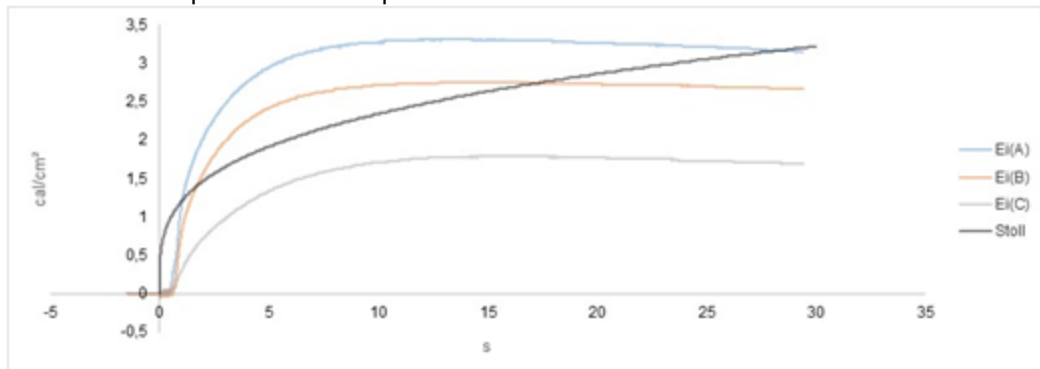
Current Plot



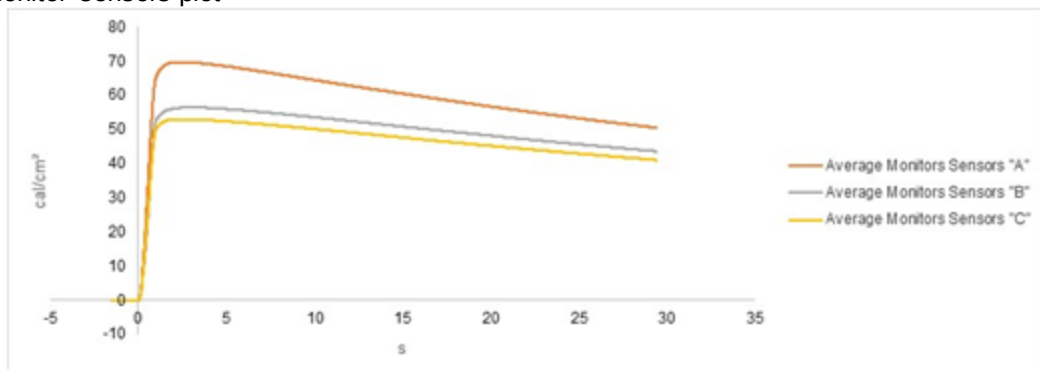
Voltage Plot



Average panel sensors response Vs. Stoll plot



Average monitor sensors plot



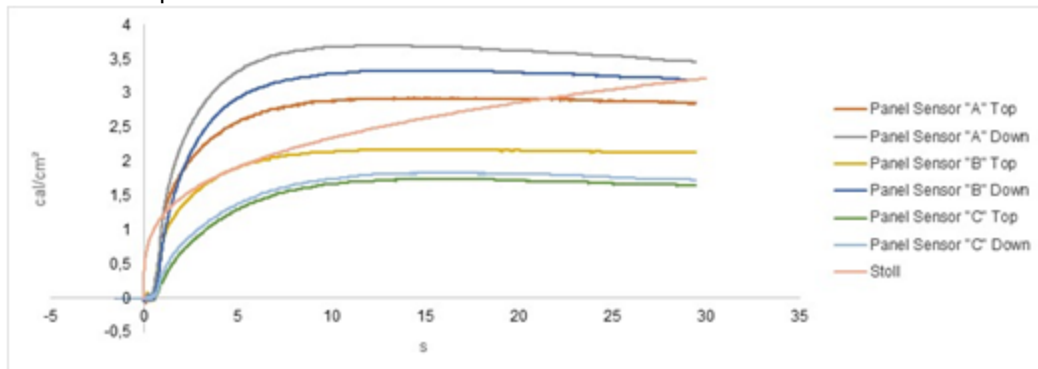
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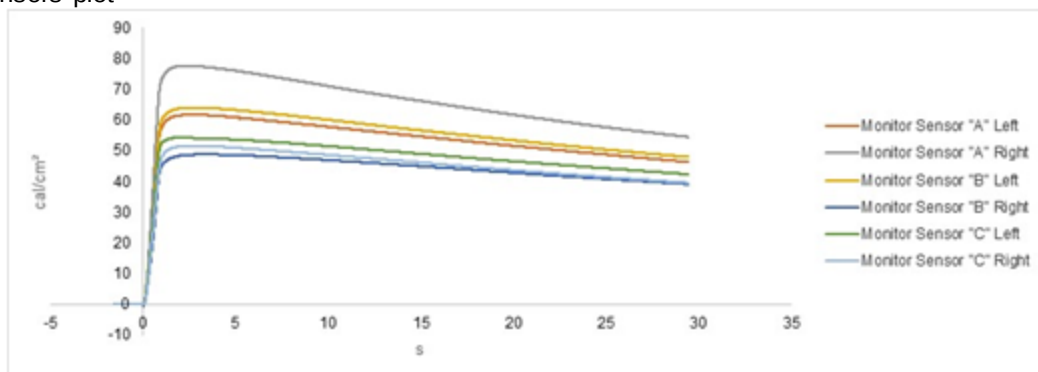
RESULTS

Electrical current and response sensor response:
Shot 1

Panel sensors Vs. Stoll plot



Monitor sensors plot



Current Total RMS (kA)	8,1	Current Peak (kA)	18,6	Arc Voltage (V)	1530,0
Duration (cycles nº)	50,2	Duration (ms)	1003,9	Arc Energy (kJ)	3265,1
Arc Voltage (kJ)	435,6				

Sensor response	PANEL A	PANEL B	PANEL C
Ei	69,63 cal/cm ²	56,35 cal/cm ²	52,87 cal/cm ²
SCD	1,06 cal/cm ²	0,52 cal/cm ²	-0,56 cal/cm ²
HAF	95,24 %	95,12 %	96,62 %

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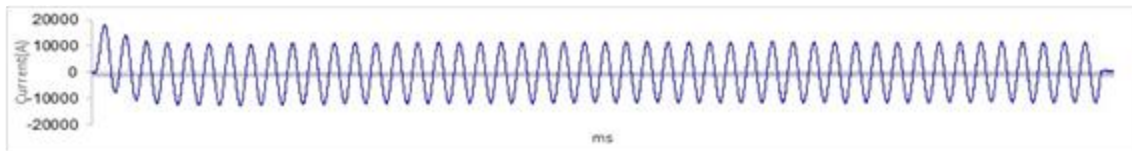


RESULTS

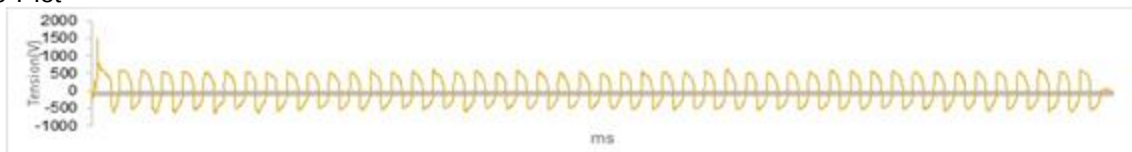
Electrical current and response sensor response:

Shot 2

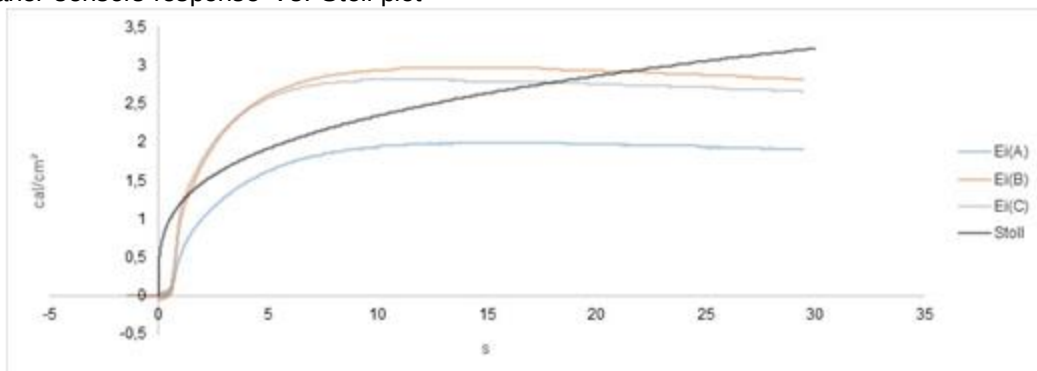
Current Plot



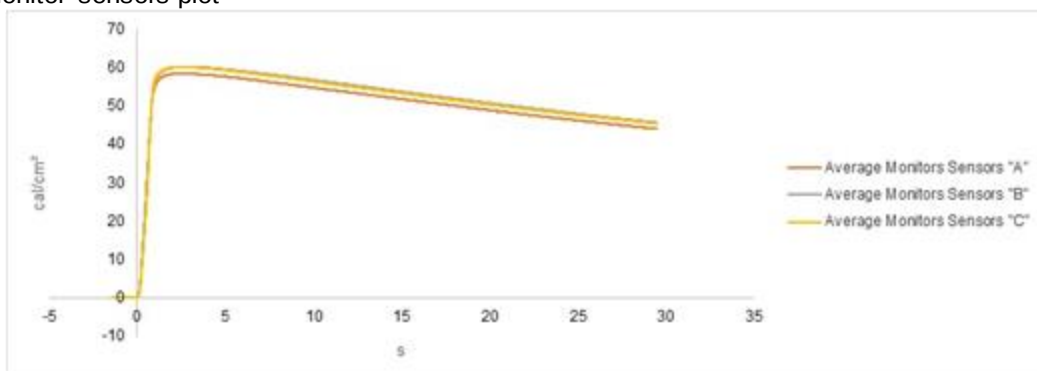
Voltage Plot



Average panel sensors response Vs. Stoll plot



Average monitor sensors plot



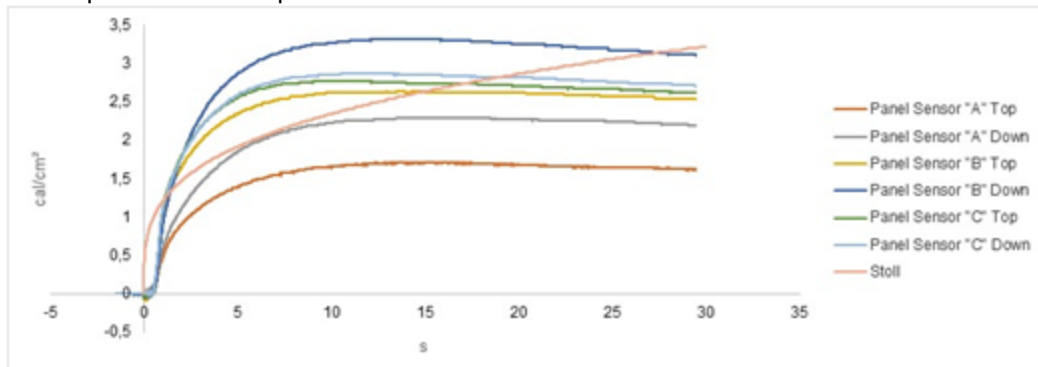
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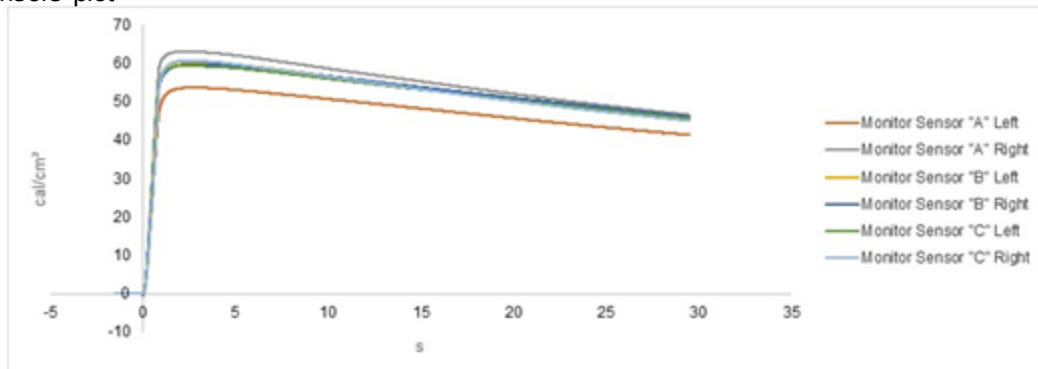
RESULTS

Electrical current and response sensor response:
Shot 2

Panel sensors response Vs. Stoll plot



Monitor sensors plot



Current Total RMS (kA)	8,1	Current Peak (kA)	18,2	Arc Voltage (V)	1530,0
Duration (cycles nº)	48,2	Duration (ms)	964,4	Arc Energy (kJ)	3122,2
Arc Voltage (kJ)	434,0				

Sensor response	PANEL A	PANEL B	PANEL C
Ei	58,33 cal/cm ²	60,10 cal/cm ²	60,00 cal/cm ²
SCD	-0,28 cal/cm ²	0,72 cal/cm ²	0,66 cal/cm ²
HAF	96,58 %	95,06 %	95,31 %

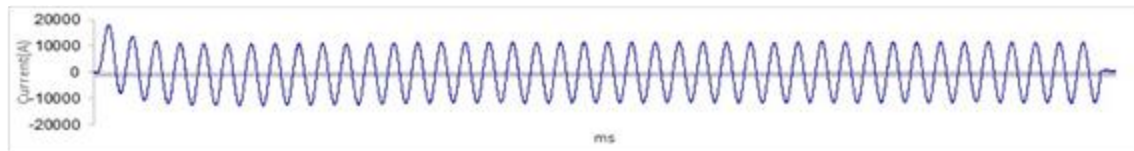
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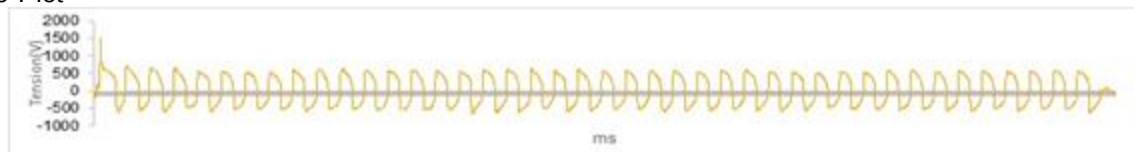
RESULTS

Electrical current and response sensor response:
Shot 3

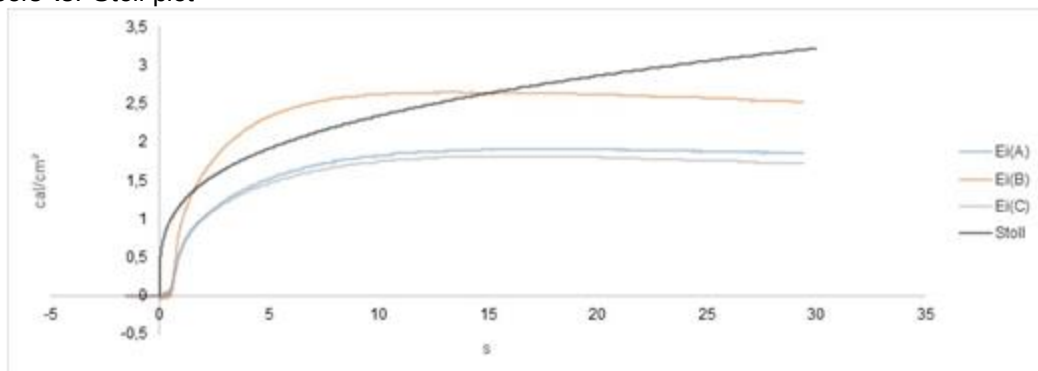
Current Plot



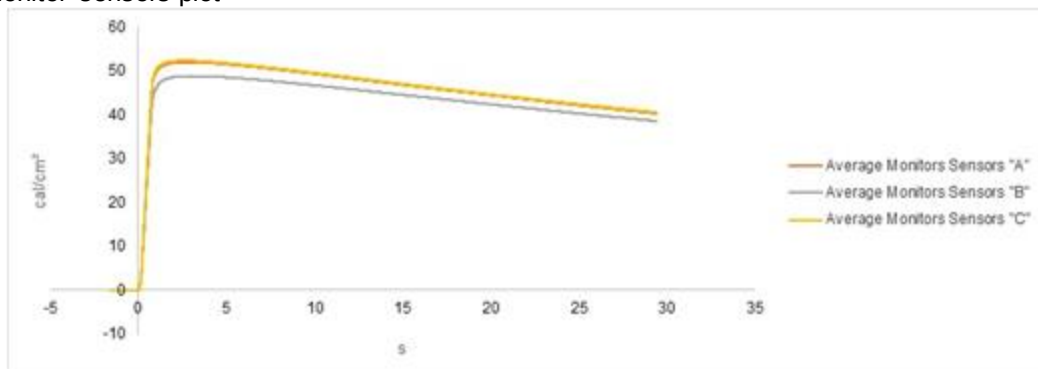
Voltage Plot



Panel sensors vs. Stoll plot



Average monitor sensors plot



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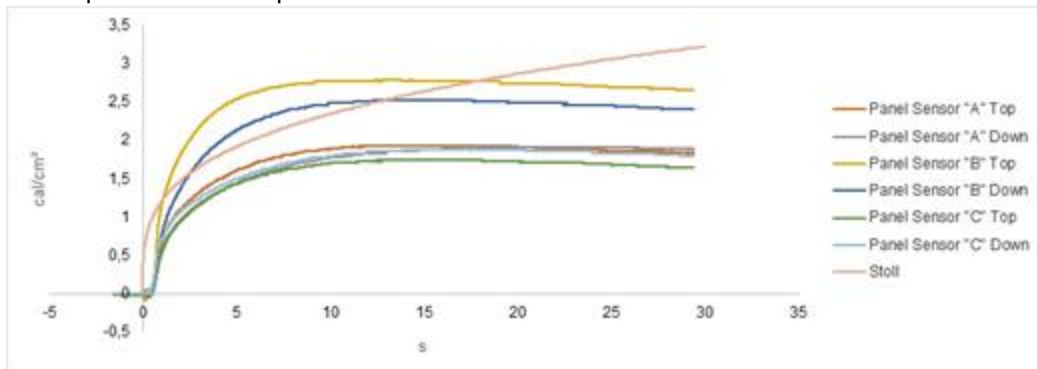


RESULTS

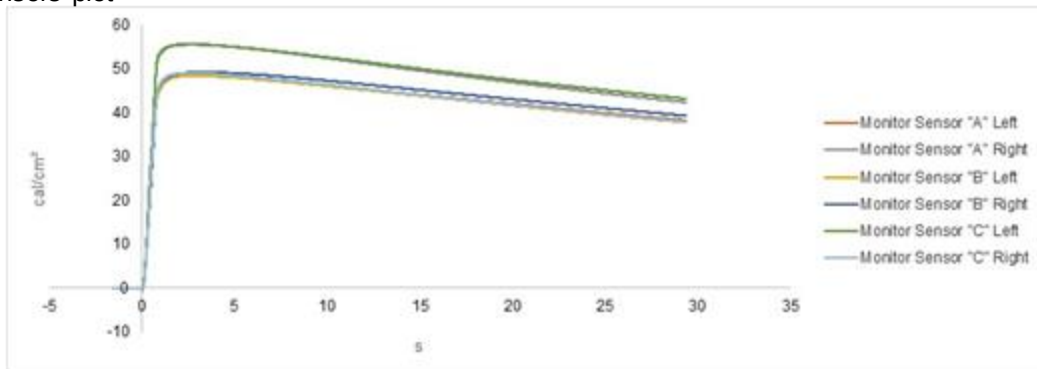
Electrical current and response sensor response:

Shot 3

Panel sensors response Vs. Stoll plot



Monitor sensors plot



Current Total RMS (kA)	8,1	Current Peak (kA)	18,2	Arc Voltage (V)	1530,0
Duration (cycles nº)	42,2	Duration (ms)	844,2	Arc Energy (kJ)	2822,1
Arc Voltage (kJ)	450,0				

Sensor response	PANEL A	PANEL B	PANEL C
Ei	51,94 cal/cm ²	48,76 cal/cm ²	52,31 cal/cm ²
SCD	-0,39 cal/cm ²	0,42 cal/cm ²	-0,44 cal/cm ²
HAF	96,31 %	94,57 %	96,54 %

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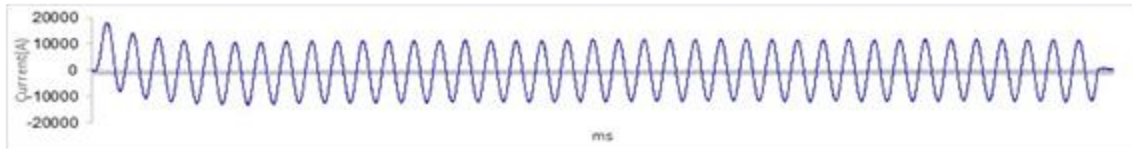


RESULTS

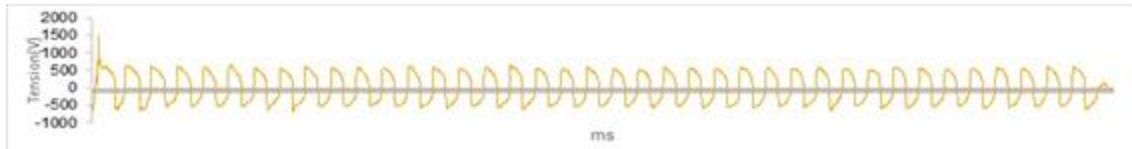
Electrical current and response sensor response:

Shot 4

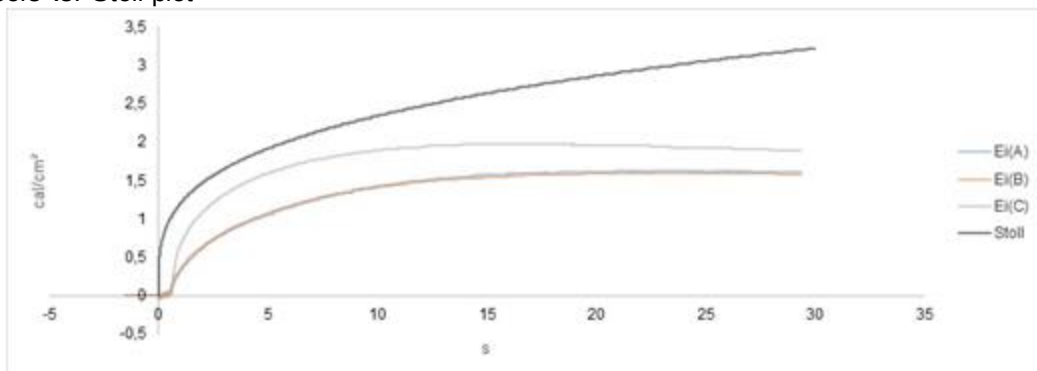
Current Plot



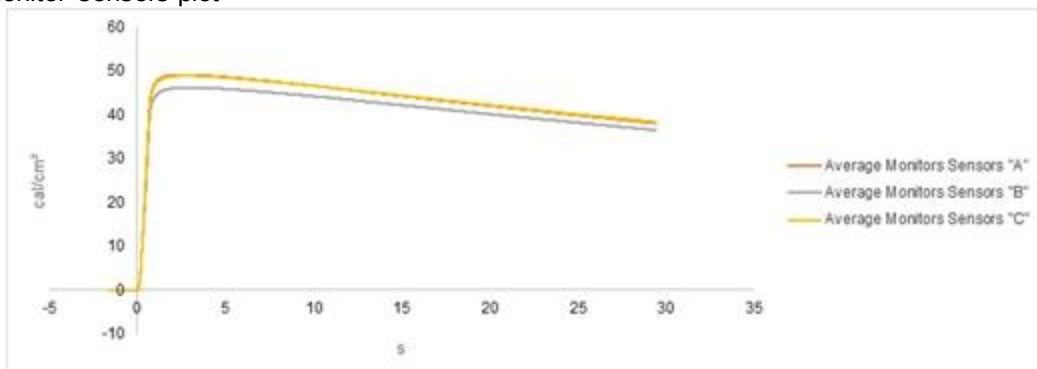
Voltage Plot



Panel sensors vs. Stoll plot



Average monitor sensors plot



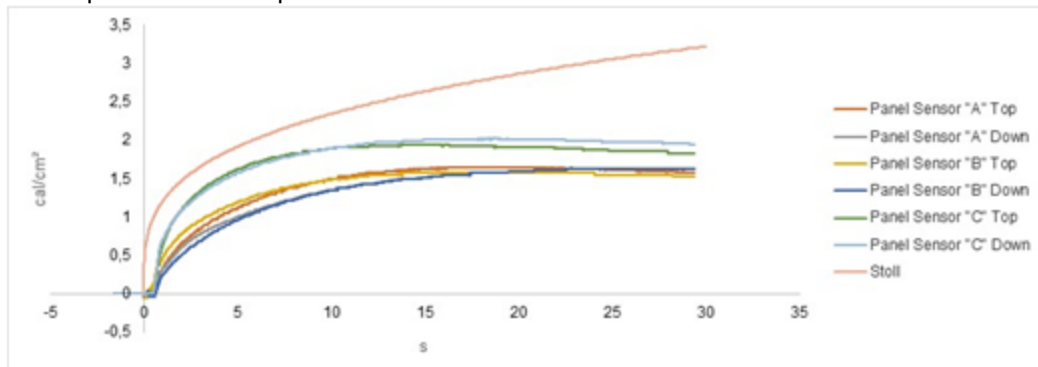
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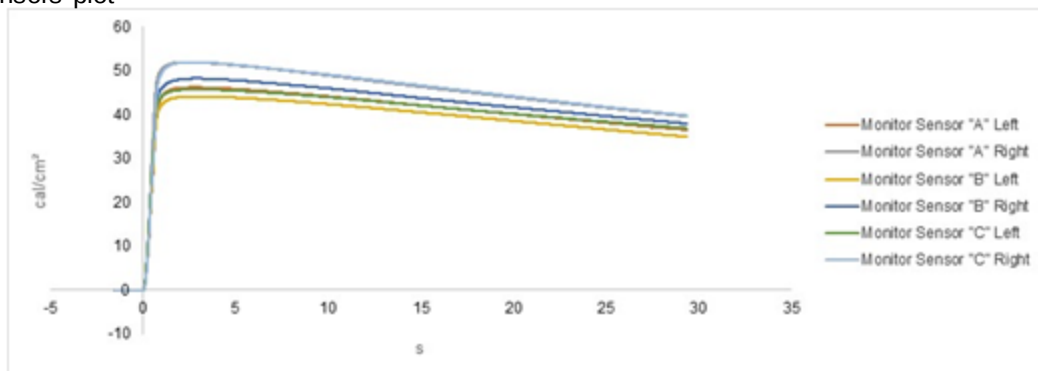
RESULTS

Electrical current and response sensor response:
Shot 4

Panel sensors response Vs. Stoll plot



Monitor sensors plot



Current Total RMS (kA)	8,2	Current Peak (kA)	18,2	Arc Voltage (V)	1530,0
Duration (cycles nº)	39,2	Duration (ms)	783,6	Arc Energy (kJ)	2656,3
Arc Voltage (kJ)	449,3				

Sensor response	PANEL A	PANEL B	PANEL C
Ei	49,03 cal/cm ²	46,13 cal/cm ²	48,82 cal/cm ²
SCD	-0,83 cal/cm ²	-0,82 cal/cm ²	-0,31 cal/cm ²
HAF	96,68 %	96,54 %	95,96 %

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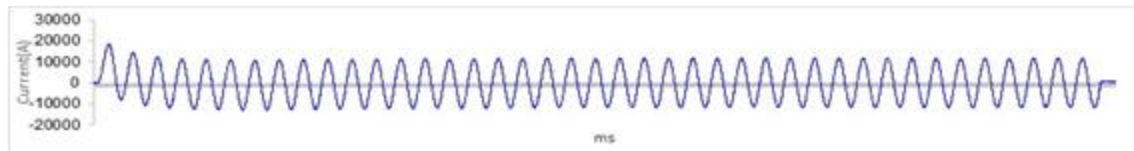


RESULTS

Electrical current and response sensor response:

Shot 5

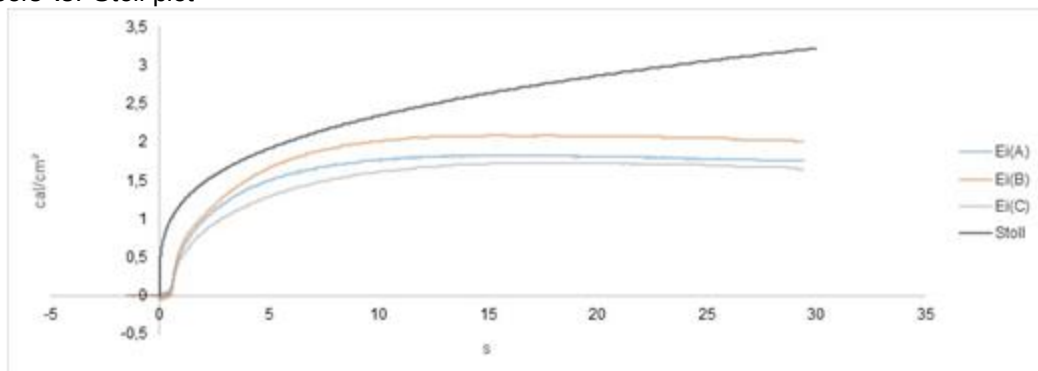
Current Plot



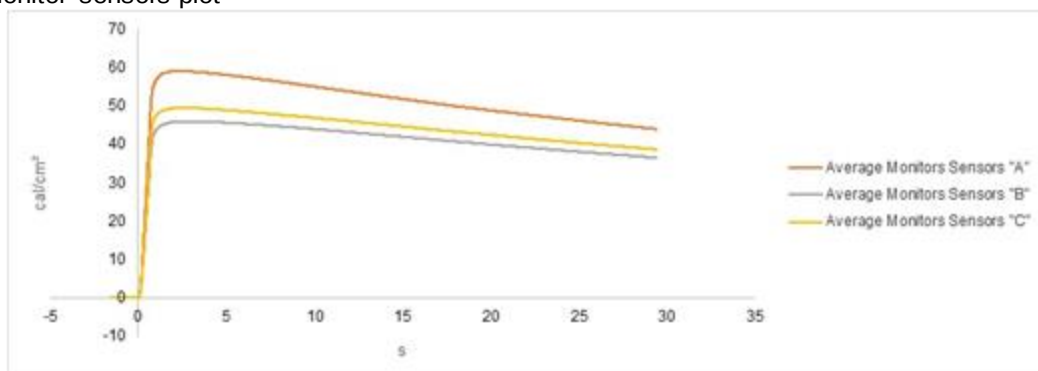
Voltage Plot



Panel sensors vs. Stoll plot



Average monitor sensors plot



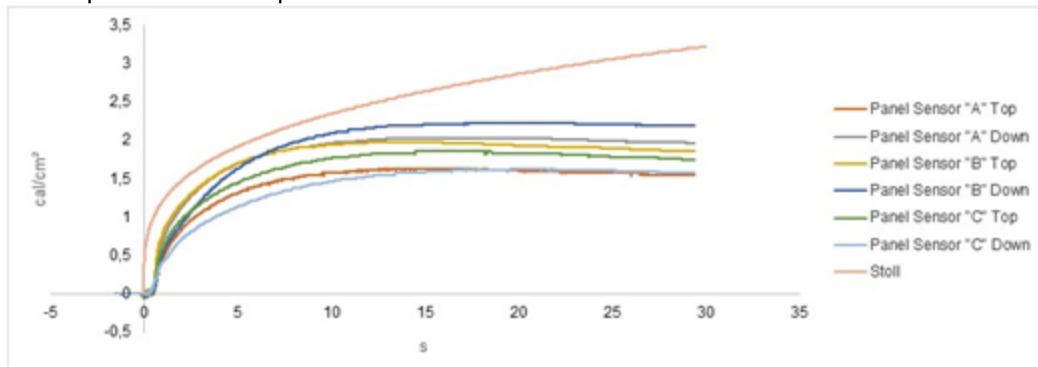
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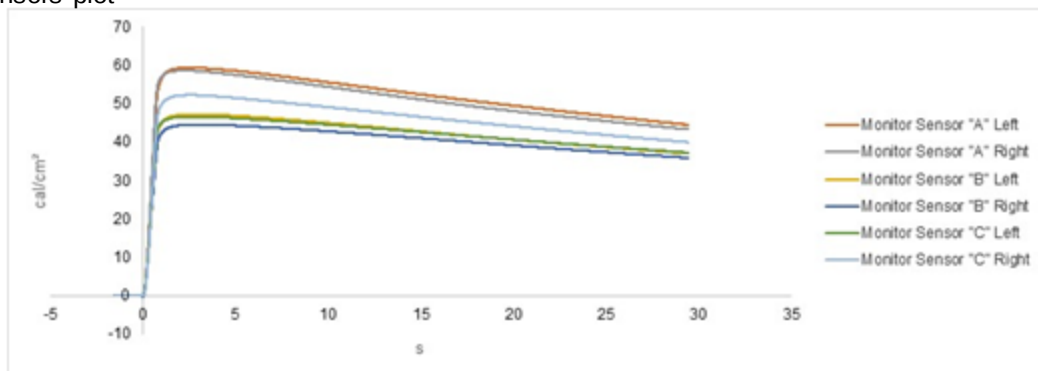
RESULTS

Electrical current and response sensor response:
Shot 5

Panel sensors response Vs. Stoll plot



Monitor sensors plot



Current Total RMS (kA)	8,2	Current Peak (kA)	18,6	Arc Voltage (V)	1530,0
Duration (cycles nº)	41,2	Duration (ms)	824,5	Arc Energy (kJ)	2740,8
Arc Voltage (kJ)	439,2				

Sensor response	PANEL A	PANEL B	PANEL C
Ei	58,95 cal/cm ²	45,87 cal/cm ²	49,39 cal/cm ²
SCD	-0,40 cal/cm ²	-0,24 cal/cm ²	-0,61 cal/cm ²
HAF	96,90 %	95,45 %	96,51 %

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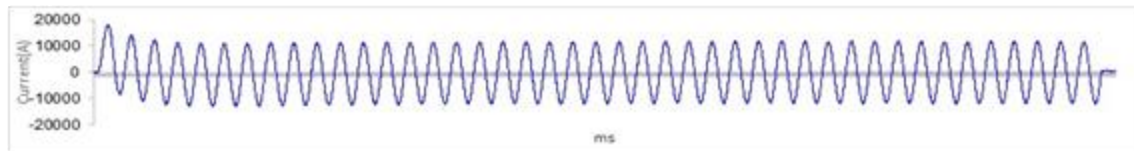


RESULTS

Electrical current and response sensor response:

Shot 6

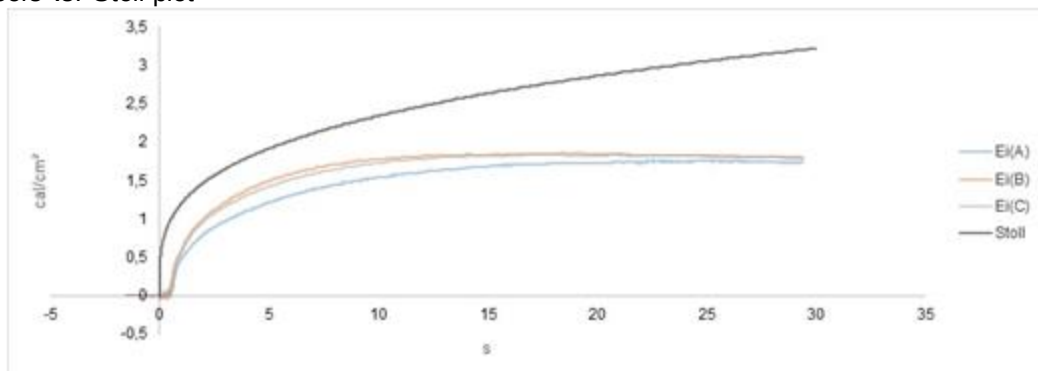
Current Plot



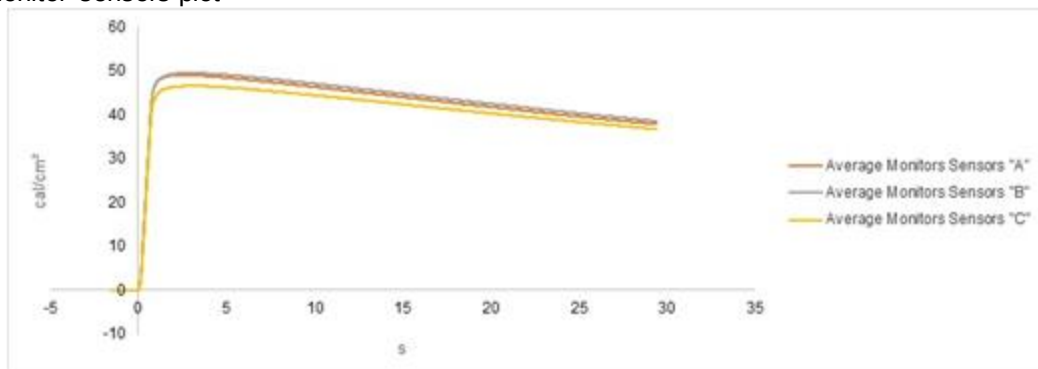
Voltage Plot



Panel sensors vs. Stoll plot



Average monitor sensors plot



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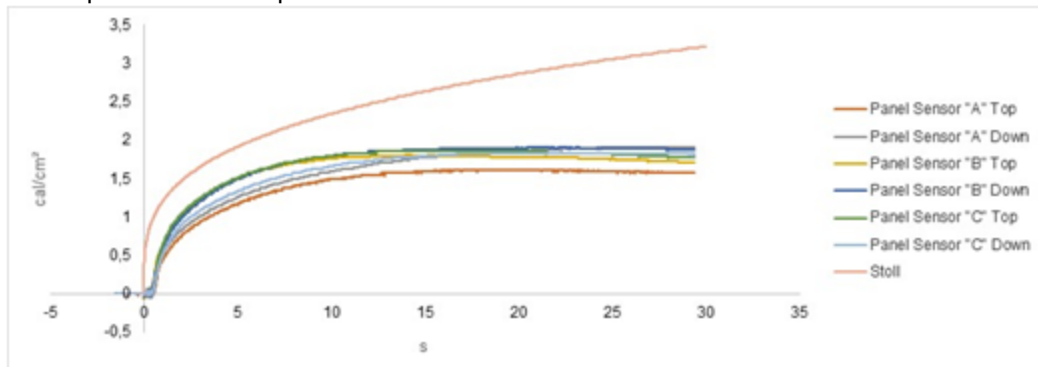


RESULTS

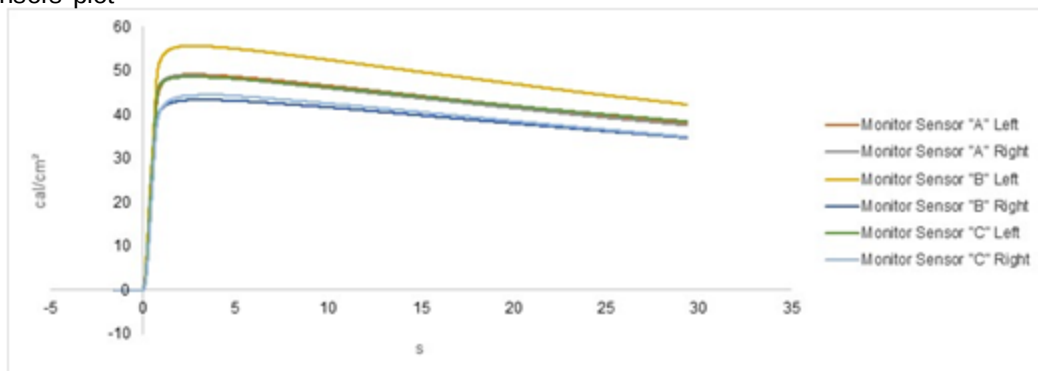
Electrical current and response sensor response:

Shot 6

Panel sensors response Vs. Stoll plot



Monitor sensors plot



Current Total RMS (kA)	8,3	Current Peak (kA)	18,2	Arc Voltage (V)	1530,0
Duration (cycles nº)	43,2	Duration (ms)	863,6	Arc Energy (kJ)	2696,8
Arc Voltage (kJ)	411,5				

Sensor response	PANEL A	PANEL B	PANEL C
Ei	48,99 cal/cm ²	49,48 cal/cm ²	46,49 cal/cm ²
SCD	-0,67 cal/cm ²	-0,41 cal/cm ²	-0,48 cal/cm ²
HAF	96,42 %	96,28 %	96,03 %

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RESULTS

Electrical current and response sensor response:
Shot 7

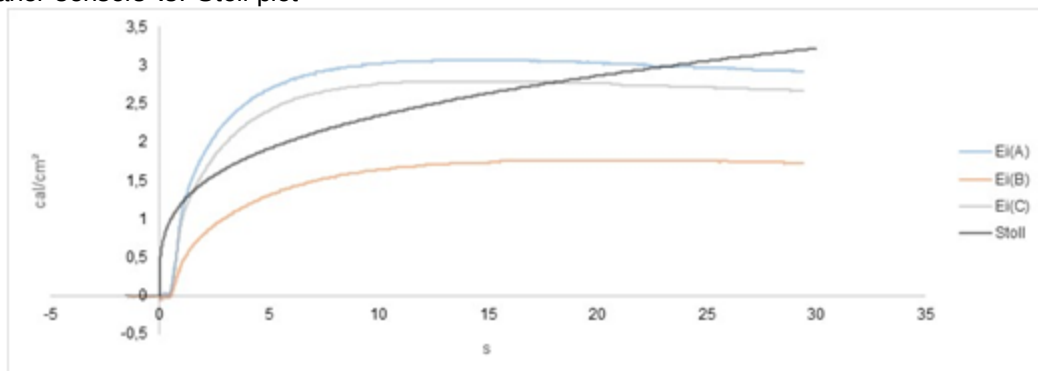
Current Plot



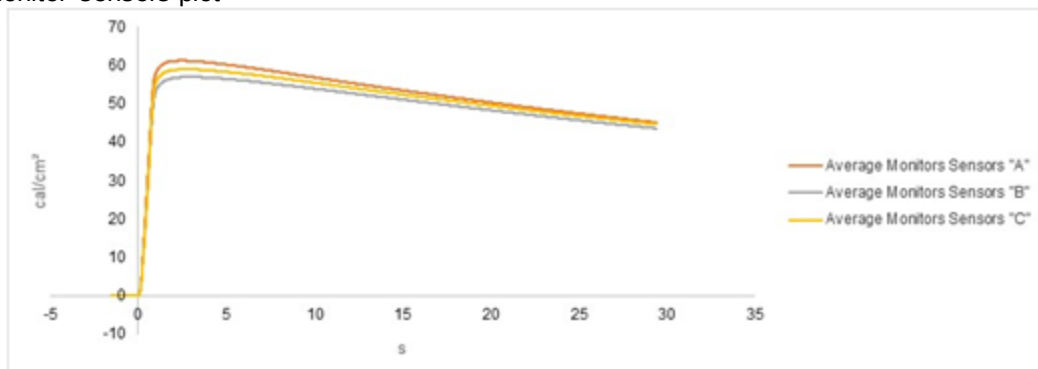
Voltage Plot



Average panel sensors vs. Stoll plot



Average monitor sensors plot



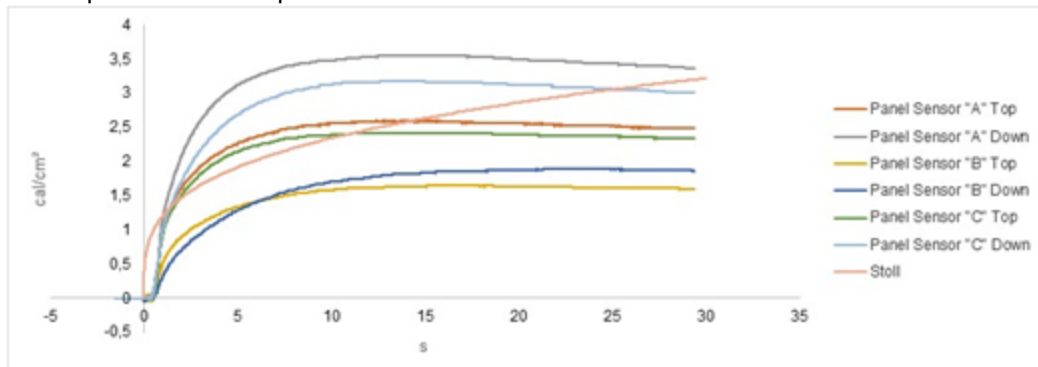
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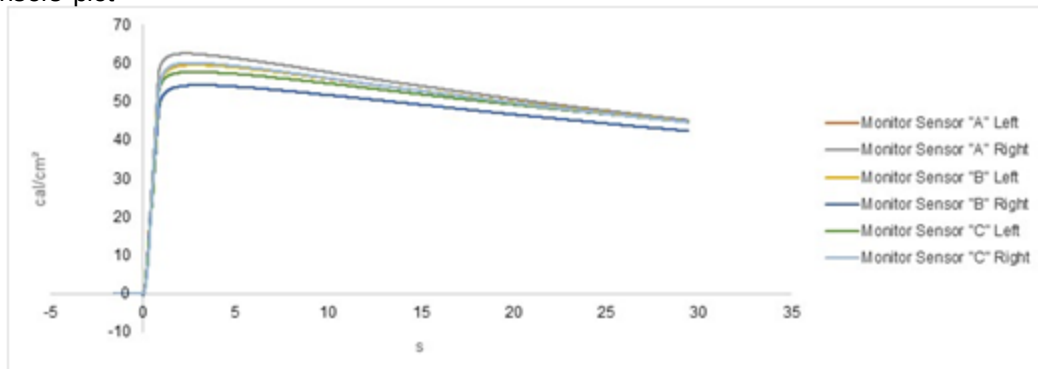
RESULTS

Electrical current and response sensor response:
Shot 7

Panel sensors response Vs. Stoll plot



Monitor sensors plot



Current Total RMS (kA)	8,3	Current Peak (kA)	18,9	Arc Voltage (V)	1530,0
Duration (cycles nº)	49,2	Duration (ms)	984,2	Arc Energy (kJ)	3026,1
Arc Voltage (kJ)	403,2				

Sensor response	PANEL A	PANEL B	PANEL C
Ei	61,14 cal/cm ²	56,91 cal/cm ²	58,91 cal/cm ²
SCD	0,79 cal/cm ²	-0,60 cal/cm ²	0,53 cal/cm ²
HAF	94,97 %	96,91 %	95,26 %

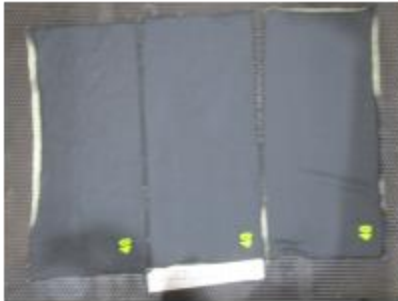
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RESULTS

Tested material pictures:

Original



Shot 1



Shot 2



Shot 3



Shot 4



Shot 5



Shot 6



Shot 7



>>>



RESULTS

Summary of results:

ATPV	57 cal/cm ²
HAF	96,0 %

FABRIC TESTED ACCORDING TO THE STANDARD ASTM F1959/F1959M-14e1

ARC RATING (ATPV)

57 cal/cm²

*According to ASTM F1506-20a and ASTM F1959/F1959M-14e1, arc rating values below 10 cal/cm² shall be reported to the nearest 0.1 cal/cm², and arc rating values above 10 cal/cm² shall be reported to the nearest 1 cal/cm².

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

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Head of PPE and Ballistics department

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