

TEN CATE PROTECT
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REPORT ISSUED BY THE RESEARCH ASSOCIATION OF THE TEXTILE
INDUSTRY, AITEX
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1/28

The test was carried out at :High Current Laboratory located 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

Applicant

TEN CATE PROTECT

Date of reception

30/01/2018

Data test

Starting: 30/01/2018

Ending: 05/02/2018

Description and identification of samples

- "FABRIC REF. TenCate Tecapro® - BG 9035"

Sample description according to the information supplied by the customer:

According to the information supplied by the customer:

TenCate Tecapro® - BG 9035
Composition: cotton/polyester/Static-Control™ 79/20/1%
Weave: 4/1 satin,
Mass: 350 g/m²
Standard: EN IEC 61482-1-1

Test Carried out

-ELECTRIC ARC EXPOSURE TEST: DETERMINATION OF THE ARC RATING (ATPV or EBT50) OF FLAME RESISTANT MATERIALS FOR CLOTHING
- PRE-TREATMENT FOR INDUSTRIAL WASHING AND DRYING PROCEDURES FOR TEXTILE TESTING

RESULTS

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

Standard

EN ISO 15797:2004+ EN ISO 15797:2004/AC:2005

Standard deviation

Reference

Sample 1 TenCate Tecapro® - BG 9035

Equipment

Industrial washing machine 2 13073E12

Washing procedure

8

Washing cycles

5

Washing temperature

75°C

Drying procedure

A (tumble dryer) - Industrial dryer 13010I12

Drying temperature

70°C

Washing powder

Detergent whitout brightener 13075N12

Dry mass of the samples

4,600 Kg

8,400
of

Kg Cotton
Polyester

Equipment

/ Lavadora
13073E12

Industrial

2

Start and finish data test

30/01/2018 - 01/02/2018

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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)

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.	05/02/2018
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	30/01/2018 - 01/02/2018

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RESULTS

Reference TenCate Tecapro® - BG 9035

Sample description according to the information supplied by the customer

Grey woven fabric style TenCate Tecapro® - BG 9035, 79% cotton, 20% polyester, 1% Static-Control, 350 g/m².

Pre-treatment

5 washing cycles at 75°C, according to standard UNE-EN ISO 15797:2004/AC:2005, method 8 and type A drying.

Washed sample weight before test

355,34 g/m²

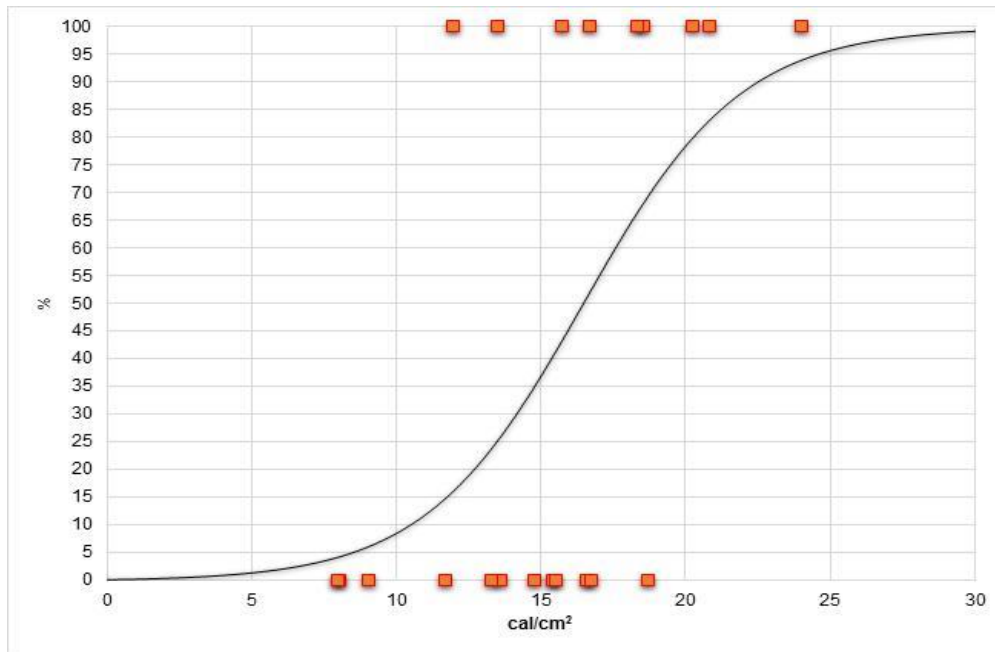
Deviation from the standard

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RESULTS

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

ATPV	16,4 cal/cm ²
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Probability %	5	10	20	30	40	50	60	70	80	95
E _i cal/cm ²	8,4	10,4	12,6	14,1	15,3	16,4	17,5	18,8	20,2	24,5

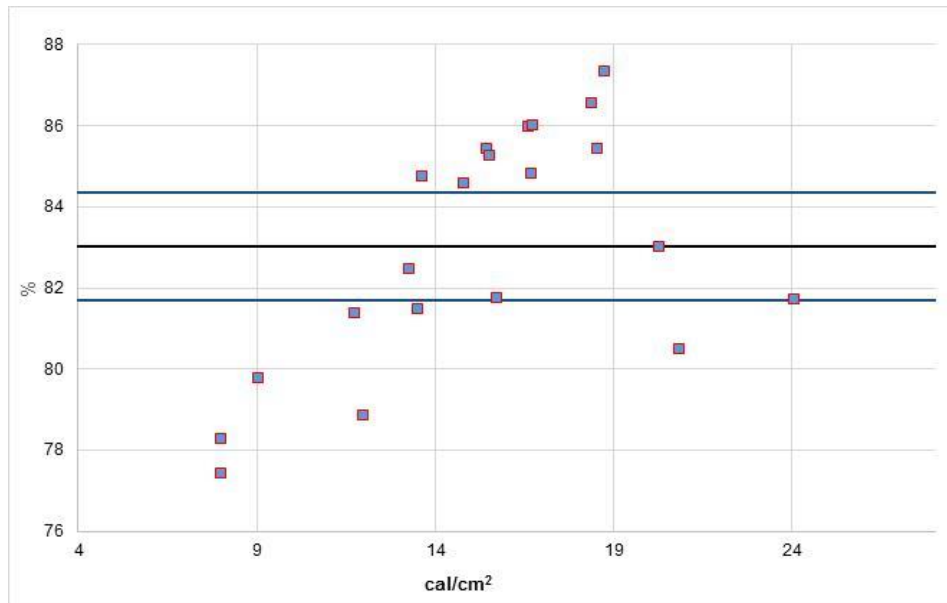
ATPV points above	3
ATPV points 20%	13
ATPV points below	4
ATPV points mix zone	14

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RESULTS

Determination of HAF, confidence Intervals 95%

HAF	83,0 %
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% HAF value :	83,0
Upper Confidence Level %:	84,4
Lower Confidence Level %:	81,7
Points above:	10
Points below:	7
Points between:	4
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	264	13,2	13,6	-0,38	84,8	N	N
1-B	264	13,2	12,0	0,17	78,9	Y	N
1-C	264	13,2	11,7	-0,03	81,4	N	N
2-A	303,8	15,19	16,6	-0,06	86,0	N	N
2-B	303,8	15,19	15,7	0,5	81,8	Y	N
2-C	303,8	15,19	13,3	-0,07	82,5	N	N
3-A	402	20,1	24,0	2,28	81,7	Y	Y
3-B	402	20,1	20,2	1,01	83,0	Y	N
3-C	402	20,1	20,8	1,87	80,5	Y	Y
4-A	163,8	8,19	9,0	-0,26	79,8	N	N
4-B	163,8	8,19	8,0	-0,29	77,5	N	N
4-C	163,8	8,19	8,0	-0,26	78,3	N	N
5-A	303,8	15,19	16,7	0,05	84,8	Y	N
5-B	303,8	15,19	16,7	-0,08	86,0	N	N
5-C	303,8	15,19	15,4	-0,11	85,5	N	N
6-A	303,6	15,18	18,7	-0,07	87,4	N	N
6-B	303,6	15,18	18,5	0,29	85,4	Y	N
6-C	303,6	15,18	15,5	-0,09	85,3	N	N
7-A	303,4	15,17	13,5	0,07	81,5	Y	N
7-B	303,4	15,17	18,4	0,02	86,6	Y	N
7-C	303,4	15,17	14,8	-0,11	84,6	N	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	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	Y	N	N	Y	Y
3-B	0	N	N	N	Y	Y
3-C	0	Y	N	N	Y	Y
4-A	0	N	N	N	Y	N
4-B	0	N	N	N	Y	N
4-C	0	N	N	N	Y	N
5-A	0	N	N	N	Y	Y
5-B	0	N	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

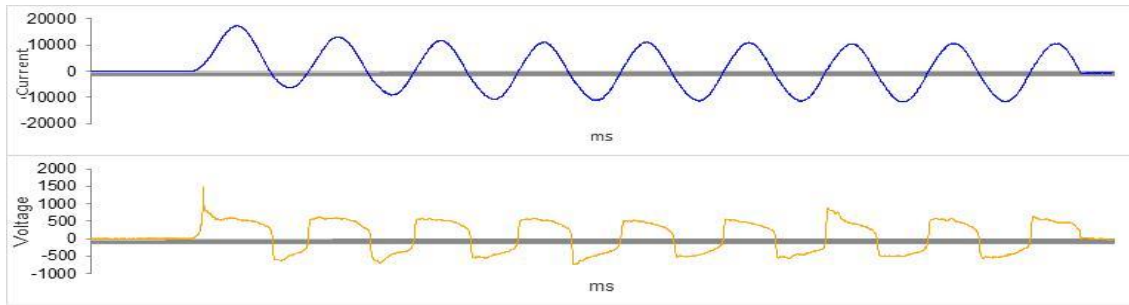
>>>

RESULTS

Electrical current and response sensor response:

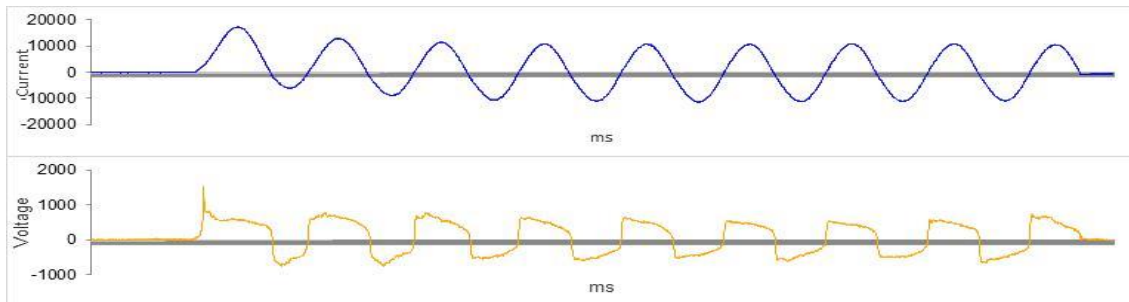
Calibration shot

INITIAL CALIBRATION



Ei Panel A	9,1 cal/cm ²	Ei Panel B	7,6 cal/cm ²	Ei Panel C	9,0 cal/cm ²
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FINAL CALIBRATION



Ei Panel A	9,0 cal/cm ²	Ei Panel B	8,2 cal/cm ²	Ei Panel C	9,2 cal/cm ²
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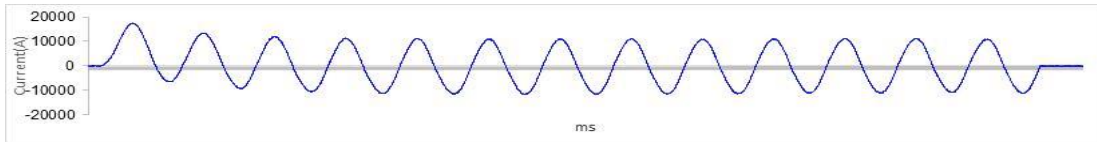
>>>

RESULTS

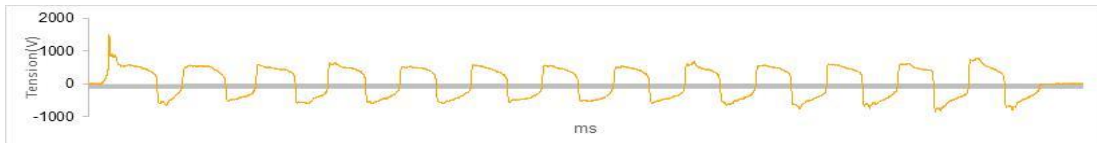
Electrical current and response sensor response:

Shot 1

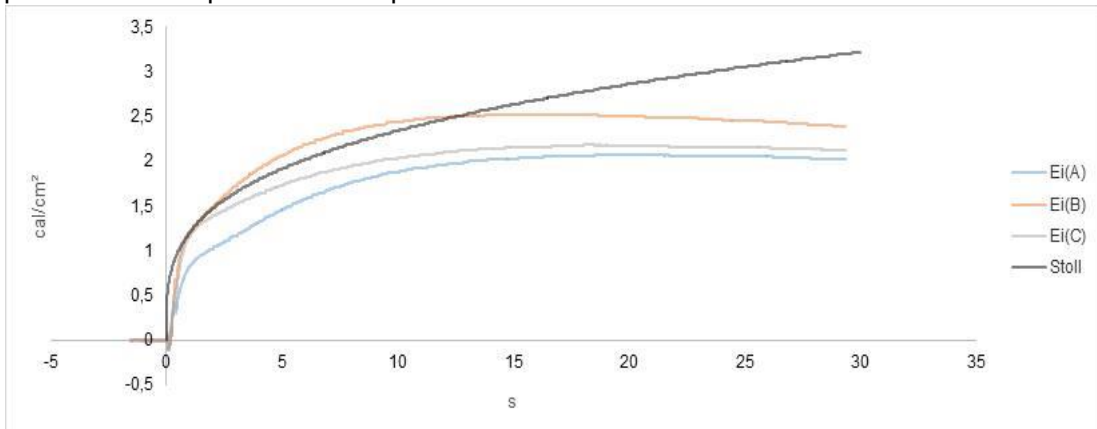
Current Plot



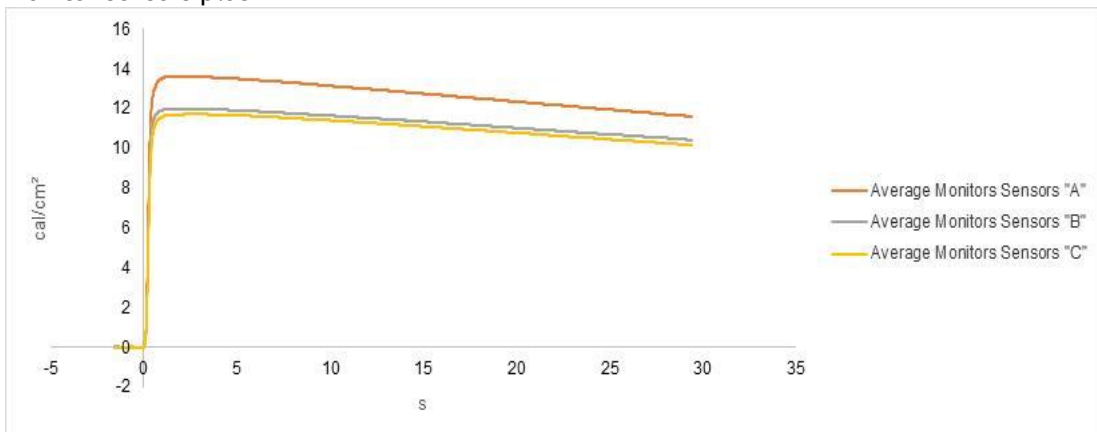
Voltage Plot



Average panel sensors response Vs. Stoll plot



Average monitor sensors plot



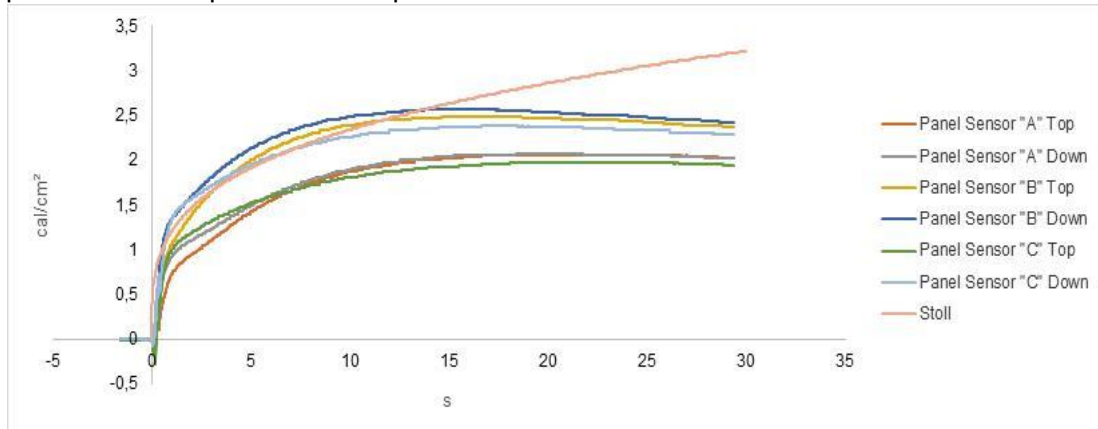
>>>

RESULTS

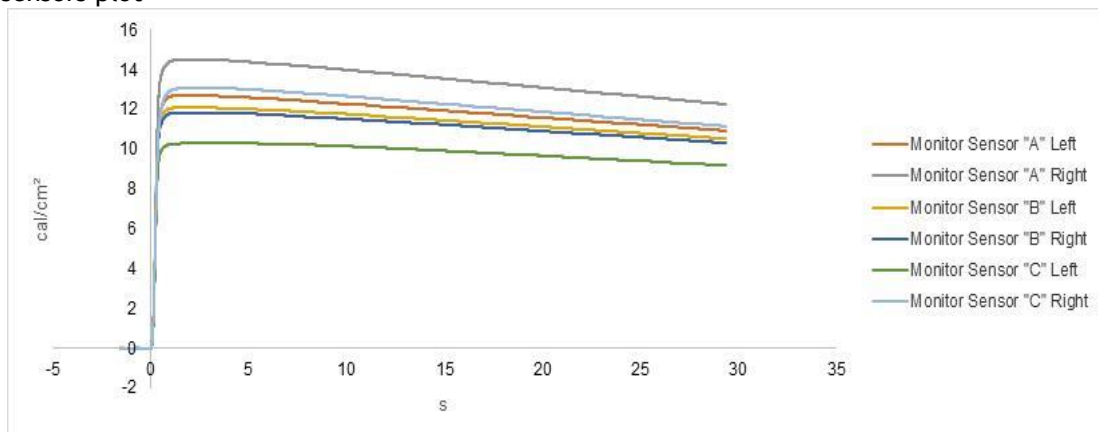
Electrical current and response sensor response:

Shot 1

Average panel sensors response Vs. Stoll plot



Monitor sensors plot



Current Total RMS (kA)	8,0	Current Peak (kA)	17,6	Arc Voltage (V)	1491,0
Duration (cycles n°)	13,2	Duration (ms)	263,9	Arc Energy (kJ)	910,3
Arc Voltage (kJ)	480,4				

sensor response	PANEL A	PANEL B	PANEL C
Ei	13,60 cal/cm ²	11,96 cal/cm ²	11,71 cal/cm ²
SCD	-0,38 cal/cm ²	0,17 cal/cm ²	-0,03 cal/cm ²
HAF	84,78 %	78,90 %	81,42 %

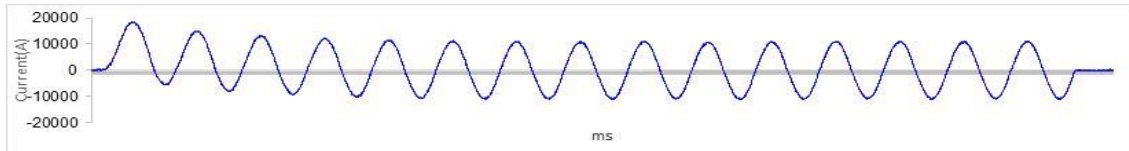
>>>

RESULTS

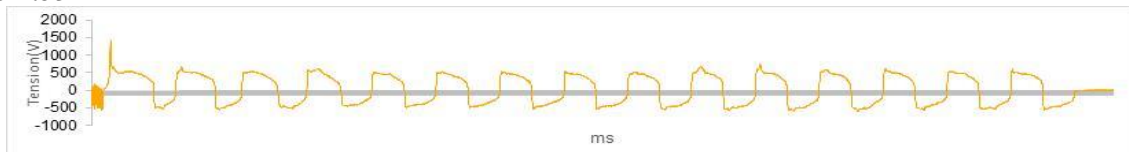
Electrical current and response sensor response:

Shot 2

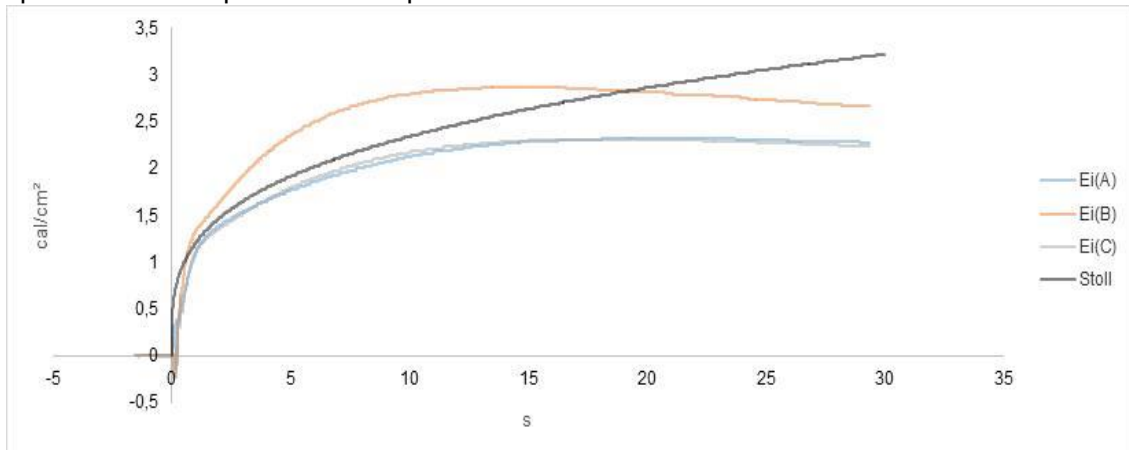
Current Plot



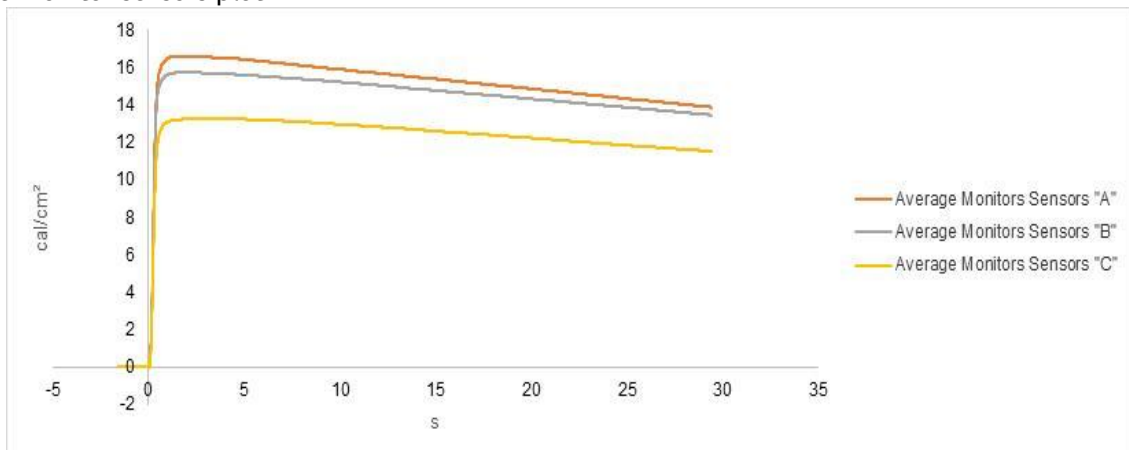
Voltage Plot



Average panel sensors response Vs. Stoll plot



Average monitor sensors plot



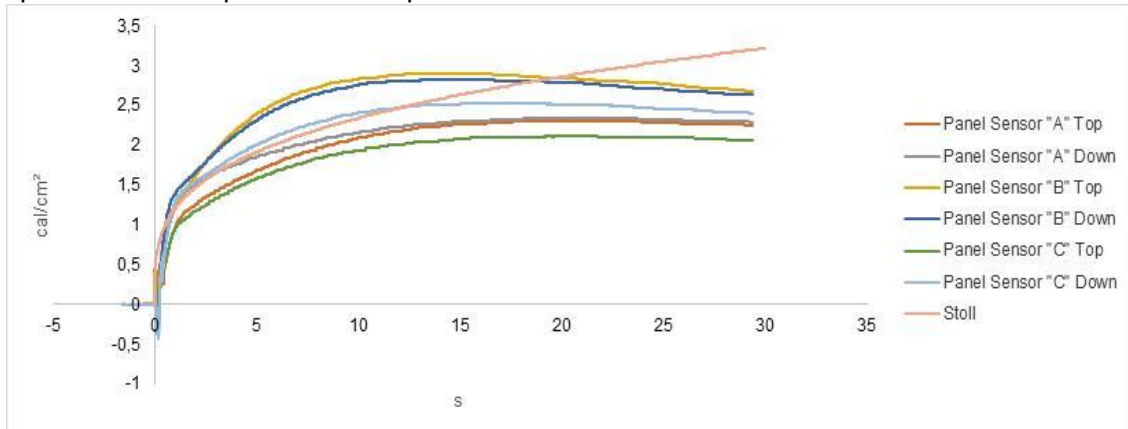
>>>

RESULTS

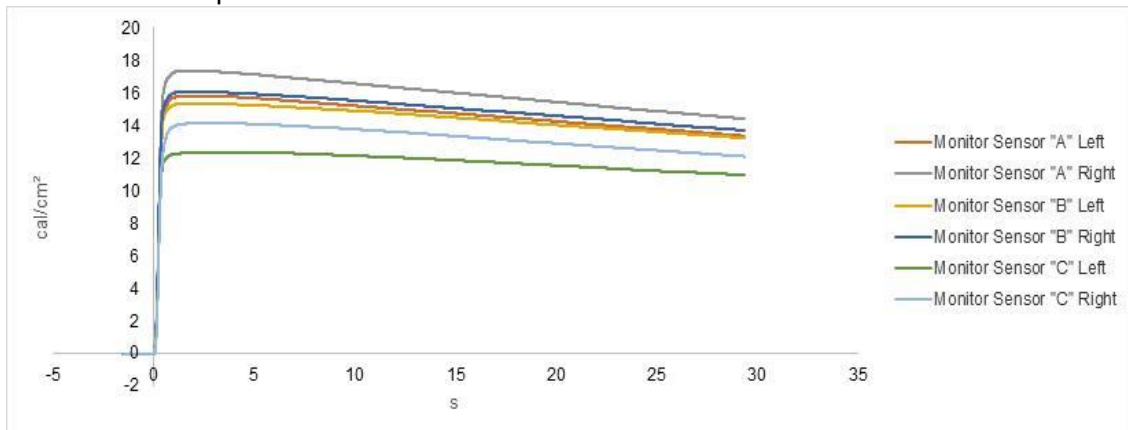
Electrical current and response sensor response:

Shot 2

Average panel sensors response Vs. Stoll plot



Average monitor sensors plot



Current Total RMS (kA)	8,0	Current Peak (kA)	18,5	Arc Voltage (V)	1443,0
Duration (cycles n°)	15,2	Duration (ms)	303,8	Arc Energy (kJ)	933,9
Arc Voltage (kJ)	429,9				

sensor response	PANEL A	PANEL B	PANEL C
Ei	16,58 cal/cm ²	15,71 cal/cm ²	13,26 cal/cm ²
SCD	-0,06 cal/cm ²	0,50 cal/cm ²	-0,07 cal/cm ²
HAF	86,01 %	81,79 %	82,50 %

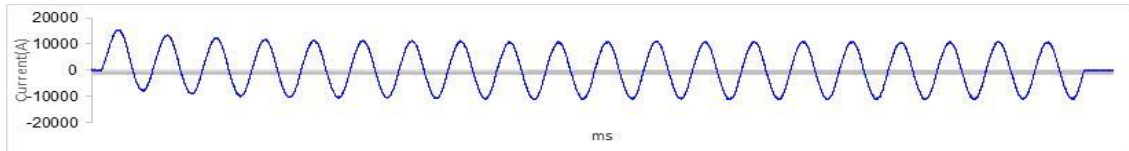
>>>

RESULTS

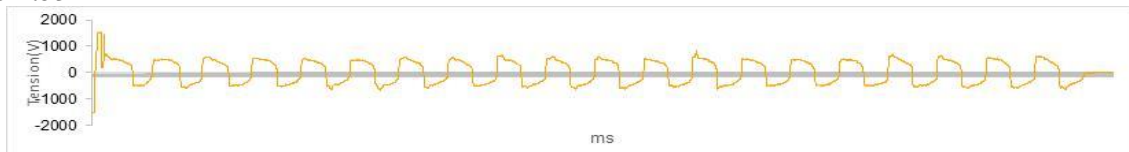
Electrical current and response sensor response:

Shot 3

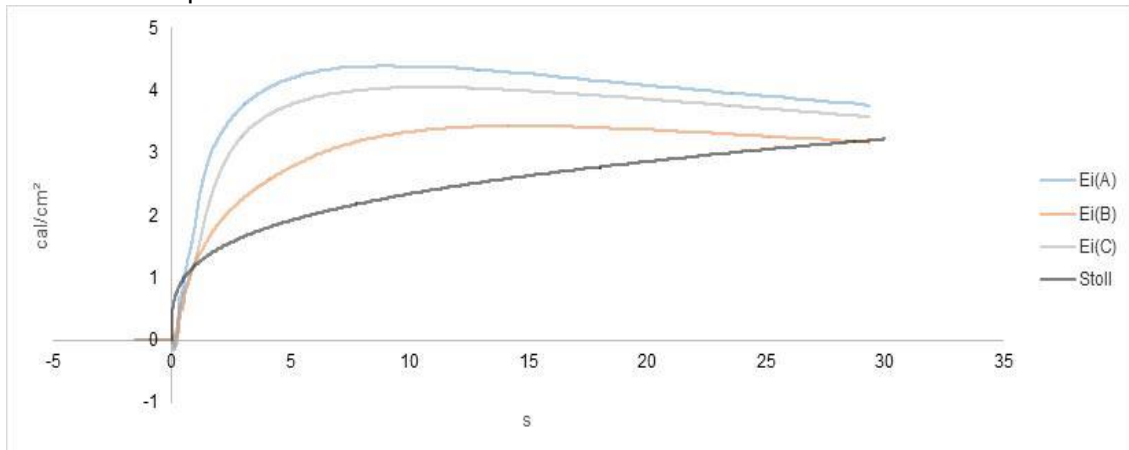
Current Plot



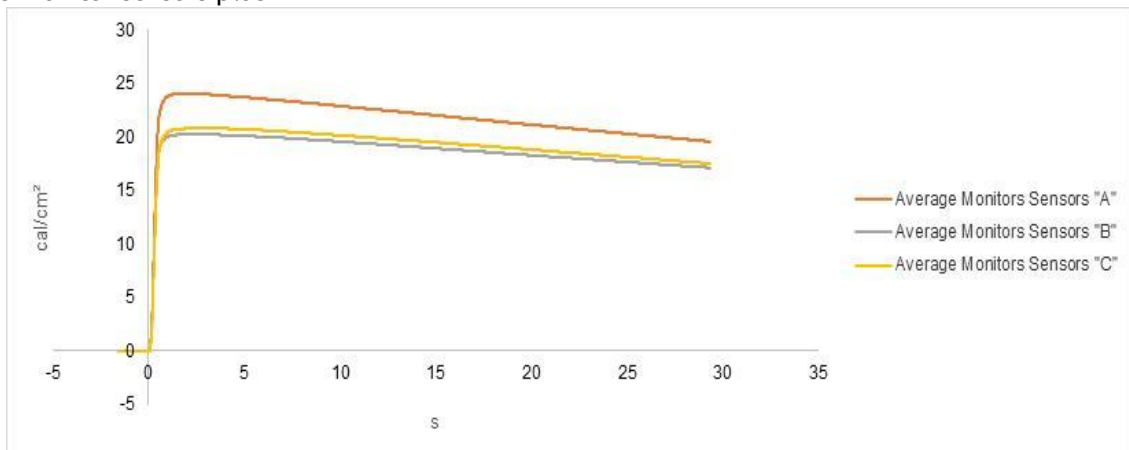
Voltage Plot



Panel sensors vs. Stoll plot



Average monitor sensors plot



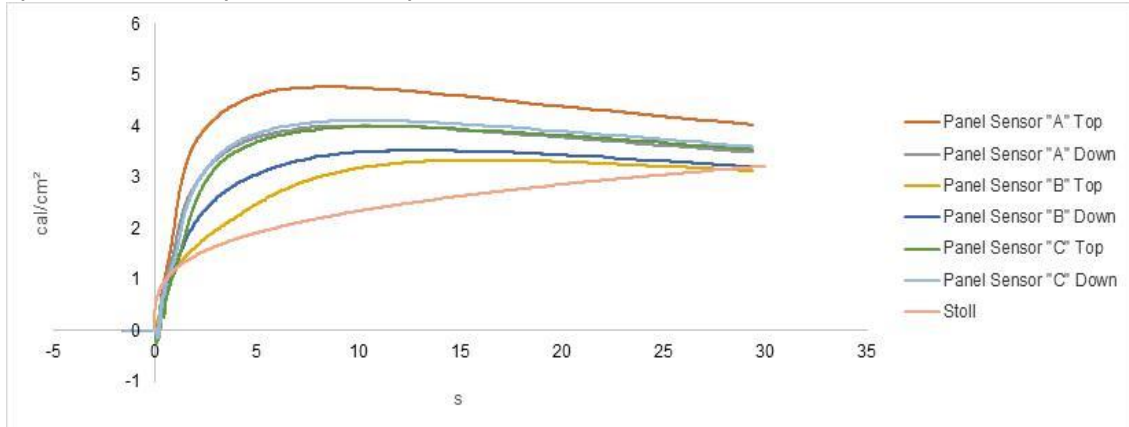
>>>

RESULTS

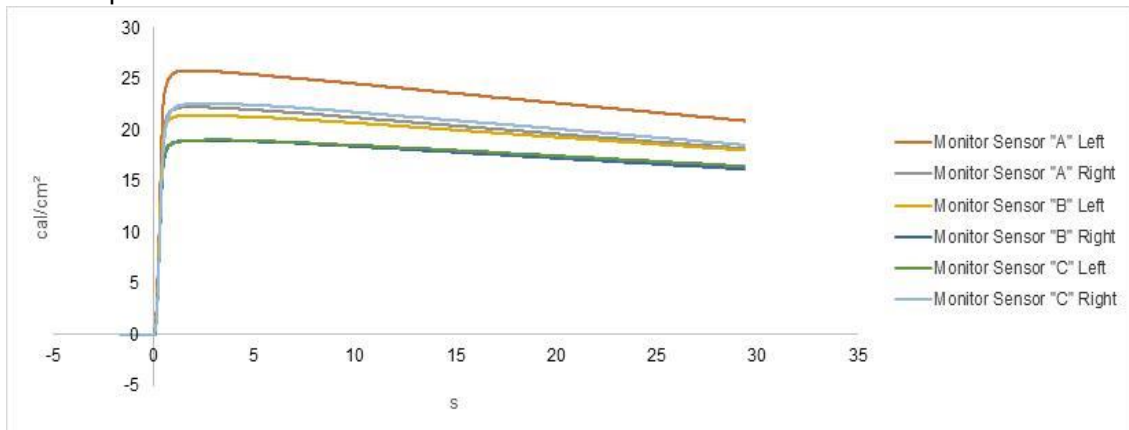
Electrical current and response sensor response:

Shot 3

Average panel sensors response Vs. Stoll plot



Monitor sensors plot



Current Total RMS (kA)	7,8	Current Peak (kA)	15,6	Arc Voltage (V)	1524,0
Duration (cycles n°)	20,1	Duration (ms)	402,0	Arc Energy (kJ)	1257,4
Arc Voltage (kJ)	447,0				

sensor response	PANEL A	PANEL B	PANEL C
Ei	24,03 cal/cm ²	20,23 cal/cm ²	20,81 cal/cm ²
SCD	2,28 cal/cm ²	1,01 cal/cm ²	1,87 cal/cm ²
HAF	81,74 %	83,05 %	80,53 %

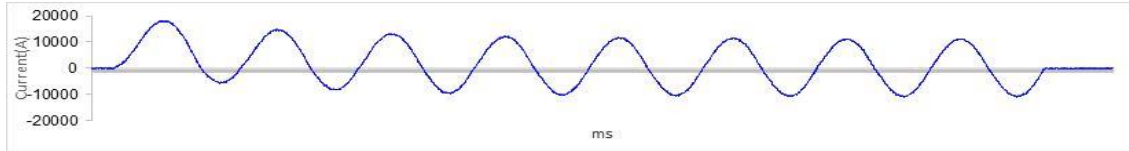
>>>

RESULTS

Electrical current and response sensor response:

Shot 4

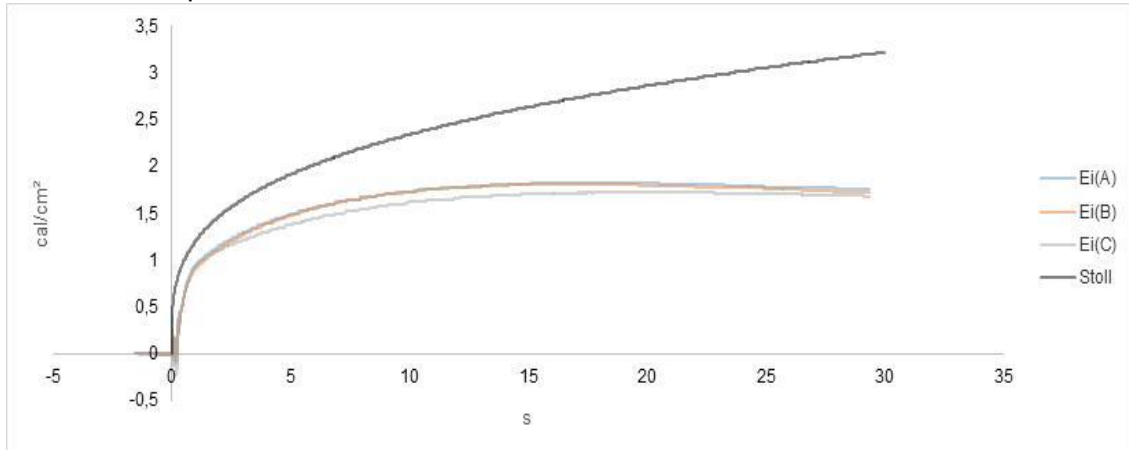
Current Plot



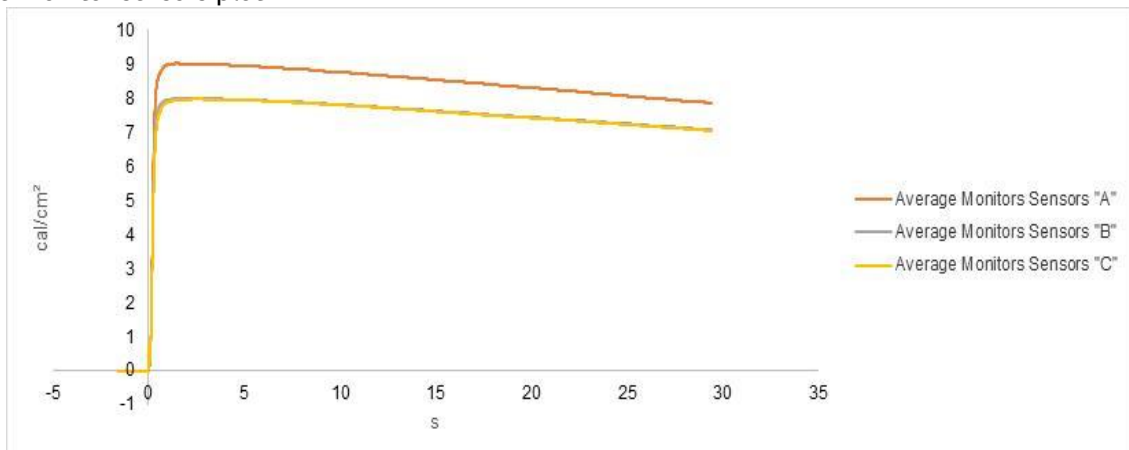
Voltage Plot



Panel sensors vs. Stoll plot



Average monitor sensors plot



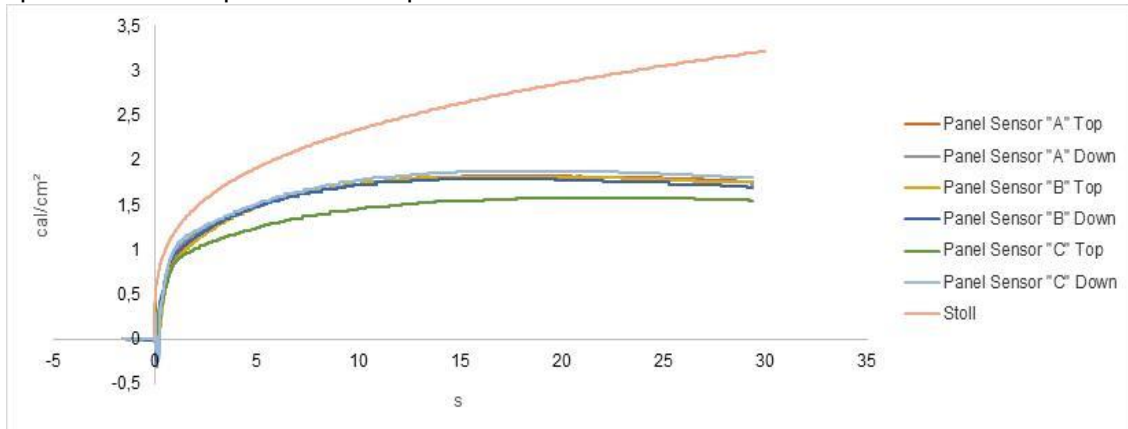
>>>

RESULTS

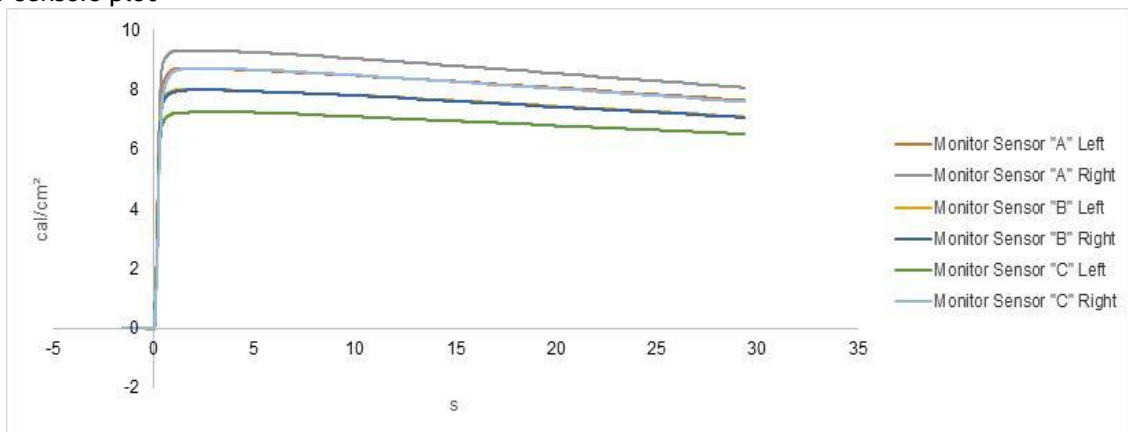
Electrical current and response sensor response:

Shot 4

Average panel sensors response Vs. Stoll plot



Monitor sensors plot



Current Total RMS (kA)	8,2	Current Peak (kA)	18,2	Arc Voltage (V)	1449,0
Duration (cycles n°)	8,2	Duration (ms)	163,8	Arc Energy (kJ)	504,3
Arc Voltage (kJ)	417,8				

sensor response	PANEL A	PANEL B	PANEL C
Ei	9,01 cal/cm ²	7,99 cal/cm ²	7,97 cal/cm ²
SCD	-0,26 cal/cm ²	-0,29 cal/cm ²	-0,26 cal/cm ²
HAF	79,81 %	77,46 %	78,32 %

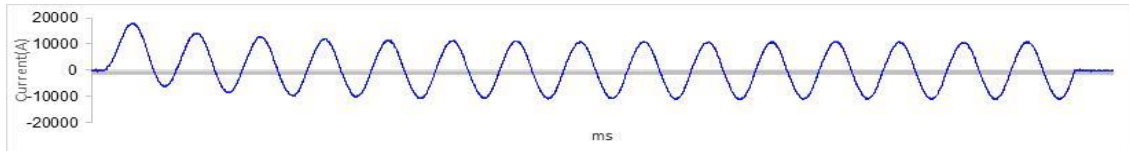
>>>

RESULTS

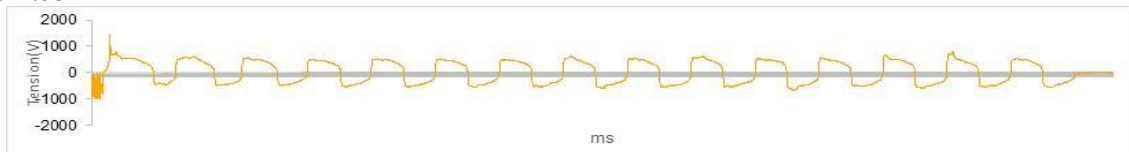
Electrical current and response sensor response:

Shot 5

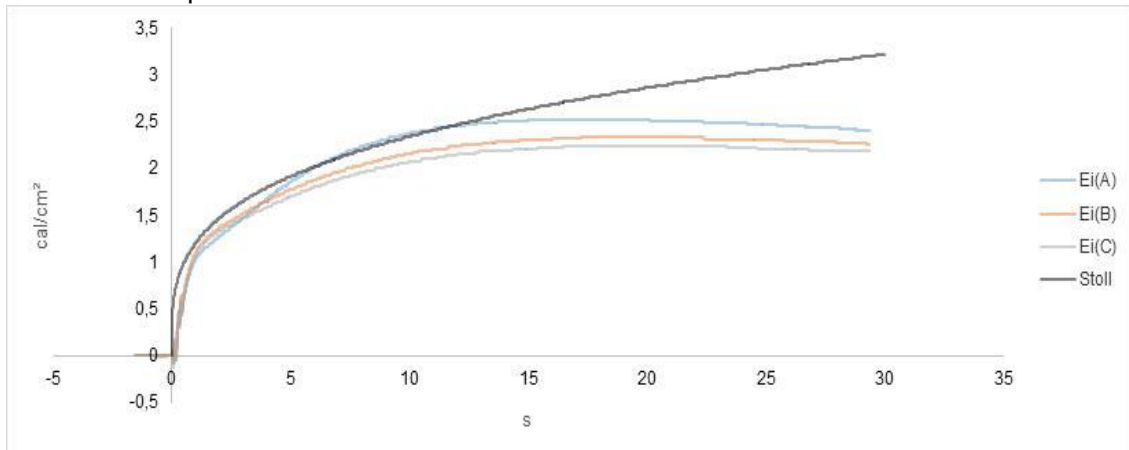
Current Plot



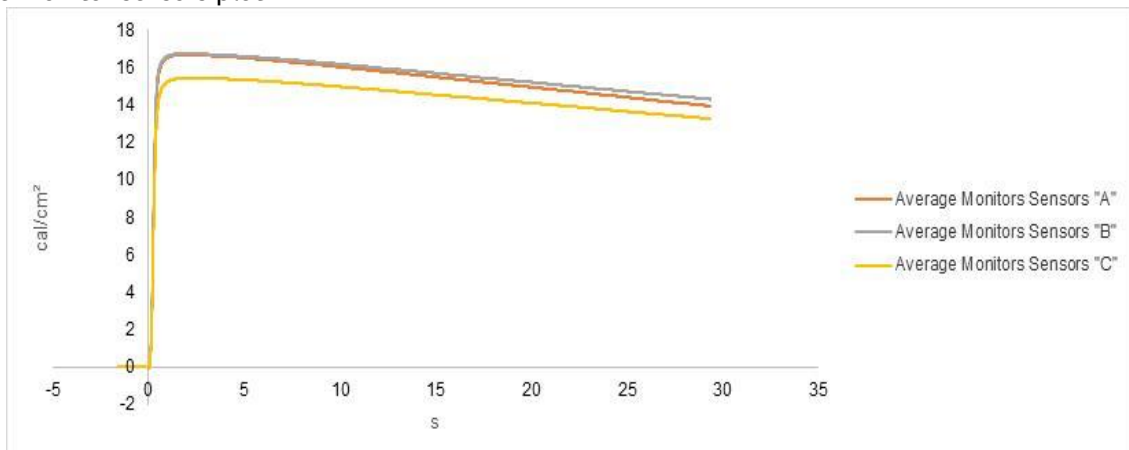
Voltage Plot



Panel sensors vs. Stoll plot



Average monitor sensors plot



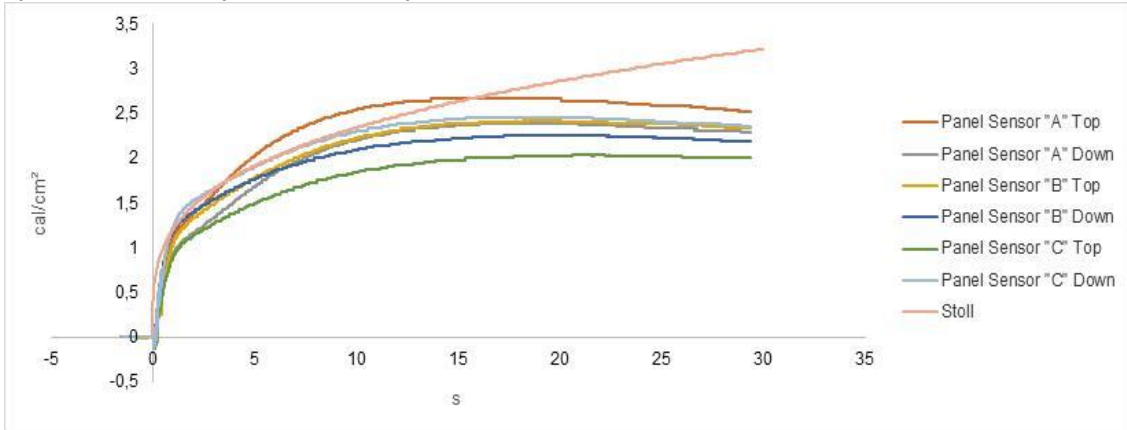
>>>

RESULTS

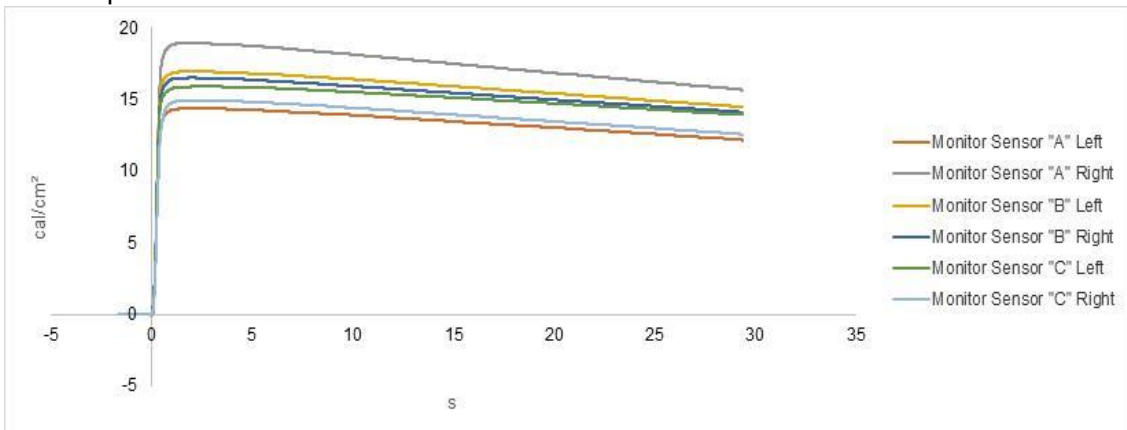
Electrical current and response sensor response:

Shot 5

Average panel sensors response Vs. Stoll plot



Monitor sensors plot



Current Total RMS (kA)	7,9	Current Peak (kA)	18,2	Arc Voltage (V)	1476,0
Duration (cycles n°)	15,2	Duration (ms)	303,7	Arc Energy (kJ)	958,0
Arc Voltage (kJ)	443,3				

sensor response	PANEL A	PANEL B	PANEL C
Ei	16,66 cal/cm ²	16,72 cal/cm ²	15,41 cal/cm ²
SCD	0,05 cal/cm ²	-0,08 cal/cm ²	-0,11 cal/cm ²
HAF	84,84 %	86,05 %	85,46 %

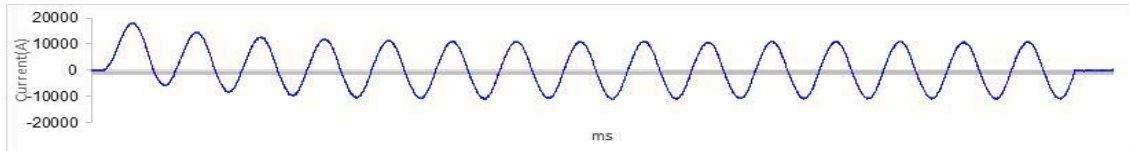
>>>

RESULTS

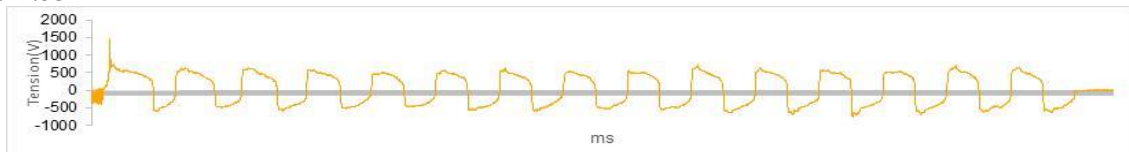
Electrical current and response sensor response:

Shot 6

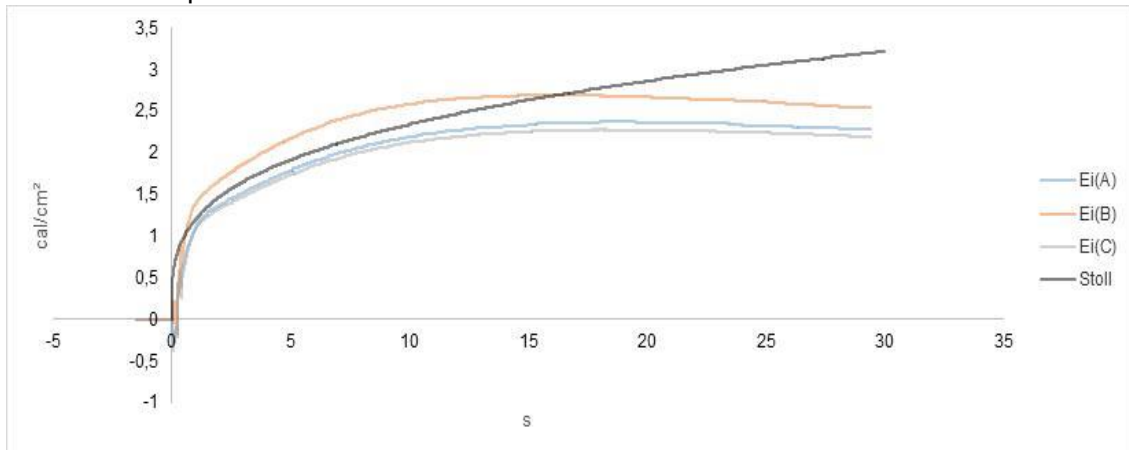
Current Plot



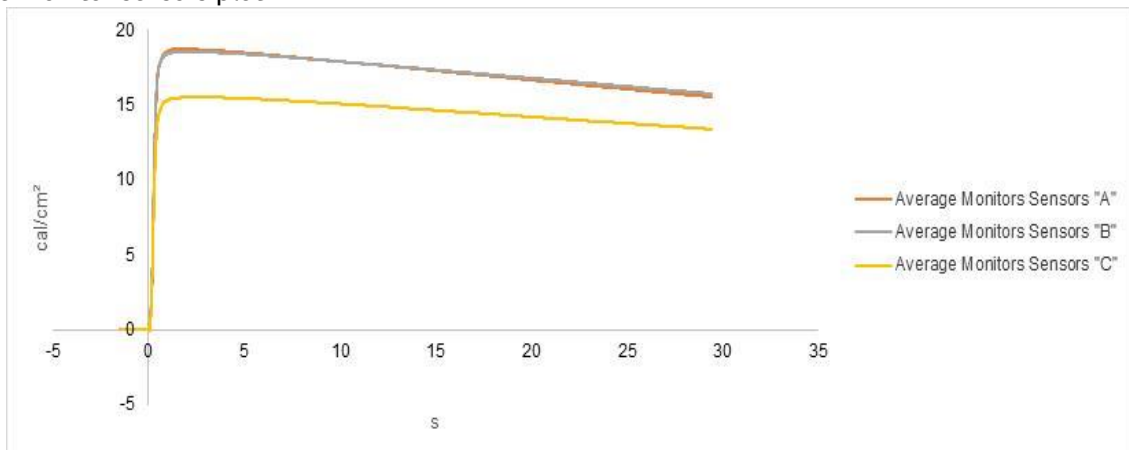
Voltage Plot



Panel sensors vs. Stoll plot



Average monitor sensors plot



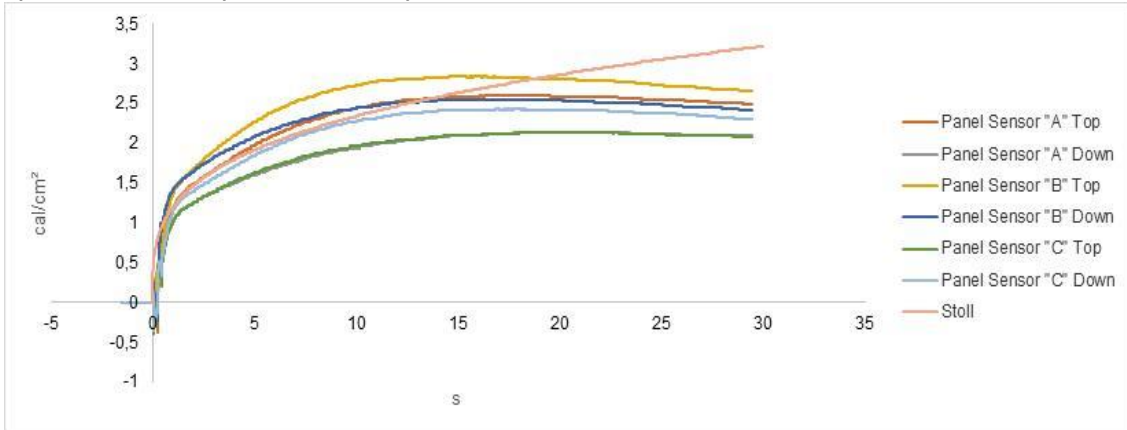
>>>

RESULTS

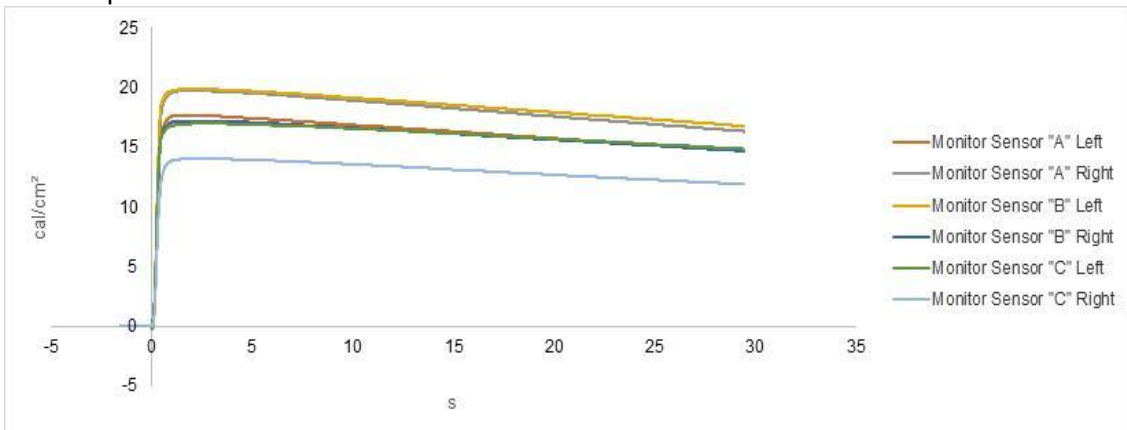
Electrical current and response sensor response:

Shot 6

Average panel sensors response Vs. Stoll plot



Monitor sensors plot



Current Total RMS (kA)	7,9	Current Peak (kA)	18,0	Arc Voltage (V)	1452,0
Duration (cycles n°)	15,2	Duration (ms)	303,7	Arc Energy (kJ)	989,4
Arc Voltage (kJ)	461,4				

Sensor response	PANEL A	PANEL B	PANEL C
Ei	18,71 cal/cm ²	18,53 cal/cm ²	15,50 cal/cm ²
SCD	-0,07 cal/cm ²	0,29 cal/cm ²	-0,09 cal/cm ²
HAF	87,35 %	85,45 %	85,28 %

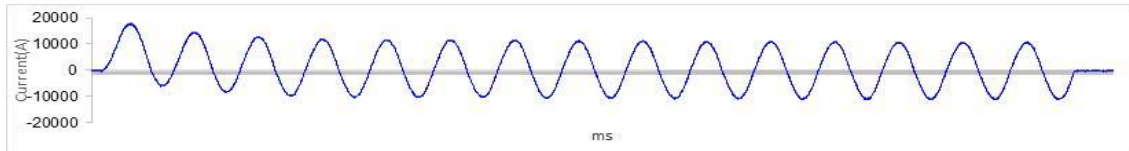
>>>

RESULTS

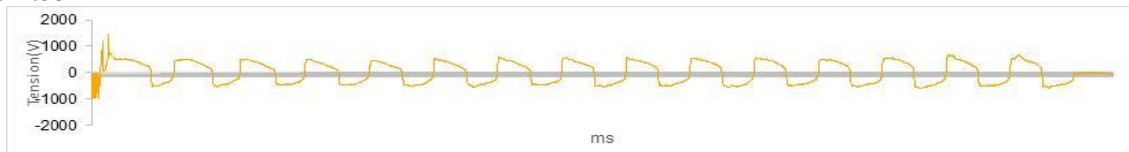
Electrical current and response sensor response:

Shot 7

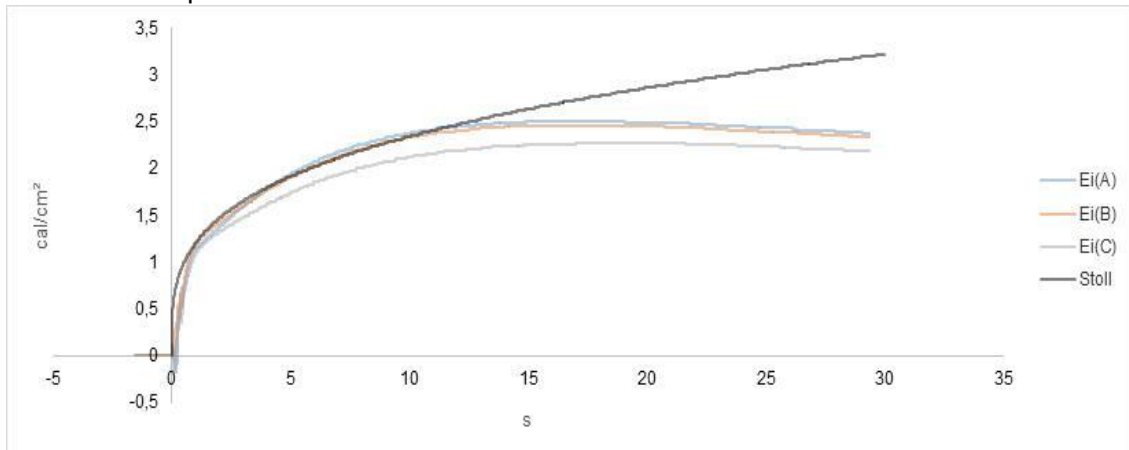
Current Plot



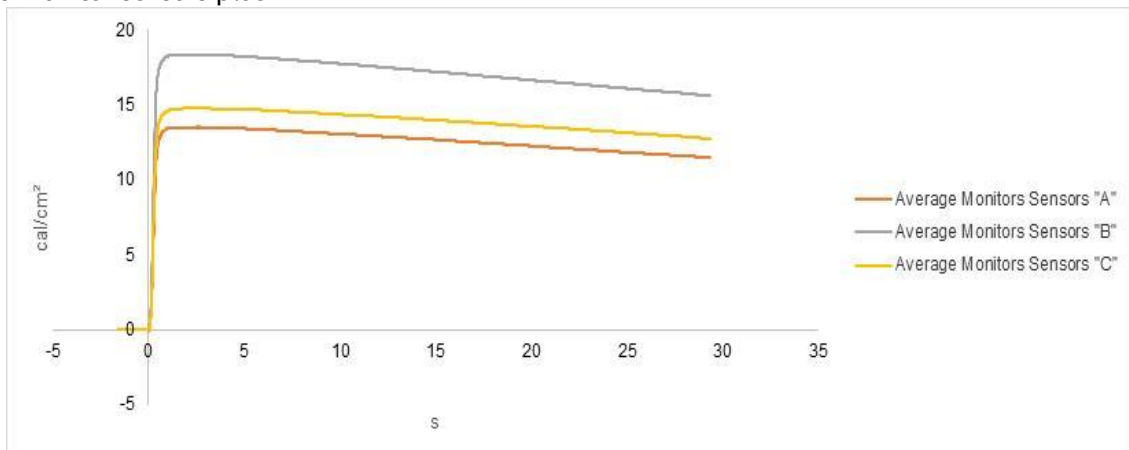
Voltage Plot



Panel sensors vs. Stoll plot



Average monitor sensors plot



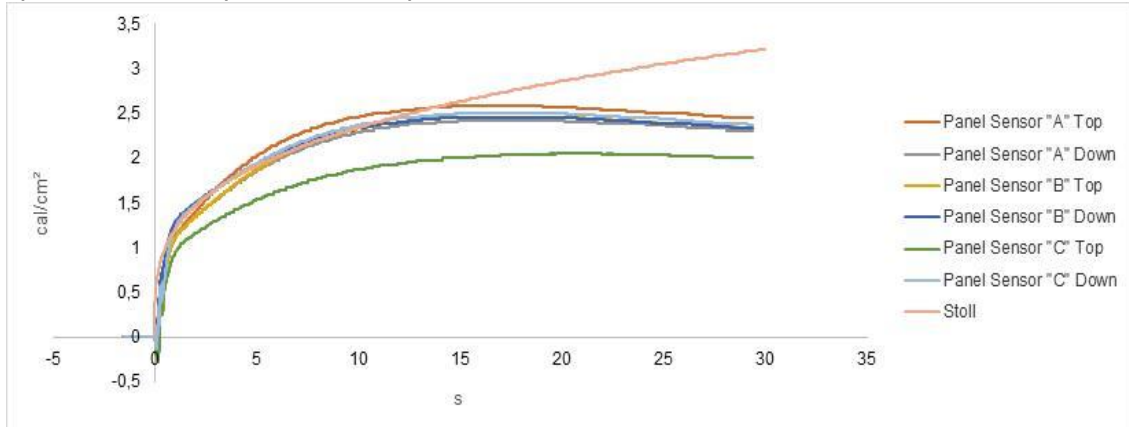
>>>

RESULTS

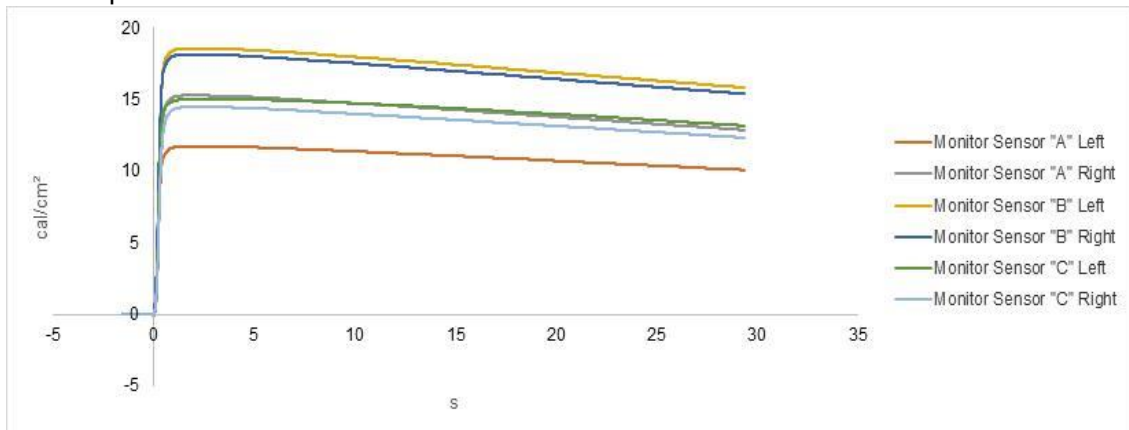
Electrical current and response sensor response:

Shot 7

Average panel sensors response Vs. Stoll plot



Monitor sensors plot



Current Total RMS (kA)	7,9	Current Peak (kA)	17,8	Arc Voltage (V)	1449,0
Duration (cycles n°)	15,2	Duration (ms)	303,4	Arc Energy (kJ)	892,0
Arc Voltage (kJ)	419,0				

sensor response	PANEL A	PANEL B	PANEL C
Ei	13,50 cal/cm ²	18,35 cal/cm ²	14,76 cal/cm ²
SCD	0,07 cal/cm ²	0,02 cal/cm ²	-0,11 cal/cm ²
HAF	81,50 %	86,60 %	84,60 %

>>>

RESULTS

Tested material pictures:

Original



Shot 1



Shot 2



Shot 3



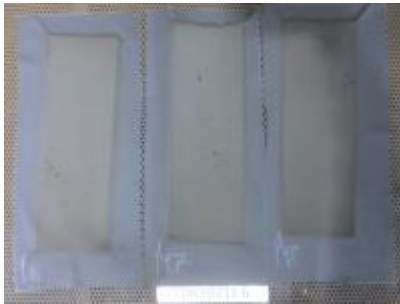
Shot 4



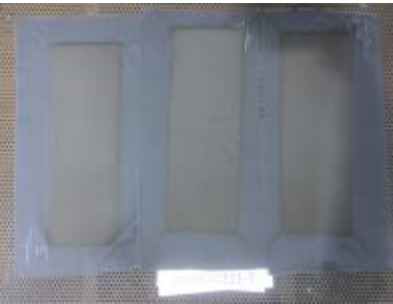
Shot 5



Shot 6



Shot 7



>>>

RESULTS

Summary of results:

ATPV	16,4 cal/cm ²
HAF	83,0 %

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

ARC RATING

16,4 cal/cm²

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Lucia Martinez
Head of PPE and Ballistics department

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