

## TEST REPORT

2021EP1867

### DATE OF RECEPTION

15/06/2021

### DATE TESTS

Starting: 15/06/2021

Ending: 28/06/2021

### APPLICANT

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### IDENTIFICATION AND DESCRIPTION OF SAMPLES

#### REFERENCES

FABRIC Aramid D2 260 EL

### TESTS CARRIED OUT

- PHOTOGRAPHY.
- 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 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](http://www.aitex.es) [info@aitex.es](mailto:info@aitex.es)

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



## RESULTS

### PHOTOGRAPHY



### Reference <sup>(1)</sup>

FABRIC Aramid D2 260 EL

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## RESULTS

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

**Standard**

ISO 6330:2012

**Standard deviation**

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**Reference**

Sample1 FABRIC Aramid D2 260 EL

**Units**

1

**Equipment** Wascator 13470E05**Dryer machine** JAMES HEAL  
13472E05**Washing procedure** 3N **Washing cycles** 5**Drying procedure**

F (tumble dryer)

**Washing powder**

ECE detergent 98 + sodium perborate + TAED

Units	Dry mass of the samples	Equipment
1	2,10 Kg	Wascator 13470E05

**Start and finish date**

16/06/2021 - 17/06/2021

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## RESULTS

### MASS PER UNIT AREA

**Standard**

EN 12127:1997; pto. 8.3

**Conditioning date** 18/06/2021 **Test date** 21/06/2021

**Atmosphere for conditioning testing**

**Temperature** (20±2) °C **Relative humidity** (65±2) %

**State of the specimens**

Washed

**Previous treatment**

5 washing cycles at 30°C, according to standard EN ISO 6330:2012, method 3N and type F drying (tumble dry)

Reference	Mass per unit area (g/m <sup>2</sup> )	CV (%)
FABRIC Aramid D2 260 EL	202	0,2

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## RESULTS

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

#### Standard

IEC 61482-1-1:2009, panel test (Method A) - Obsolete

#### 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	25/06/2021
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	24
Starting and ending pre-treatment date	16/06/2021 - 17/06/2021

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## RESULTS

**Reference**

FABRIC Aramid D2 260 EL

**Sample description according to the information supplied by the customer**

Navy woven fabric style Aramid D2 260 EL , 88% m-aramid, 5% elastane, 5%p-aramid, 2% Carbon, fabric structure twill, 240-260 g/m<sup>2</sup>, manufacturer Ariteks.

**Pre-treatment**

5 washing cycles at 30°C, according to standard UNE-EN ISO 6330:2012, method 3N and type F drying.

**Washed sample weight before test**

202 g/m<sup>2</sup>

**Deviation from the standard**

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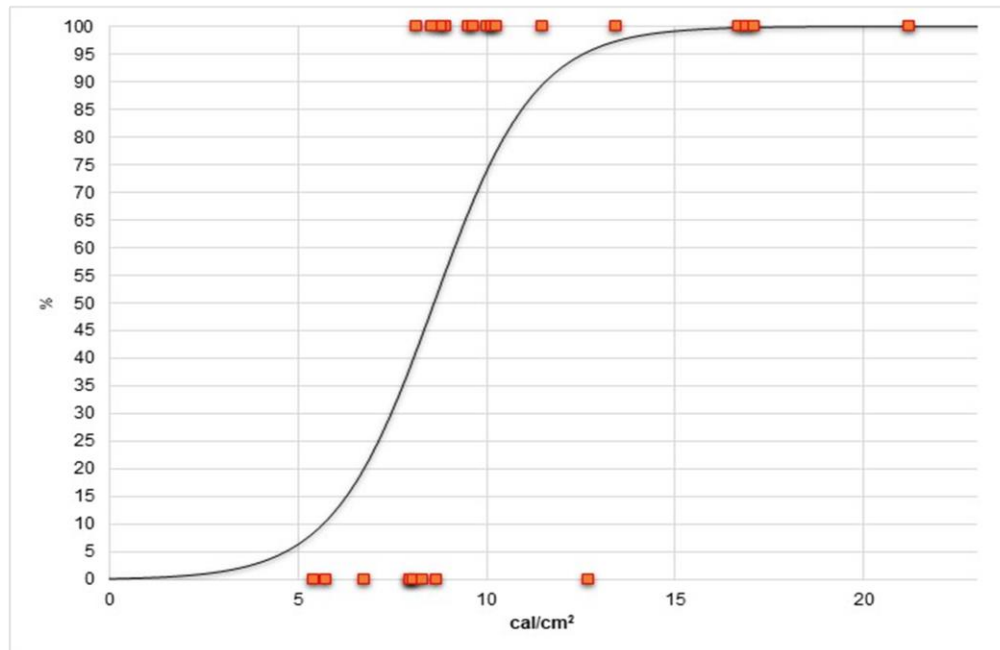
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## RESULTS

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

ATPV	8,6 cal/cm <sup>2</sup>
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Probability%	5	10	20	30	40	50	60	70	80	95
E <sub>i</sub> cal/cm <sup>2</sup>	4,6	5,6	6,7	7,5	8,0	8,6	9,1	9,7	10,5	12,6

ATPV points above	5
ATPV points 20%	14
ATPV points below	6
ATPV points mix zone	13

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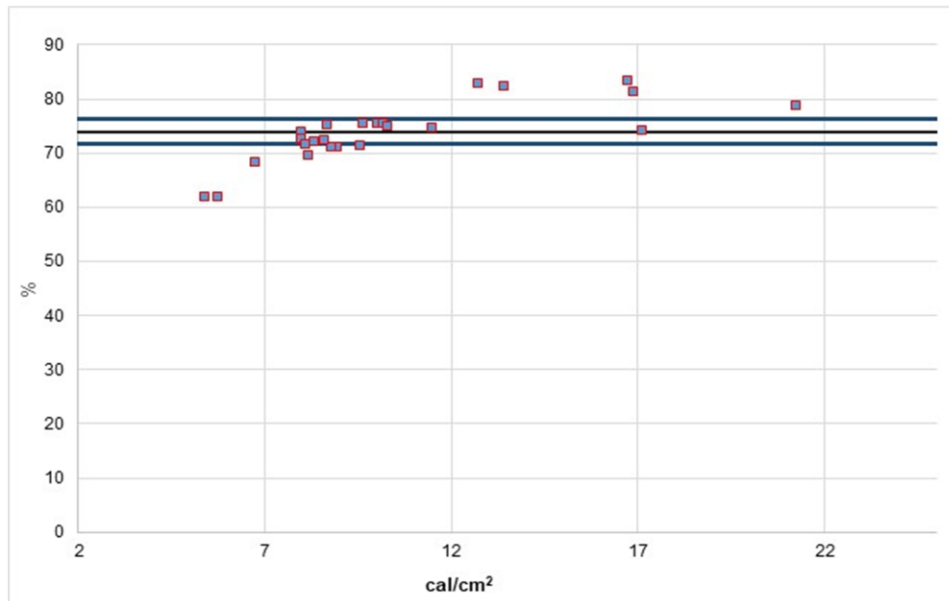




## RESULTS

Determination of HAF, confidence Intervals 95%

HAF	73,9 %
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% HAF value :	73,9
Upper Confidence Level %:	76,3
Lower Confidence Level %:	71,6
Points above:	5
Points below:	7
Points between:	12
Total Points:	24

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## RESULTS

Summary of measured energy and subjective evaluation:

Test	Time (ms)	Cycles 50Hz	Ei cal/cm <sup>2</sup>	SCD cal/cm <sup>2</sup>	HAF %	Burn	Break Open
1-A	192,6	9,63	12,7	-0,05	82,9	N	Y
1-B	192,6	9,63	9,5	0,43	71,4	Y	N
1-C	192,6	9,63	8,9	0,21	71,1	Y	N
2-A	242,8	12,14	16,7	0,54	83,4	Y	Y
2-B	242,8	12,14	11,5	0,57	74,9	Y	Y
2-C	242,8	12,14	13,4	0,23	82,5	Y	Y
3-A	123,8	6,19	8,0	-0,2	74,0	N	N
3-B	123,8	6,19	5,7	-0,14	62,1	N	N
3-C	123,8	6,19	5,4	-0,23	61,9	N	N
4-A	202,4	10,12	10,0	0,21	75,7	Y	N
4-B	202,4	10,12	8,8	0,2	71,2	Y	N
4-C	202,4	10,12	10,2	0,3	75,4	Y	N
5-A	172	8,6	8,0	-0,23	72,7	N	N
5-B	172	8,6	10,3	0,25	74,9	Y	N
5-C	172	8,6	9,6	0,07	75,6	Y	N
6-A	171,8	8,59	8,7	-0,3	75,4	N	N
6-B	171,8	8,59	8,2	0,1	69,7	Y	N
6-C	171,8	8,59	8,6	0,06	72,4	Y	N
7-A	152,2	7,61	6,8	-0,31	68,4	N	N
7-B	152,2	7,61	8,1	-0,14	71,8	N	N
7-C	152,2	7,61	8,3	-0,13	72,3	N	N
8-A	322,4	16,12	16,9	0,87	81,5	Y	Y
8-B	322,4	16,12	21,2	2,2	78,8	Y	Y
8-C	322,4	16,12	17,1	2,15	74,3	Y	Y

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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	Y	Y	Y
1-B	0	N	N	Y	Y	Y
1-C	0	N	N	Y	Y	Y
2-A	5,3	Y	N	Y	Y	Y
2-B	0	Y	N	Y	Y	Y
2-C	4,8	Y	N	Y	Y	Y
3-A	0	N	N	Y	Y	Y
3-B	0	N	N	Y	Y	Y
3-C	0	N	N	Y	Y	Y
4-A	0	N	N	Y	Y	Y
4-B	0	N	N	Y	Y	Y
4-C	0	N	N	Y	Y	Y
5-A	0	N	N	Y	Y	Y
5-B	0	N	N	Y	Y	Y
5-C	0	N	N	Y	Y	Y
6-A	0	N	N	Y	Y	Y
6-B	0	N	N	Y	Y	Y
6-C	0	N	N	Y	Y	Y
7-A	0	N	N	Y	Y	Y
7-B	0	N	N	Y	Y	Y
7-C	0	N	N	Y	Y	Y
8-A	0	Y	N	Y	Y	Y
8-B	0	Y	N	Y	Y	Y
8-C	0	Y	N	Y	Y	Y

Y Yes N No

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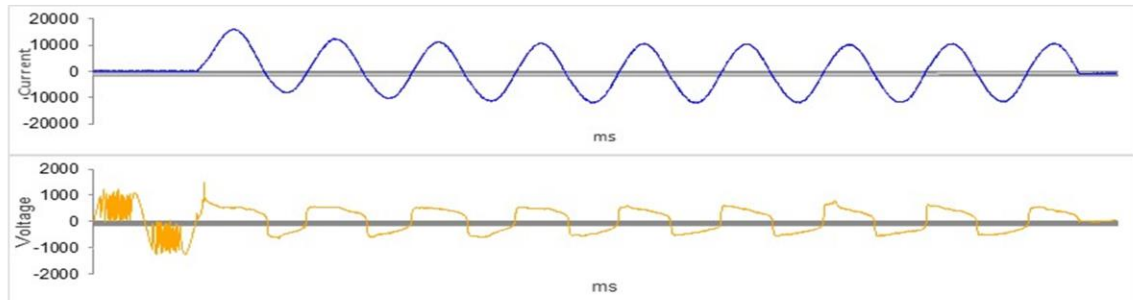


## RESULTS

Electrical current and response sensor response:

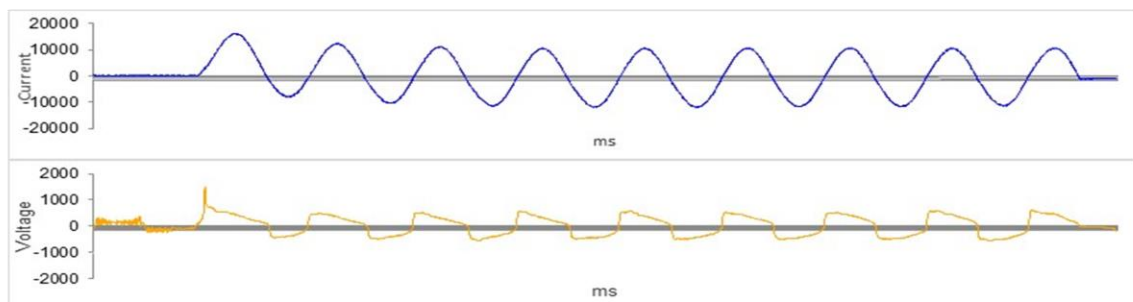
Calibration shot

### INITIAL CALIBRATION



<b>Ei Panel A</b>	8,8 cal/cm <sup>2</sup>	<b>Ei Panel B</b>	8,2 cal/cm <sup>2</sup>	<b>Ei Panel C</b>	7,1 cal/cm <sup>2</sup>
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### FINAL CALIBRATION



<b>Ei Panel A</b>	7,6 cal/cm <sup>2</sup>	<b>Ei Panel B</b>	7,0 cal/cm <sup>2</sup>	<b>Ei Panel C</b>	6,9 cal/cm <sup>2</sup>
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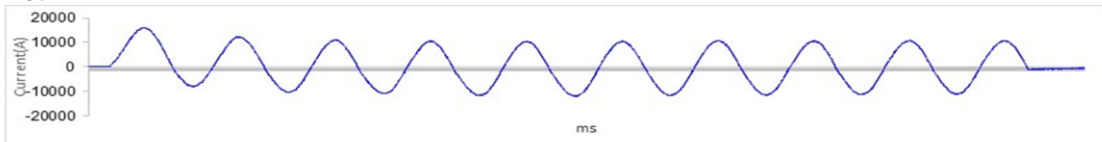


# RESULTS

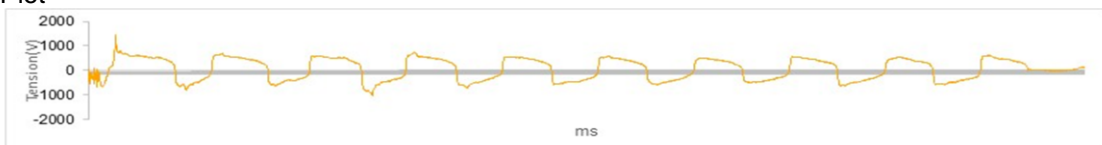
## Electrical current and response sensor response:

Shot 1

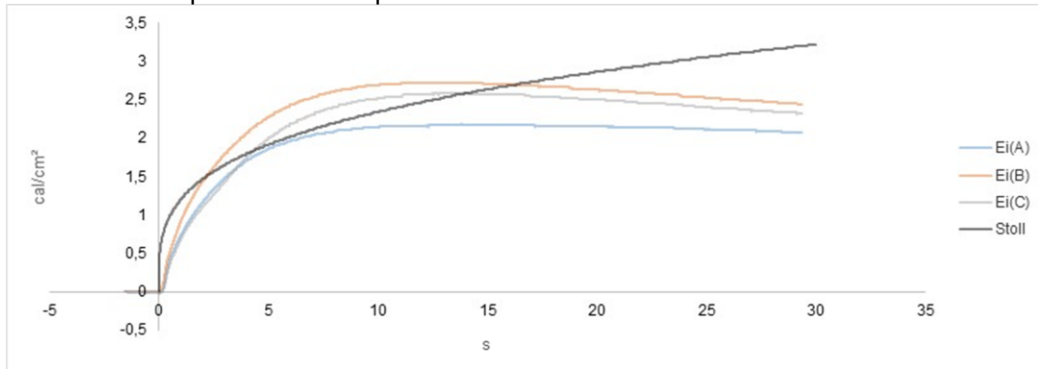
Current Plot



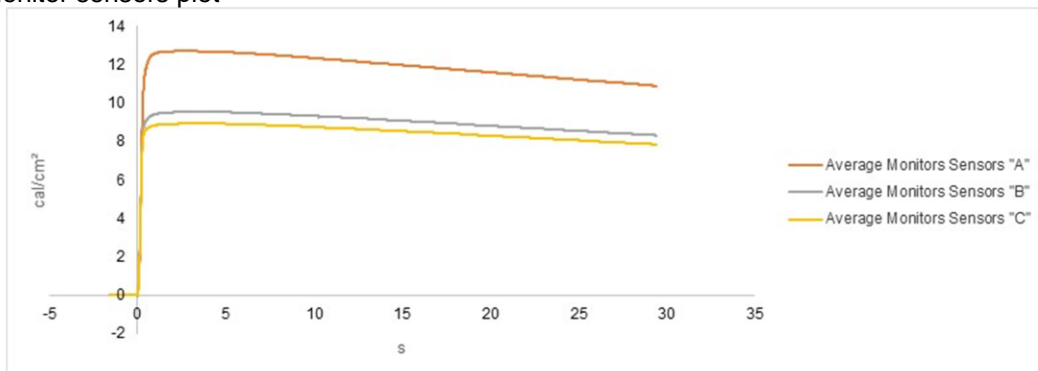
Voltage Plot



Average panel sensors response Vs. Stoll plot



Average monitor sensors plot



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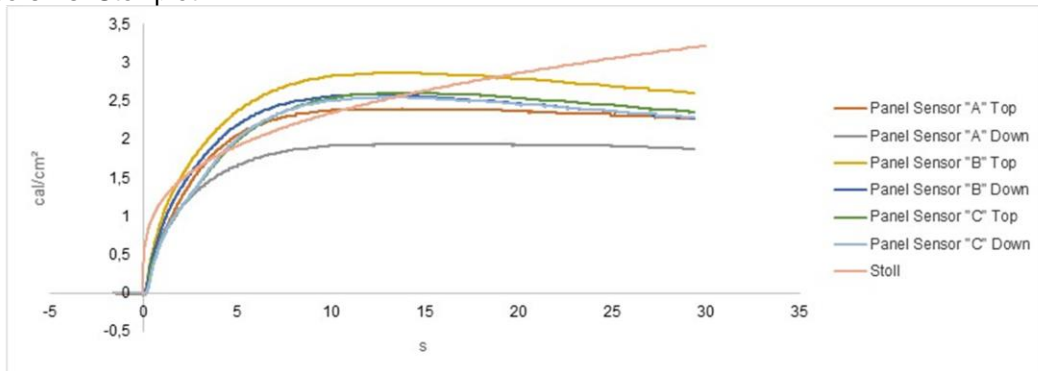


## RESULTS

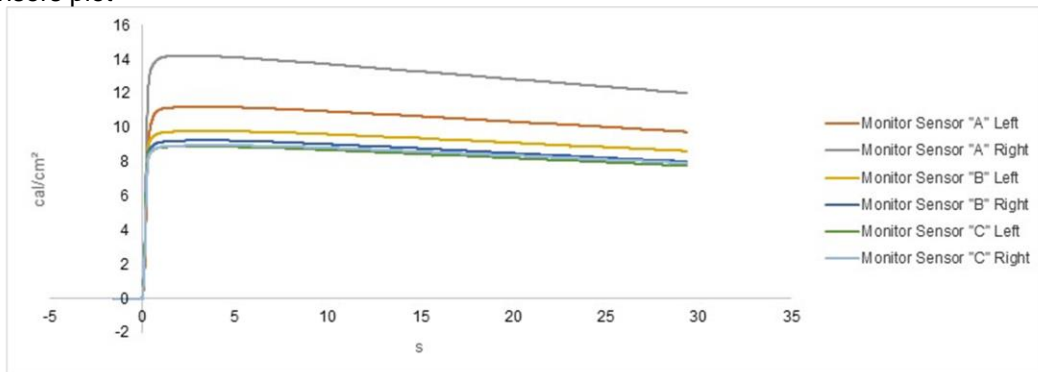
### Electrical current and response sensor response:

Shot 1

Panel sensors Vs. Stoll plot



Monitor sensors plot



<b>Current Total RMS (kA)</b>	7,8	<b>Current Peak (kA)</b>	16,0	<b>Arc Voltage (V)</b>	1473,0
<b>Duration (cycles nº)</b>	9,6	<b>Duration (ms)</b>	192,7	<b>Arc Energy (kJ)</b>	624,8
<b>Arc Voltage (kJ)</b>	463,5				

Sensor response	PANEL A	PANEL B	PANEL C
<b>Ei</b>	12,70 cal/cm <sup>2</sup>	9,53 cal/cm <sup>2</sup>	8,93 cal/cm <sup>2</sup>
<b>SCD</b>	-0,05 cal/cm <sup>2</sup>	0,43 cal/cm <sup>2</sup>	0,21 cal/cm <sup>2</sup>
<b>HAF</b>	82,88 %	71,43 %	71,14 %

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## RESULTS

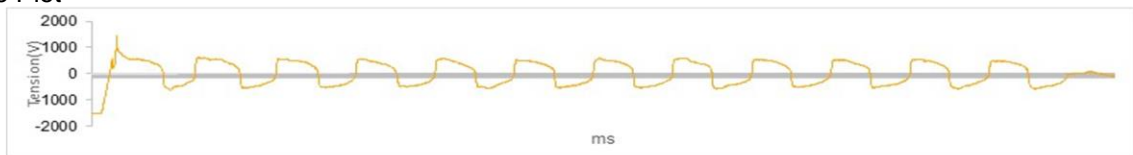
### Electrical current and response sensor response:

Shot 2

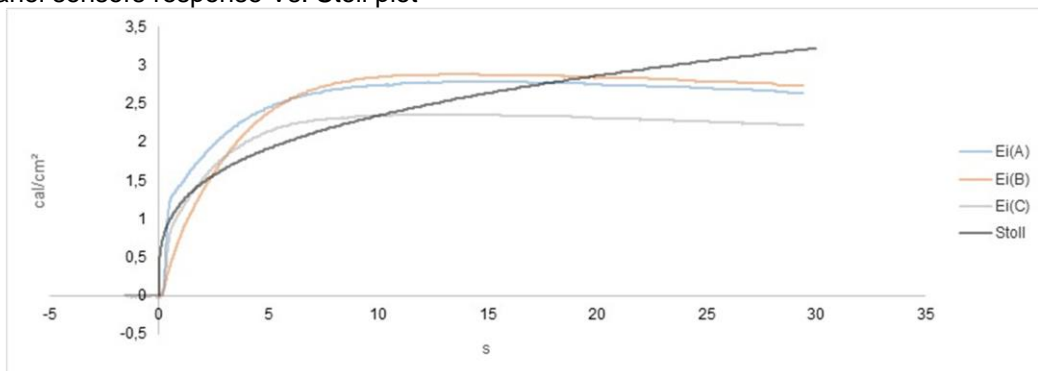
Current Plot



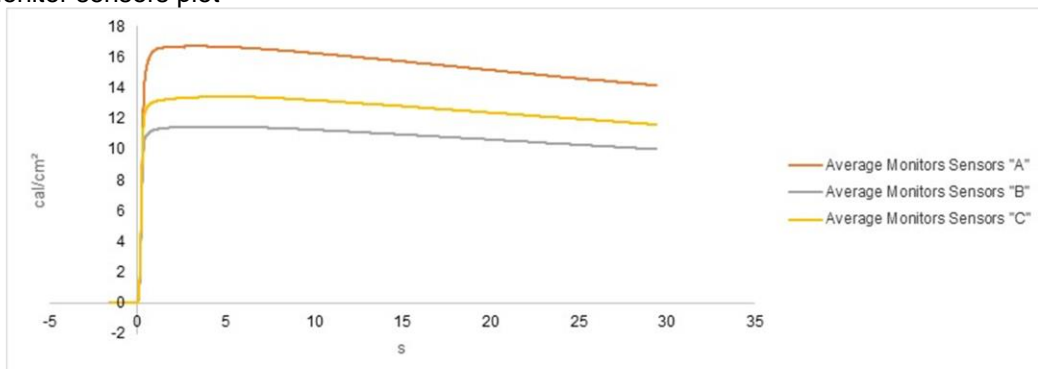
Voltage Plot



Average panel sensors response Vs. Stoll plot



Average monitor sensors plot



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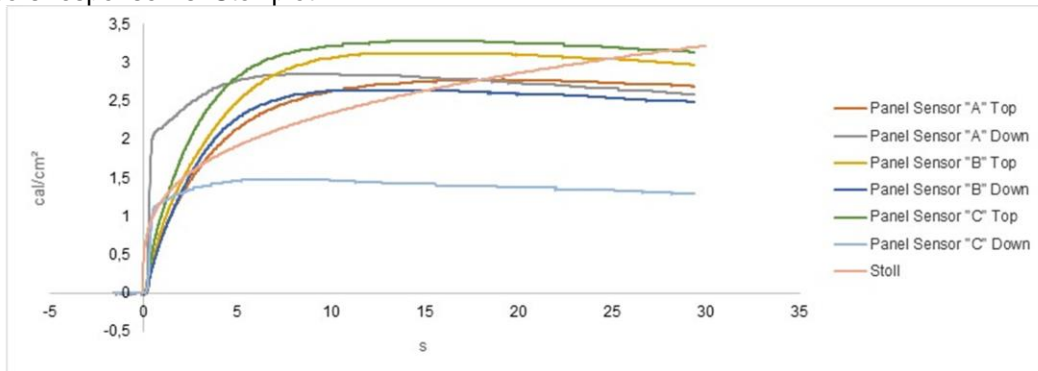


## RESULTS

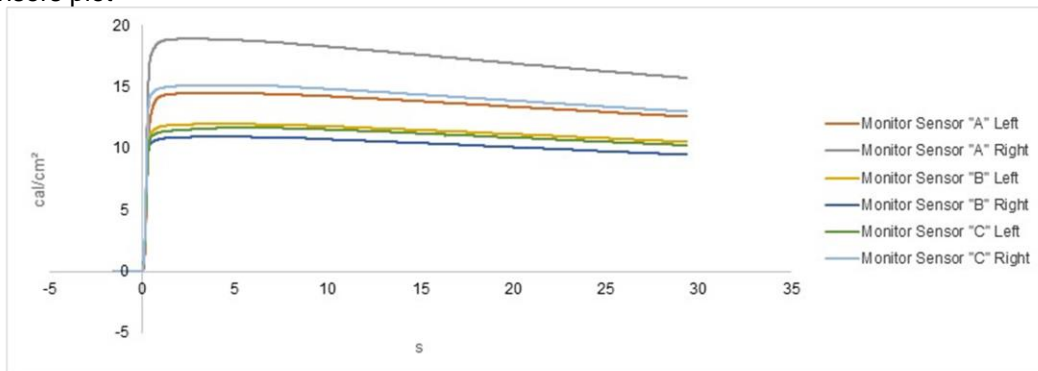
### Electrical current and response sensor response:

Shot 2

Panel sensors response Vs. Stoll plot



Monitor sensors plot



<b>Current Total RMS (kA)</b>	7,8	<b>Current Peak (kA)</b>	15,1	<b>Arc Voltage (V)</b>	1524,0
<b>Duration (cycles n°)</b>	12,1	<b>Duration (ms)</b>	242,8	<b>Arc Energy (kJ)</b>	760,8
<b>Arc Voltage (kJ)</b>	439,5				

Sensor response	PANEL A	PANEL B	PANEL C
<b>Ei</b>	16,71 cal/cm <sup>2</sup>	11,47 cal/cm <sup>2</sup>	13,42 cal/cm <sup>2</sup>
<b>SCD</b>	0,54 cal/cm <sup>2</sup>	0,57 cal/cm <sup>2</sup>	0,23 cal/cm <sup>2</sup>
<b>HAF</b>	83,35 %	74,89 %	82,46 %

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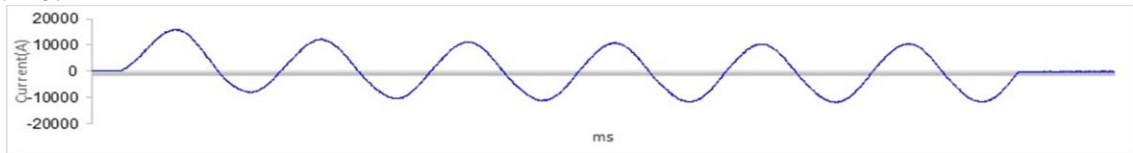


# RESULTS

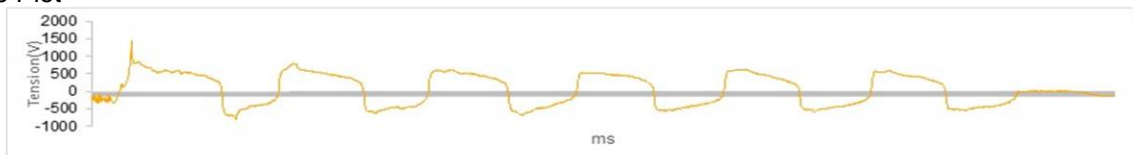
## Electrical current and response sensor response:

Shot 3

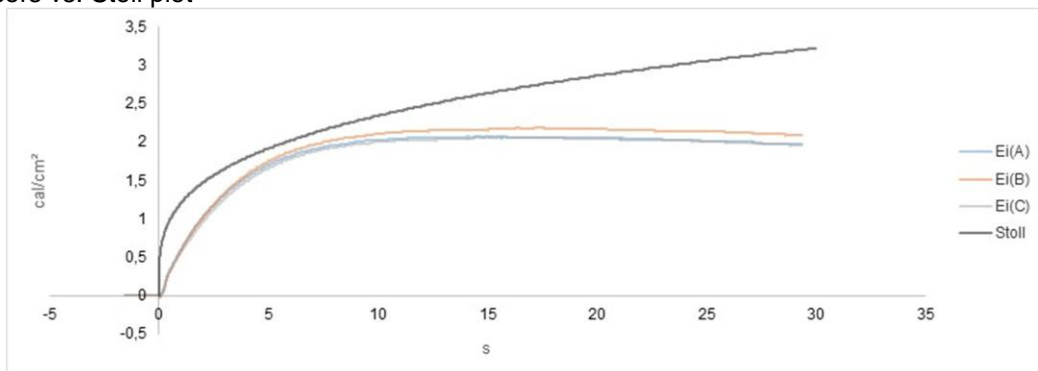
Current Plot



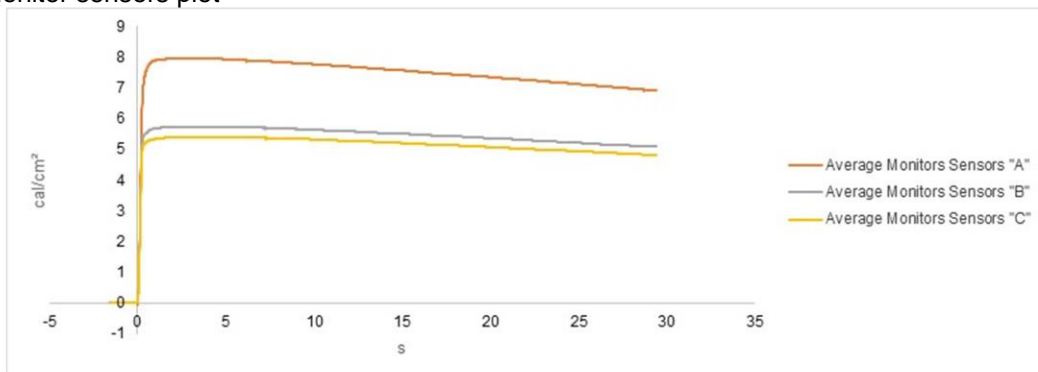
Voltage Plot



Panel sensors vs. Stoll plot



Average monitor sensors plot



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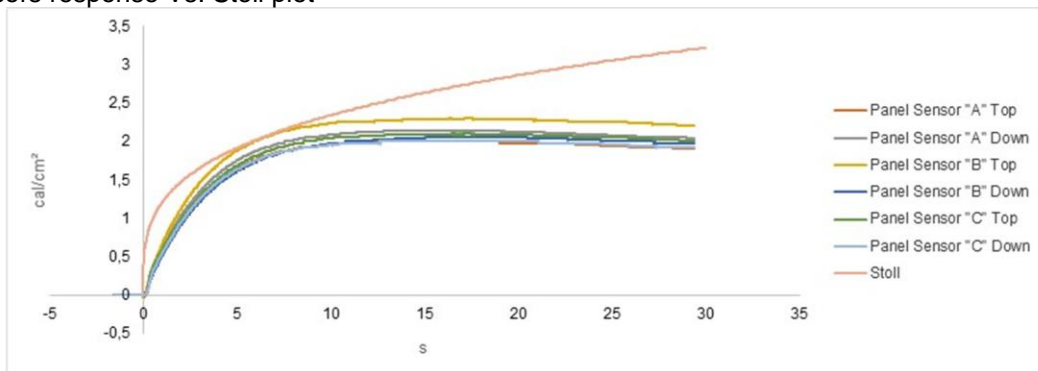


## RESULTS

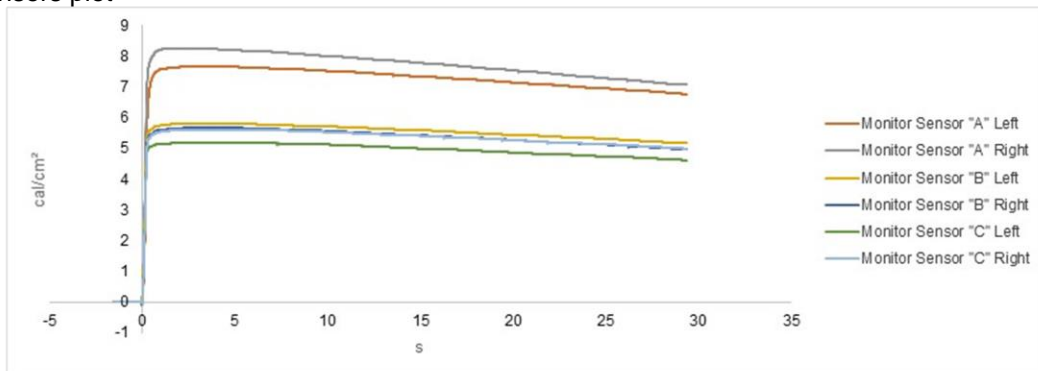
### Electrical current and response sensor response:

Shot 3

Panel sensors response Vs. Stoll plot



Monitor sensors plot



<b>Current Total RMS (kA)</b>	8,0	<b>Current Peak (kA)</b>	15,8	<b>Arc Voltage (V)</b>	1467,0
<b>Duration (cycles nº)</b>	6,2	<b>Duration (ms)</b>	123,8	<b>Arc Energy (kJ)</b>	415,9
<b>Arc Voltage (kJ)</b>	472,4				

Sensor response	PANEL A	PANEL B	PANEL C
<b>Ei</b>	7,96 cal/cm <sup>2</sup>	5,74 cal/cm <sup>2</sup>	5,40 cal/cm <sup>2</sup>
<b>SCD</b>	-0,20 cal/cm <sup>2</sup>	-0,14 cal/cm <sup>2</sup>	-0,23 cal/cm <sup>2</sup>
<b>HAF</b>	74,00 %	62,08 %	61,91 %

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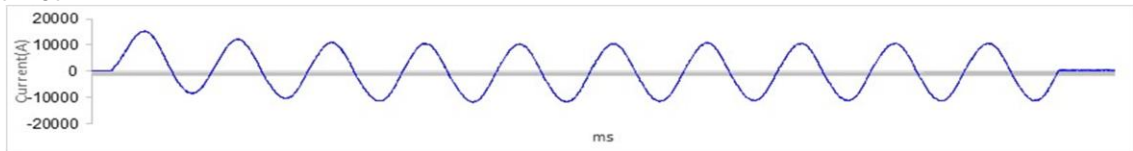


## RESULTS

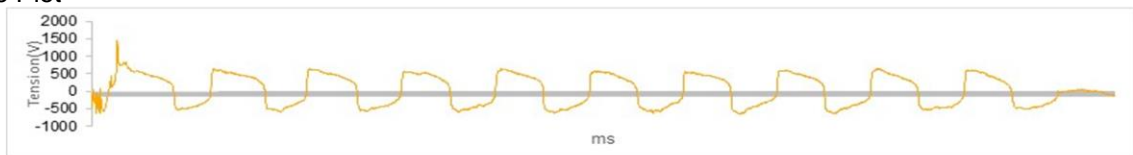
### Electrical current and response sensor response:

Shot 4

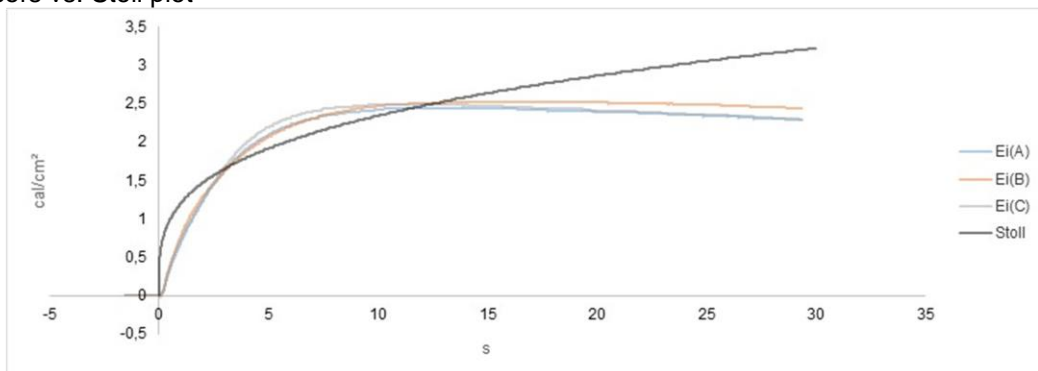
Current Plot



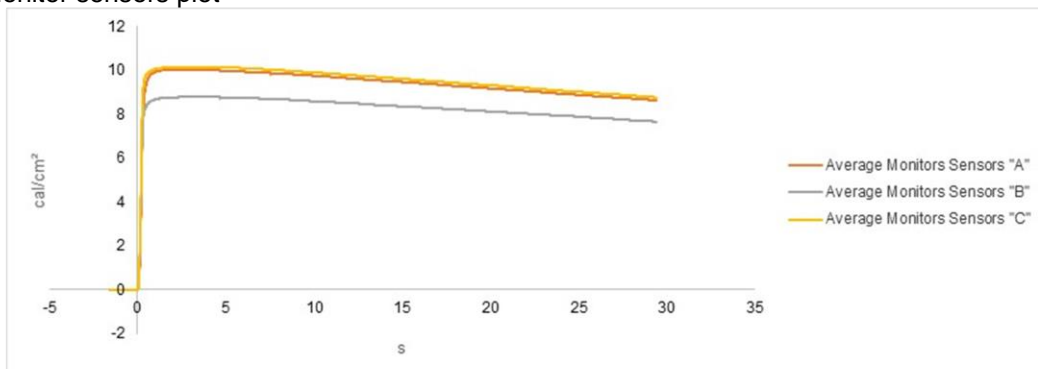
Voltage Plot



Panel sensors vs. Stoll plot



Average monitor sensors plot



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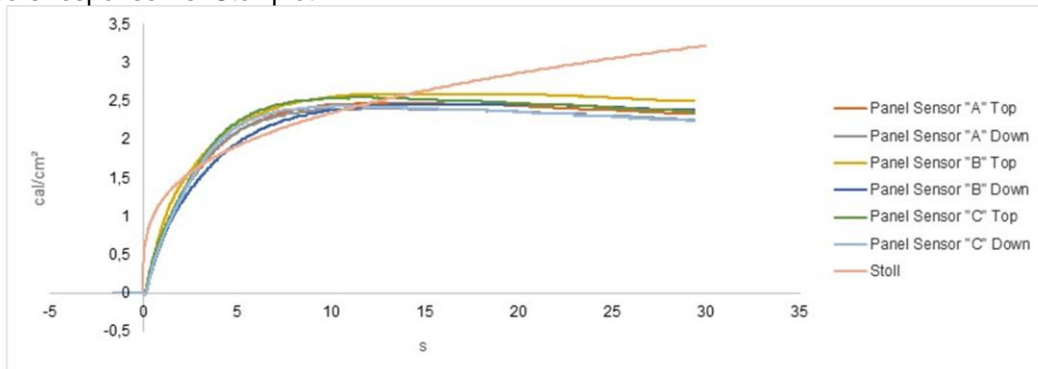


## RESULTS

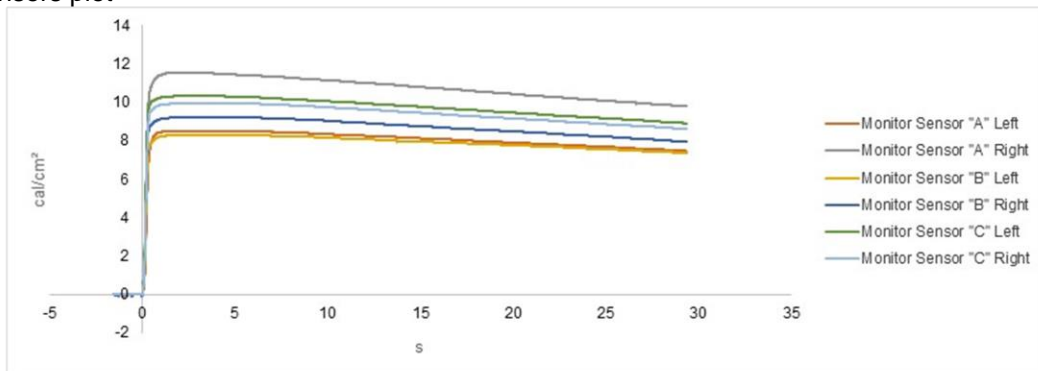
### Electrical current and response sensor response:

Shot 4

Panel sensors response Vs. Stoll plot



Monitor sensors plot



<b>Current Total RMS (kA)</b>	7,8	<b>Current Peak (kA)</b>	15,4	<b>Arc Voltage (V)</b>	1470,0
<b>Duration (cycles n°)</b>	10,1	<b>Duration (ms)</b>	202,4	<b>Arc Energy (kJ)</b>	657,6
<b>Arc Voltage (kJ)</b>	458,2				

Sensor response	PANEL A	PANEL B	PANEL C
<b>Ei</b>	10,02 cal/cm <sup>2</sup>	8,78 cal/cm <sup>2</sup>	10,15 cal/cm <sup>2</sup>
<b>SCD</b>	0,21 cal/cm <sup>2</sup>	0,20 cal/cm <sup>2</sup>	0,30 cal/cm <sup>2</sup>
<b>HAF</b>	75,67 %	71,25 %	75,44 %

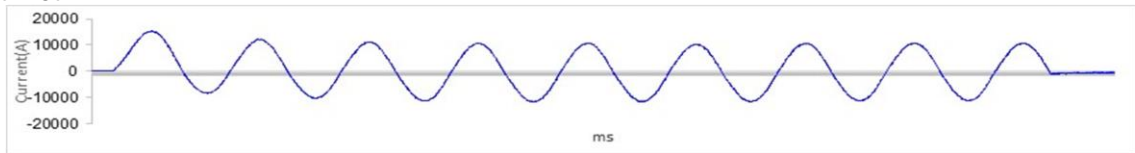
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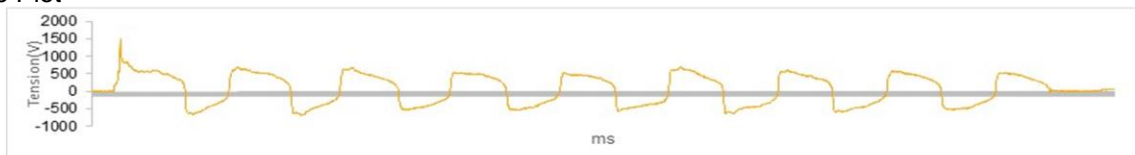
# RESULTS

Electrical current and response sensor response:  
Shot 5

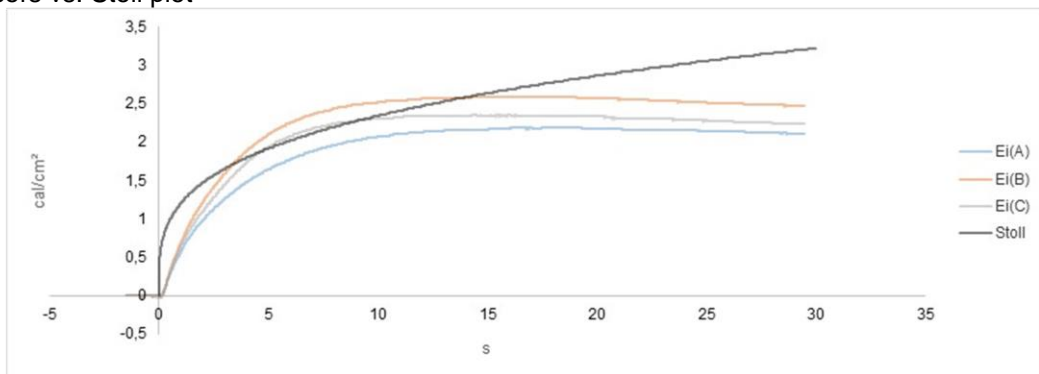
Current Plot



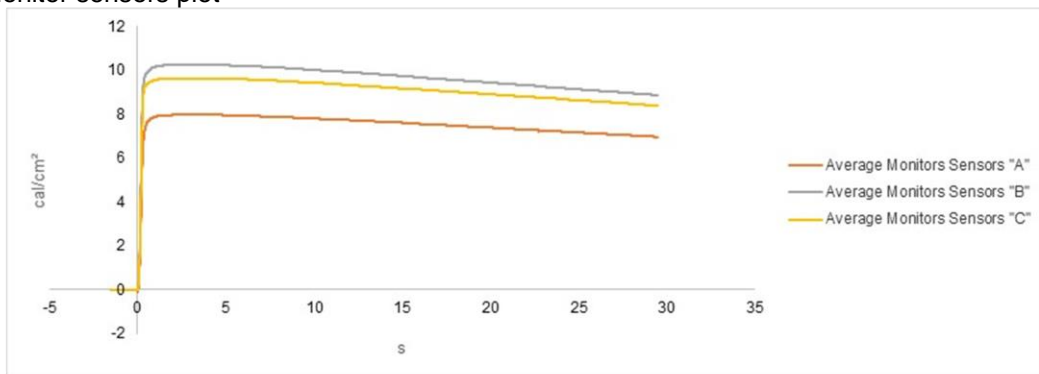
Voltage Plot



Panel sensors vs. Stoll plot



Average monitor sensors plot



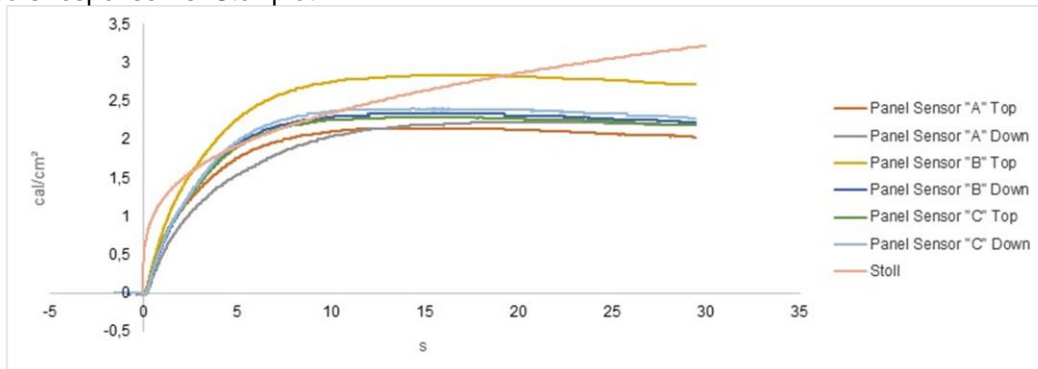
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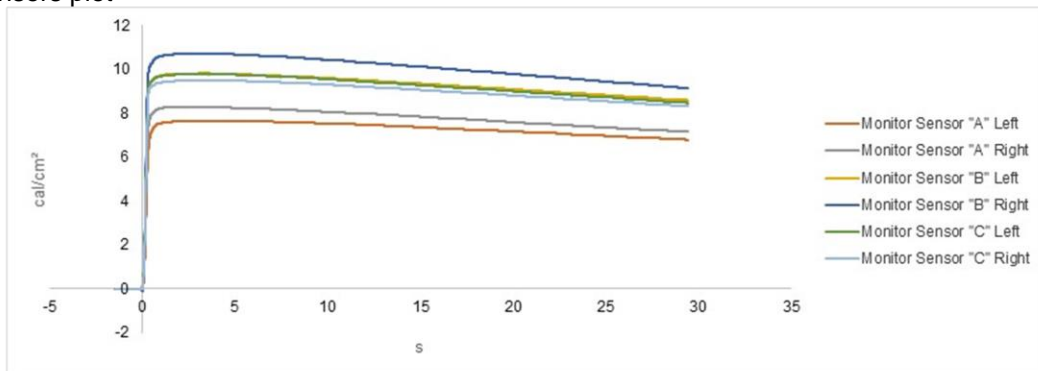
## RESULTS

**Electrical current and response sensor response:**  
Shot 5

Panel sensors response Vs. Stoll plot



Monitor sensors plot



<b>Current Total RMS (kA)</b>	7,9	<b>Current Peak (kA)</b>	15,4	<b>Arc Voltage (V)</b>	1488,0
<b>Duration (cycles n°)</b>	8,6	<b>Duration (ms)</b>	172,0	<b>Arc Energy (kJ)</b>	554,5
<b>Arc Voltage (kJ)</b>	455,9				

Sensor response	PANEL A	PANEL B	PANEL C
<b>Ei</b>	7,97 cal/cm <sup>2</sup>	10,27 cal/cm <sup>2</sup>	9,64 cal/cm <sup>2</sup>
<b>SCD</b>	-0,23 cal/cm <sup>2</sup>	0,25 cal/cm <sup>2</sup>	0,07 cal/cm <sup>2</sup>
<b>HAF</b>	72,70 %	74,91 %	75,65 %

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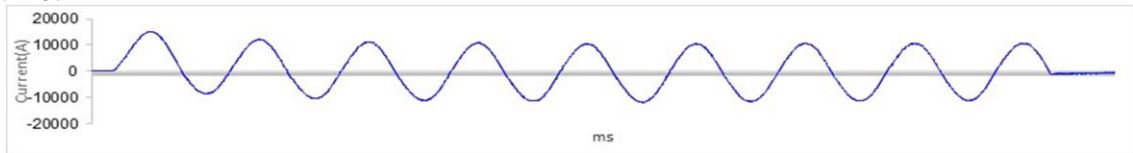


# RESULTS

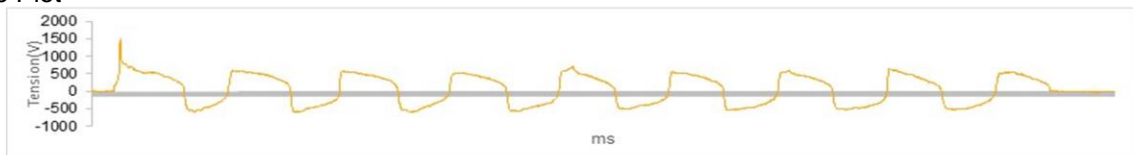
## Electrical current and response sensor response:

Shot 6

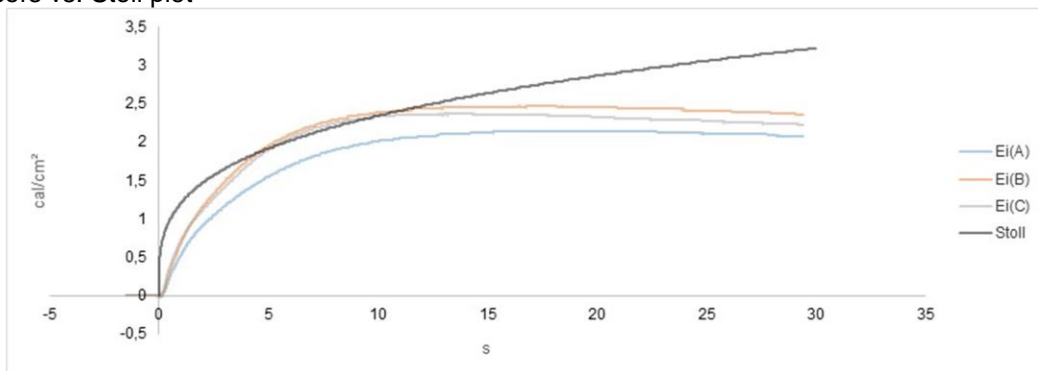
Current Plot



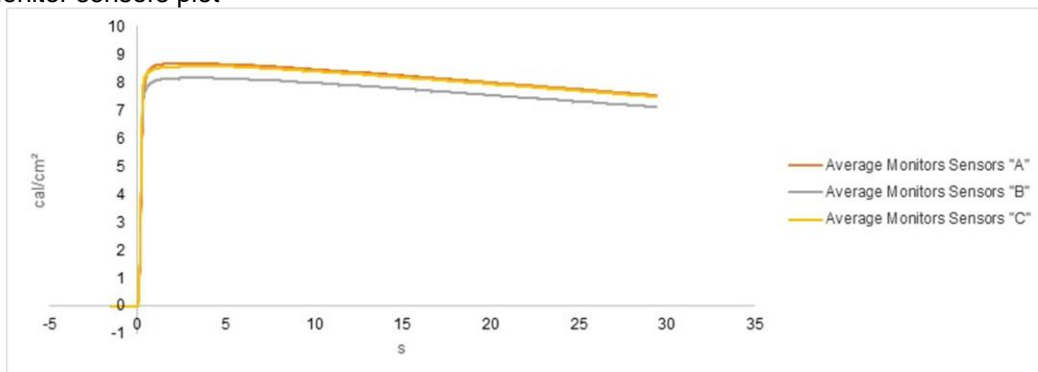
Voltage Plot



Panel sensors vs. Stoll plot



Average monitor sensors plot



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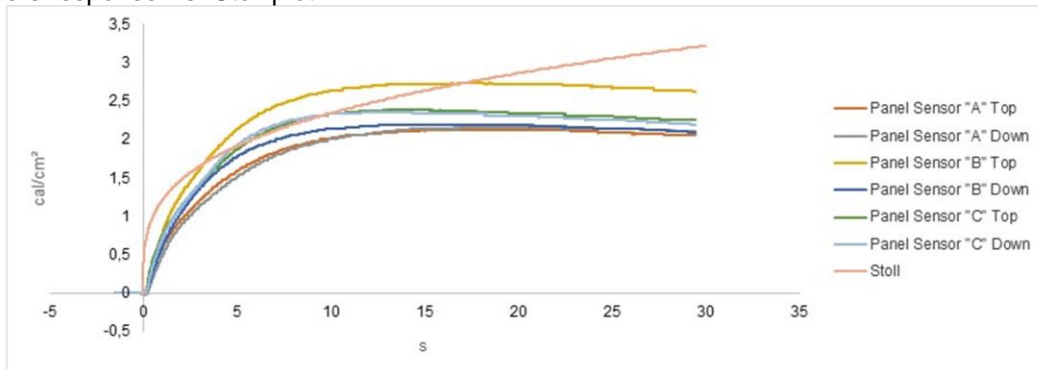


## RESULTS

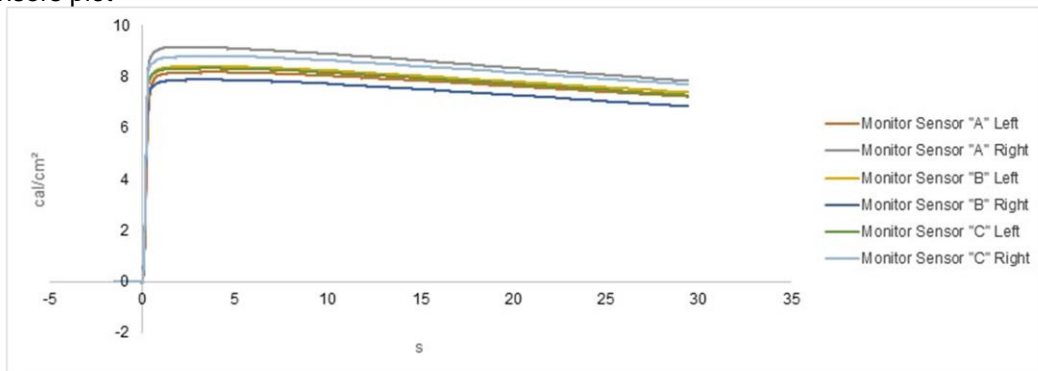
### Electrical current and response sensor response:

Shot 6

Panel sensors response Vs. Stoll plot



Monitor sensors plot



<b>Current Total RMS (kA)</b>	7,9	<b>Current Peak (kA)</b>	15,0	<b>Arc Voltage (V)</b>	1488,0
<b>Duration (cycles nº)</b>	8,6	<b>Duration (ms)</b>	171,8	<b>Arc Energy (kJ)</b>	538,7
<b>Arc Voltage (kJ)</b>	439,9				

Sensor response	PANEL A	PANEL B	PANEL C
<b>Ei</b>	8,67 cal/cm <sup>2</sup>	8,15 cal/cm <sup>2</sup>	8,57 cal/cm <sup>2</sup>
<b>SCD</b>	-0,30 cal/cm <sup>2</sup>	0,10 cal/cm <sup>2</sup>	0,06 cal/cm <sup>2</sup>
<b>HAF</b>	75,37 %	69,74 %	72,40 %

>>>



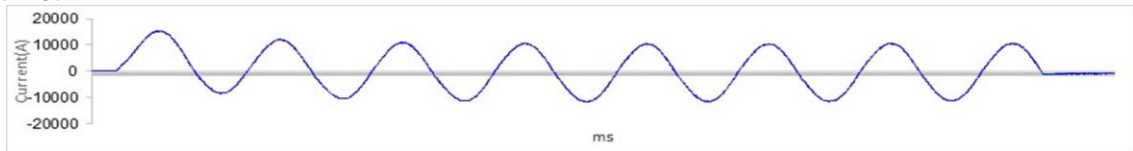


## RESULTS

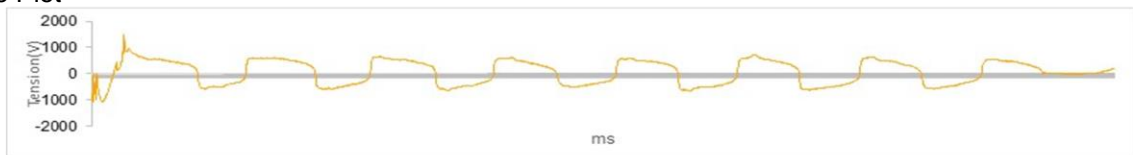
### Electrical current and response sensor response:

Shot 7

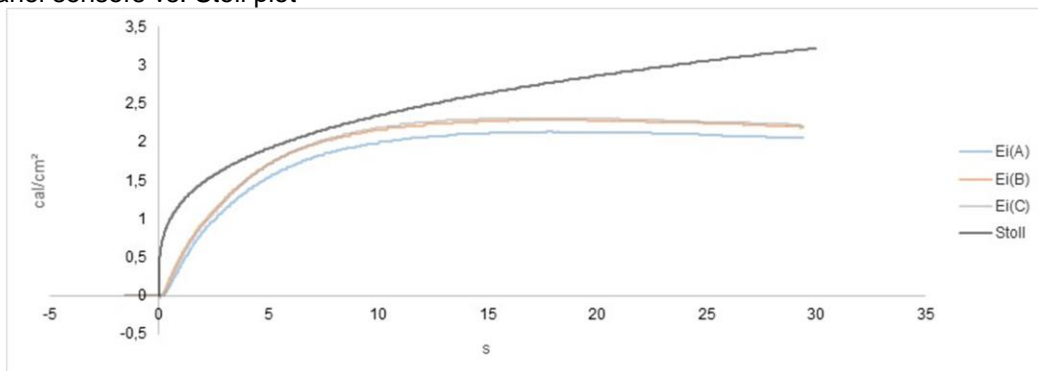
Current Plot



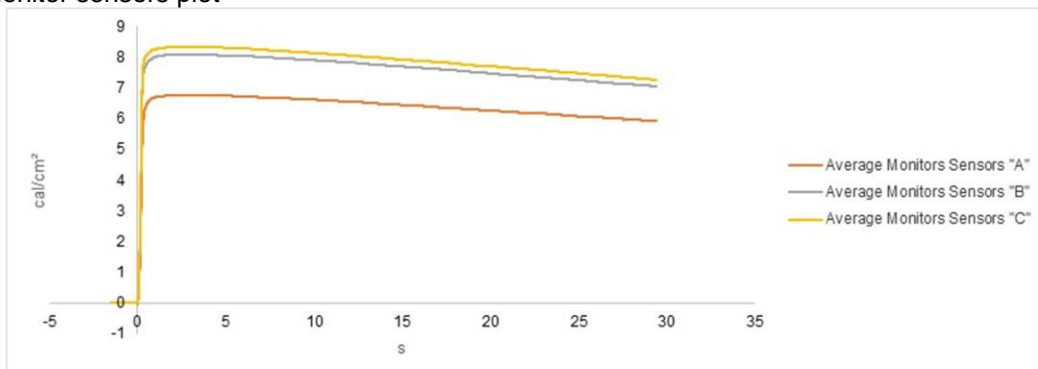
Voltage Plot



Average panel sensors vs. Stoll plot



Average monitor sensors plot



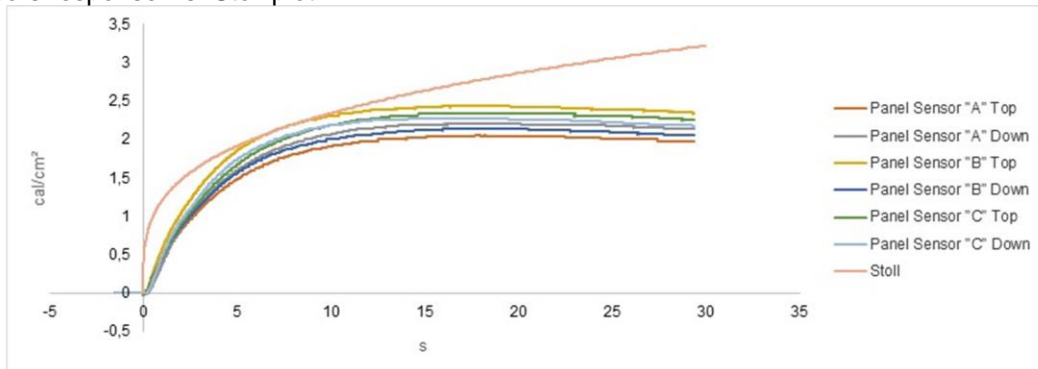
>>>



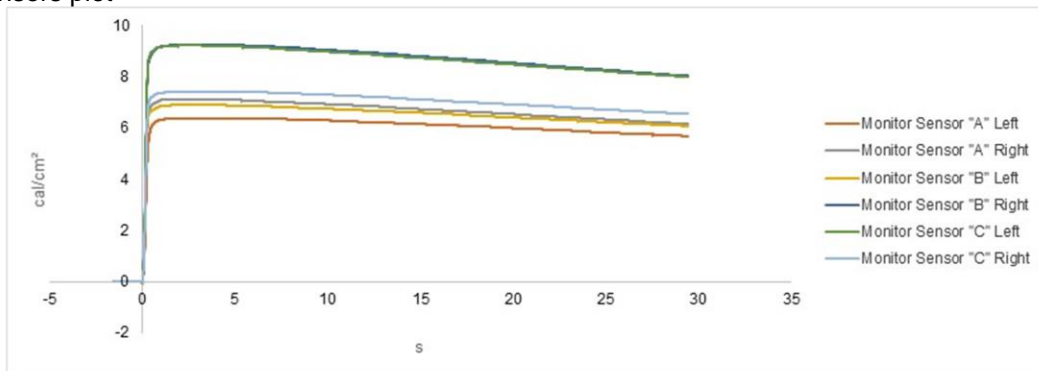
## RESULTS

**Electrical current and response sensor response:**  
Shot 7

Panel sensors response Vs. Stoll plot



Monitor sensors plot



<b>Current Total RMS (kA)</b>	7,9	<b>Current Peak (kA)</b>	15,5	<b>Arc Voltage (V)</b>	1500,0
<b>Duration (cycles n°)</b>	7,6	<b>Duration (ms)</b>	152,1	<b>Arc Energy (kJ)</b>	514,2
<b>Arc Voltage (kJ)</b>	475,5				

Sensor response	PANEL A	PANEL B	PANEL C
<b>Ei</b>	6,75 cal/cm <sup>2</sup>	8,08 cal/cm <sup>2</sup>	8,32 cal/cm <sup>2</sup>
<b>SCD</b>	-0,31 cal/cm <sup>2</sup>	-0,14 cal/cm <sup>2</sup>	-0,13 cal/cm <sup>2</sup>
<b>HAF</b>	68,45 %	71,79 %	72,29 %

>>>



## RESULTS

### Electrical current and response sensor response:

Shot 8

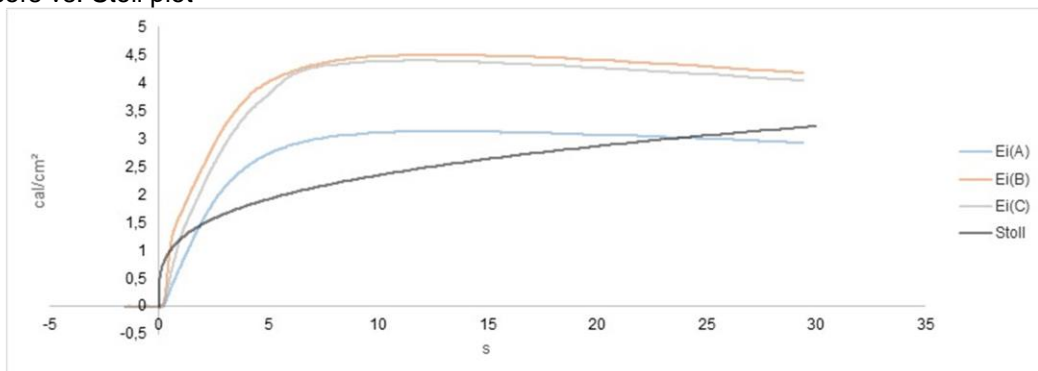
Current Plot



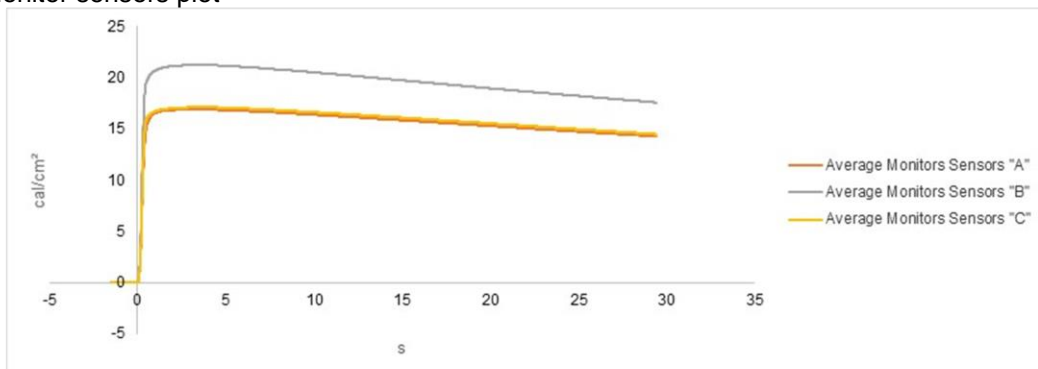
Voltage Plot



Panel sensors vs. Stoll plot



Average monitor sensors plot



>>>

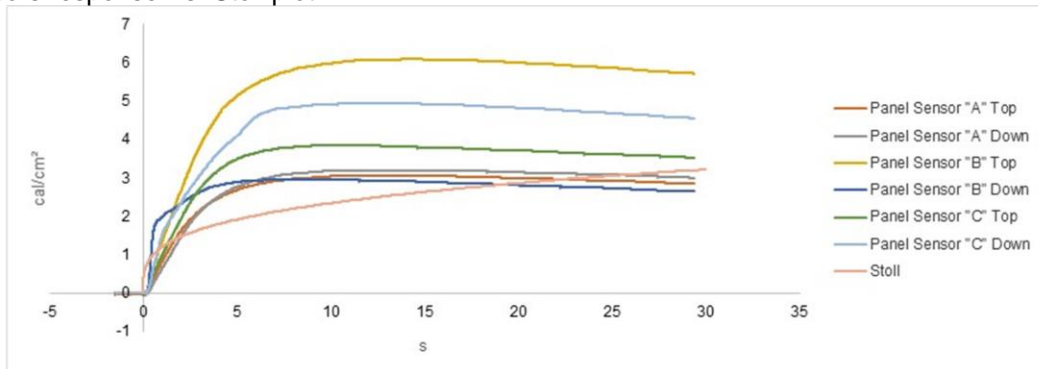


## RESULTS

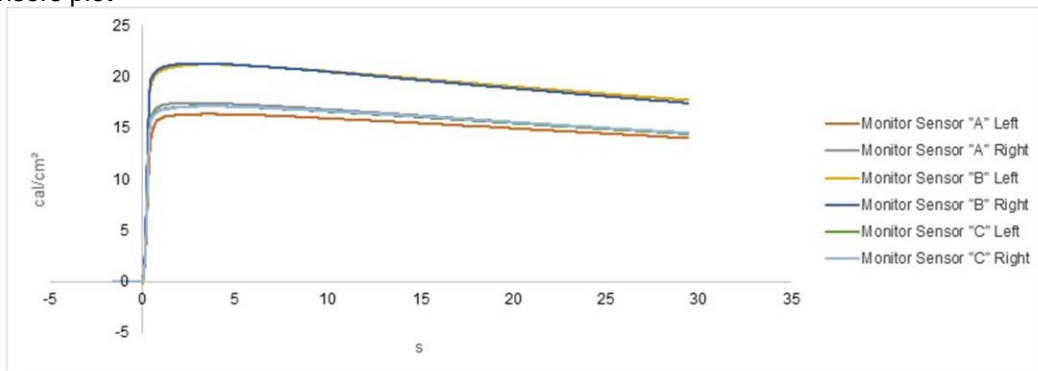
### Electrical current and response sensor response:

Shot 8

Panel sensors response Vs. Stoll plot



Monitor sensors plot



<b>Current Total RMS (kA)</b>	7,8	<b>Current Peak (kA)</b>	15,5	<b>Arc Voltage (V)</b>	1485,0
<b>Duration (cycles nº)</b>	16,1	<b>Duration (ms)</b>	322,4	<b>Arc Energy (kJ)</b>	1016,8
<b>Arc Voltage (kJ)</b>	446,9				

Sensor response	PANEL A	PANEL B	PANEL C
<b>Ei</b>	16,89 cal/cm <sup>2</sup>	21,22 cal/cm <sup>2</sup>	17,10 cal/cm <sup>2</sup>
<b>SCD</b>	0,87 cal/cm <sup>2</sup>	2,20 cal/cm <sup>2</sup>	2,15 cal/cm <sup>2</sup>
<b>HAF</b>	81,49 %	78,78 %	74,33 %

>>>



# RESULTS

Tested material pictures:

Original



Shot 1



Shot 2



Shot 3



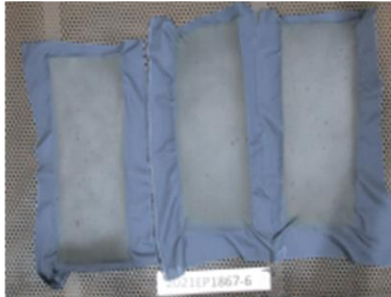
Shot 4



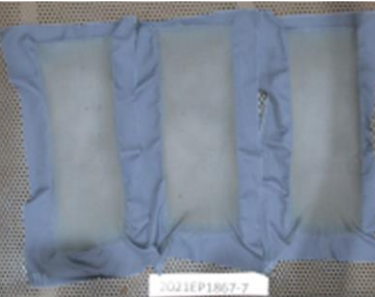
Shot 5



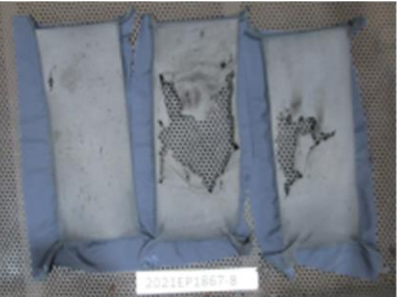
Shot 6



Shot 7



Shot 8



>>>



## RESULTS

### Summary of results:

ATPV	8,6 cal/cm <sup>2</sup>
HAF	73,9 %

FABRIC TESTED ACCORDING TO THE STANDARD IEC 61482-1-1:2009, panel test (Method A) - Obsolete

#### ARC RATING (ATPV)

8,6 cal/cm<sup>2</sup>

///



**Lucia Martinez**  
**Head of PPE and Ballistics department**

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