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**REPORT ISSUED BY THE RESEARCH ASSOCIATION OF THE TEXTILE
INDUSTRY, AITEX**

N° 2023EP6038

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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ITE
INSTITUTO TECNOLÓGICO DE
LA ENERGÍA

APPLICANT

TRECK, S.A.

Date of reception 15/10/2020

Date Test Starting: 20/10/2020
Ending: 27/11/2020

IDENTIFICATION AND DESCRIPTION OF SAMPLES

REFERENCES

Gloves 4452C

According to information supplied by the customer:

Reference: 4452C

LAYER 1:

Style COATED GLOVE

Fiber content and percentages: ARAMID/ACRYLIC/GLASSFIBER/HPPE/SPANDEX

Colour: YELLOW/BLACK

LAYER 2:

Style: COATING

Colour: BLACK

Fiber content and percentages: Neoprene

TESTS CARRIED OUT

- ELECTRIC ARC EXPOSURE TEST: DETERMINATION OF THE ARC RATING (ATPV OR EBT50) OF FLAME RESISTANT MATERIAL OF HAND PROTECTIVE PRODUCTS.

PHOTOGRAPHY



Reference ⁽¹⁾
Gloves 4452C

RESULTS/RESULTADOS

ELECTRIC ARC EXPOSURE TEST: DETERMINATION OF THE ARC RATING (ATPV OR E_{BT50}) OF FLAME RESISTANT MATERIAL OF HAND PROTECTIVE PRODUCTS

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).

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Standard

ASTM F2675/ F2675M : 2019

Test conditions	
Date test.	26/11/2020
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	20
Face test	Back.

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Reference Gloves 4452C

Sample type

Knitted gloves.

Colour

Yellow/Black.

Size

Composition

YELLOW/BLACK style COATED GLOVE, ARAMID, ACRYLIC, GLASSFIBER, HPPE, SPANDEX, manufacturer JIANGSU CLS.

Black non woven style Coating, Neoprene.

Upper and lower thickness samples before tests

Average, maximum, and minimum thickness was measured over population of 21 gloves

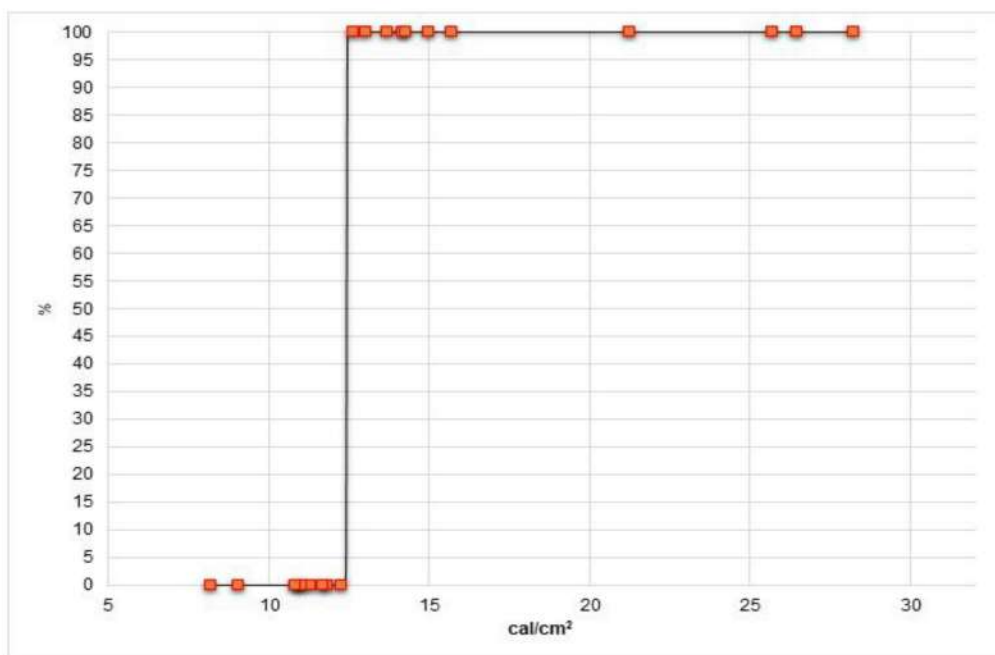
Max: 1,21 mm. – Min: 1,05 mm. – Average: 1,14 mm.

Deviation from the standard

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

ATPV 12,4 cal/cm²



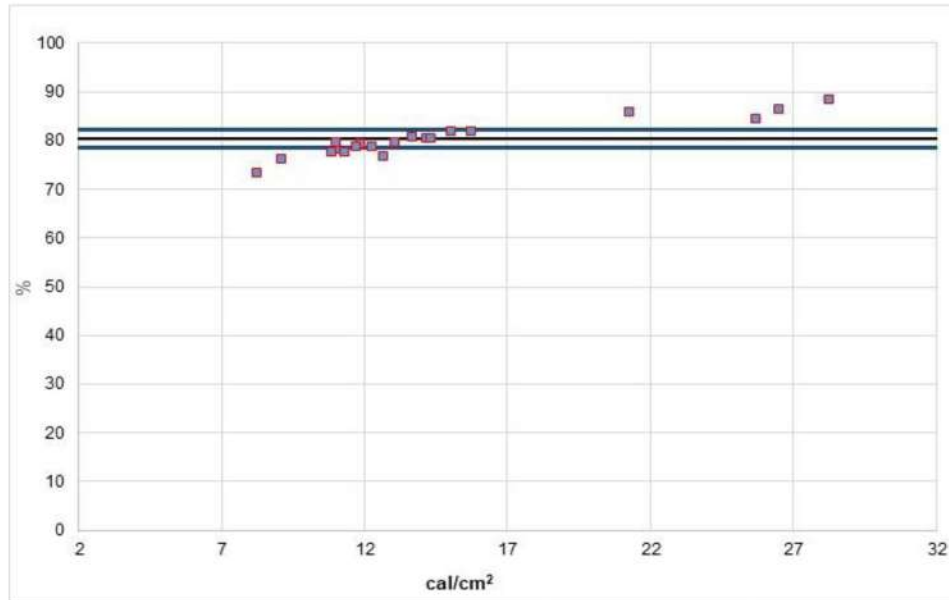
Probability %	5	10	20	30	40	50	60	70	80	95
E _i cal/cm ²	12,4	12,4	12,4	12,4	12,4	12,4	12,4	12,4	12,4	12,4

ATPV points above	11
ATPV points 20%	12
ATPV points below	9
ATPV points mix zone	0

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Determination of HAF, confidence Intervals 95%

HAF	80,4 %
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% HAF value :	80,4
Upper Confidence Level %:	82,1
Lower Confidence Level %:	78,7
Points above:	4
Points below:	6
Points between:	10
Total Points:	20

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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	603,8	30,19	21,2	0,3	85,9	Y	N
1-B	603,8	30,19	25,7	1,29	84,6	Y	N
1-C	603,8	30,19	28,2	0,6	88,5	Y	N
1-D	603,8	30,19	26,5	0,9	86,6	Y	N
2-A	303,8	15,19	11,3	-0,07	77,7	N	N
2-B	303,8	15,19	11,8	-0,15	79,3	N	N
2-C	303,8	15,19	13,7	0,09	80,7	Y	N
2-D	303,8	15,19	14,2	0,2	80,4	Y	N
3-A	243,6	12,18	8,2	-0,41	73,4	N	N
3-B	243,6	12,18	9,1	-0,41	76,4	N	N
3-C	243,6	12,18	11,0	-0,21	78,3	N	N
3-D	243,6	12,18	11,0	-0,37	79,7	N	N
4-A	309	15,45	10,8	-0,22	77,7	N	N
4-B	309	15,45	12,2	-0,01	79,0	N	N
4-C	309	15,45	13,0	0,04	79,6	Y	N
4-D	309	15,45	11,7	-0,06	79,0	N	N
5-A	363,4	18,17	14,3	0,19	80,5	Y	N
5-B	363,4	18,17	15,7	0,26	82,0	Y	N
5-C	363,4	18,17	15,0	0,13	81,8	Y	N
5-D	363,4	18,17	12,6	0,26	77,0	Y	N

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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
1-D	0	N	N	N	Y	Y
1-A	0	N	N	N	Y	Y
2-B	0	N	N	N	Y	Y
2-C	0	N	N	N	Y	Y
2-D	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
3-D	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
4-D	0	N	N	N	Y	Y
5-A	0	N	N	N	Y	Y
5-B	0	N	N	N	Y	Y
5-C	0	N	N	N	Y	Y
5-D	0	N	N	N	Y	Y

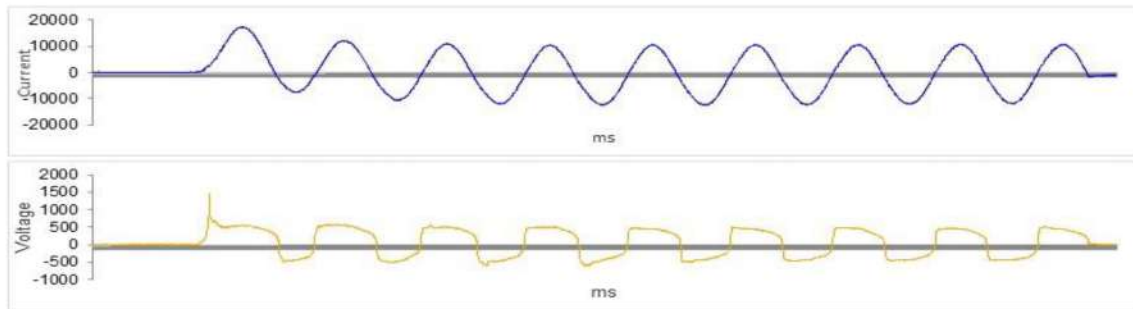
Y Yes N No

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Electrical current and response sensor response:

Calibration shot

INITIAL CALIBRATION



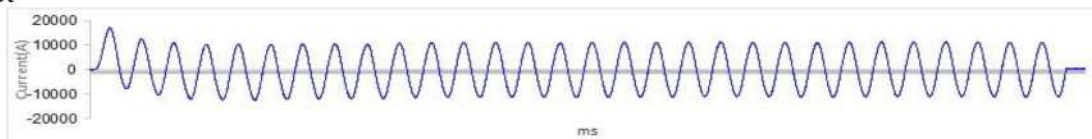
Ei Panel A	5,8 cal/cm ²	Ei Panel B	6,2 cal/cm ²	Ei Panel C	7,6 cal/cm ²	Ei Panel D	7,1 cal/cm ²
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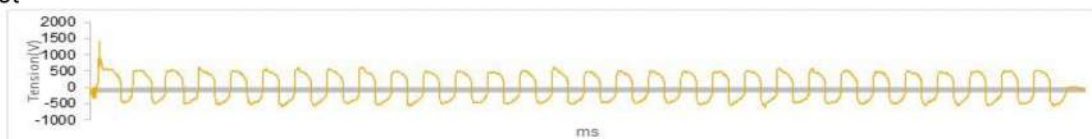
Electrical current and response sensor response:

Shot 1

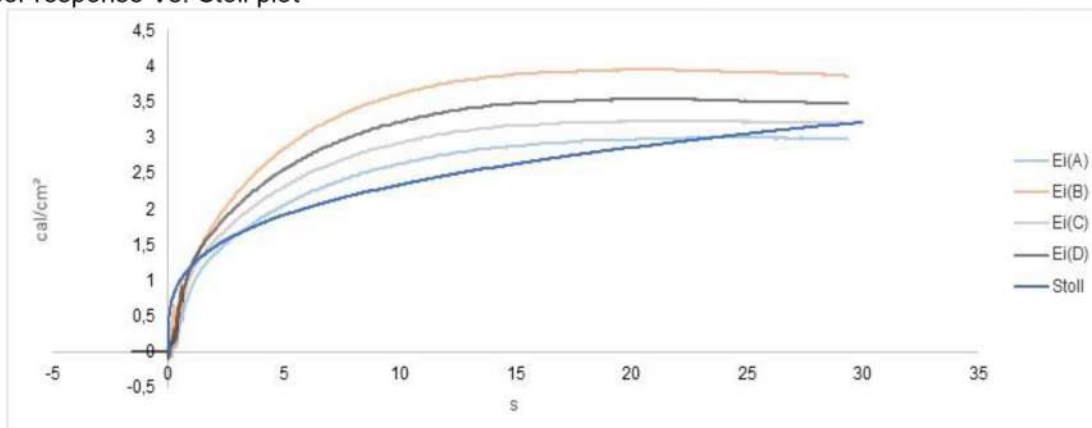
Current Plot



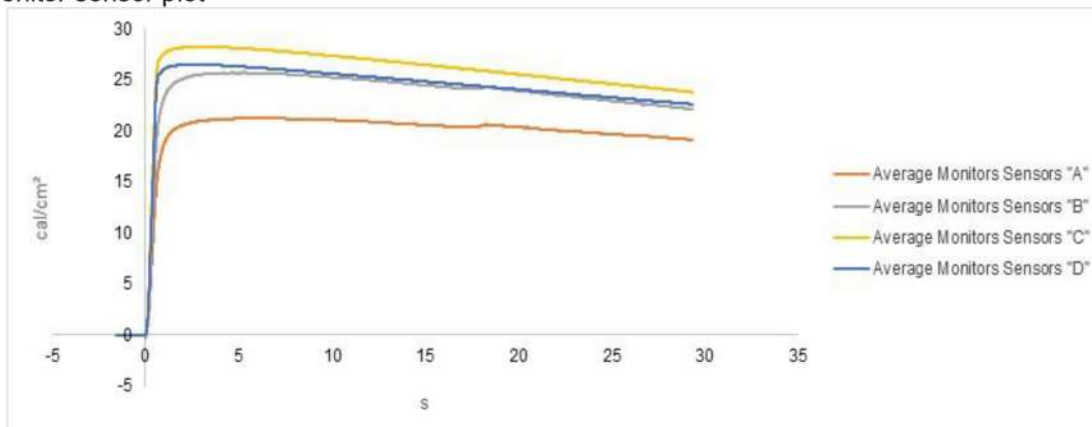
Tension Plot



Panel sensor response Vs. Stoll plot



Average monitor sensor plot



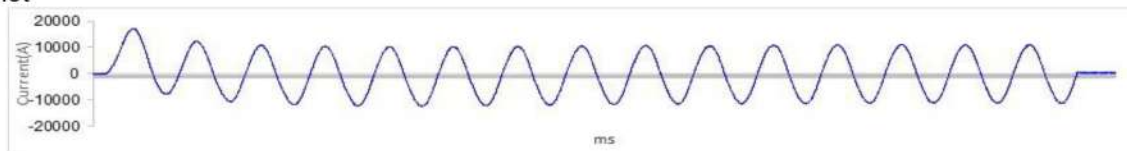
Current Total RMS (kA)	7,9	Current Peak (kA)	17,1	Arc Voltage (V)	1431,0
Duration (cycles n°)	30,2	Duration (ms)	603,8	Arc Energy (kJ)	1887,5

sensor response	PANEL A	PANEL B	PANEL C	PANEL D
Ei	21,24 cal/cm ²	25,69 cal/cm ²	28,24 cal/cm ²	26,49 cal/cm ²
SCD	0,30 cal/cm ²	1,29 cal/cm ²	0,60 cal/cm ²	0,90 cal/cm ²
HAF	85,88 %	84,62 %	88,54 %	86,63 %

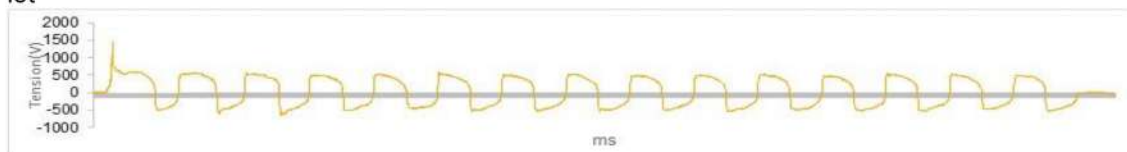
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Shot 2

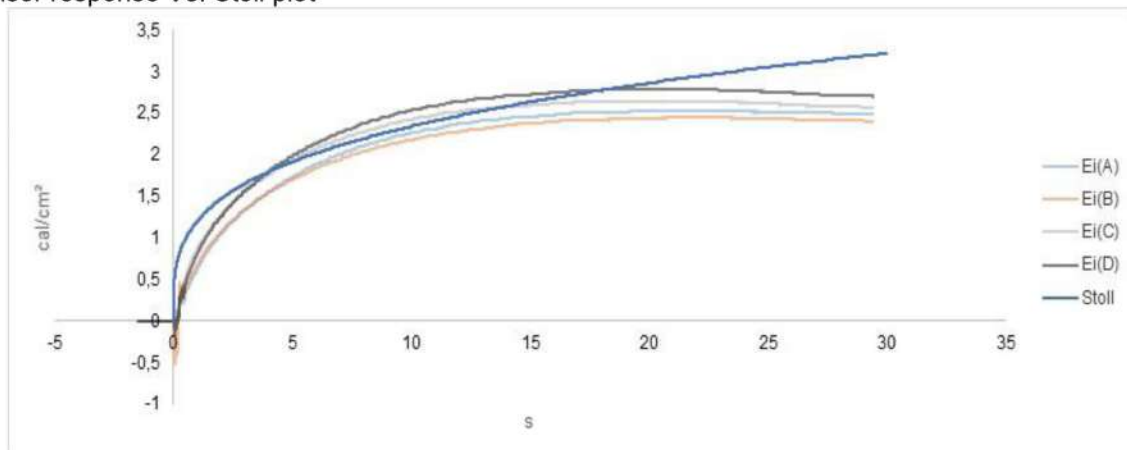
Current Plot



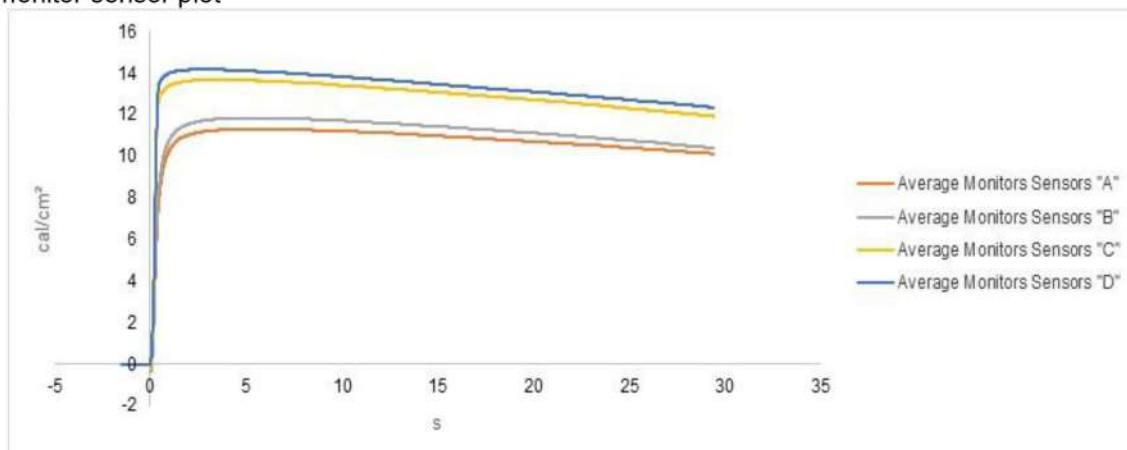
Tension Plot



Panel sensor response Vs. Stoll plot



Average monitor sensor plot



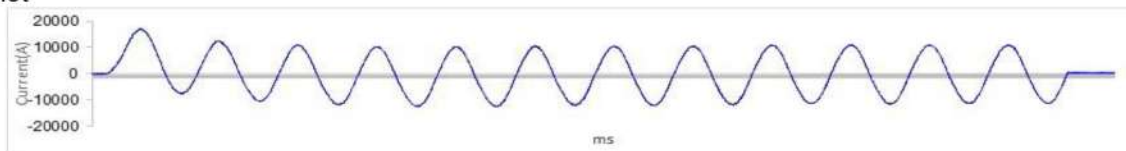
Current Total RMS (kA)	8,0	Current Peak (kA)	17,3	Arc Voltage (V)	1470,0
Duration (cycles n°)	15,2	Duration (ms)	303,8	Arc Energy (kJ)	955,7

sensor response	PANEL A	PANEL B	PANEL C	PANEL D
Ei	11,31 cal/cm ²	11,83 cal/cm ²	13,68 cal/cm ²	14,17 cal/cm ²
SCD	-0,07 cal/cm ²	-0,15 cal/cm ²	0,09 cal/cm ²	0,20 cal/cm ²
HAF	77,67 %	79,34 %	80,68 %	80,41 %

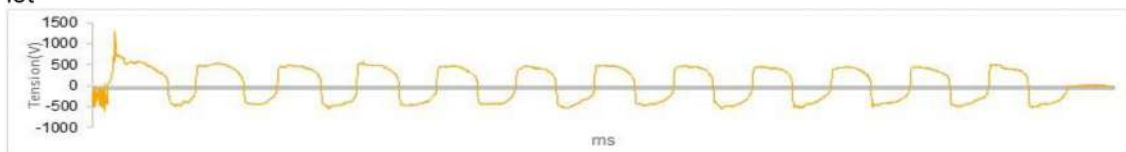
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Shot 3

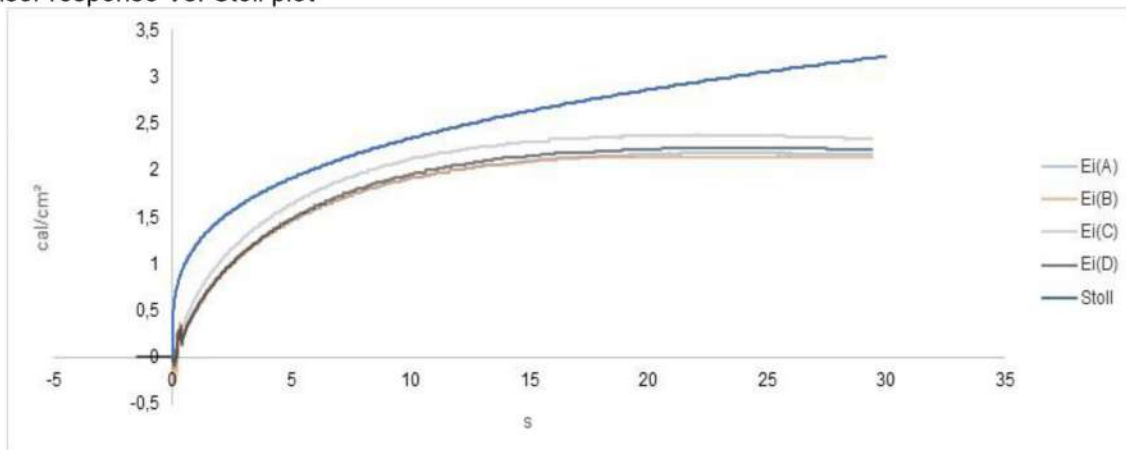
Current Plot



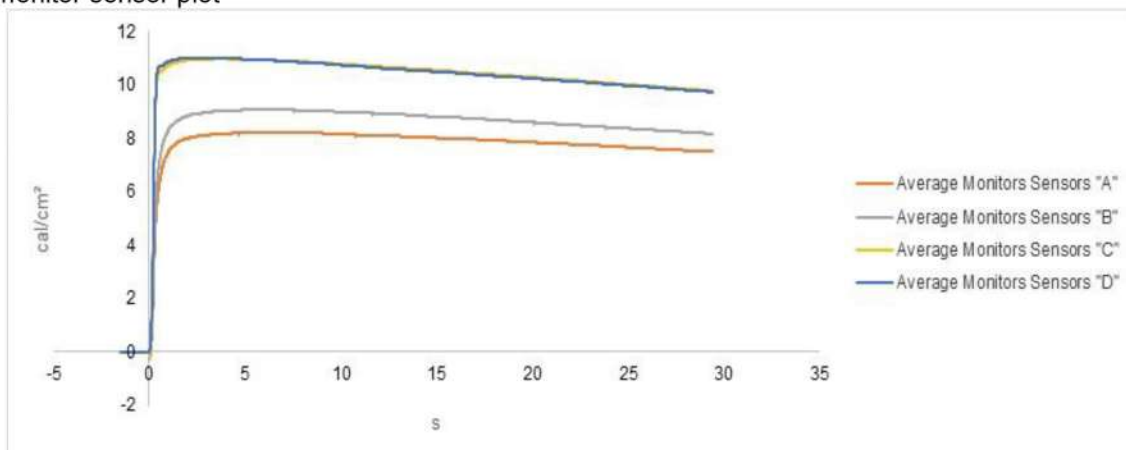
Tension Plot



Panel sensor response Vs. Stoll plot



Average monitor sensor plot



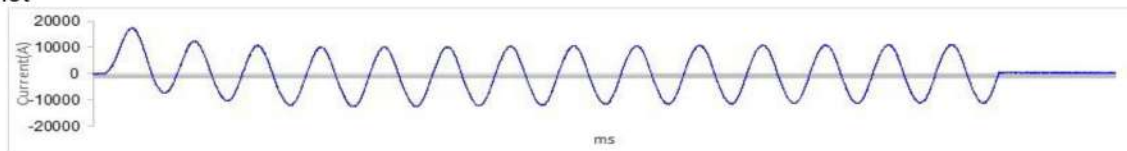
Current Total RMS (kA)	8,0	Current Peak (kA)	17,0	Arc Voltage (V)	1284,0
Duration (cycles n°)	12,2	Duration (ms)	243,6	Arc Energy (kJ)	741,3

sensor response	PANEL A	PANEL B	PANEL C	PANEL D
Ei	8,21 cal/cm ²	9,08 cal/cm ²	10,97 cal/cm ²	11,01 cal/cm ²
SCD	-0,41 cal/cm ²	-0,41 cal/cm ²	-0,21 cal/cm ²	-0,37 cal/cm ²
HAF	73,42 %	76,40 %	78,32 %	79,70 %

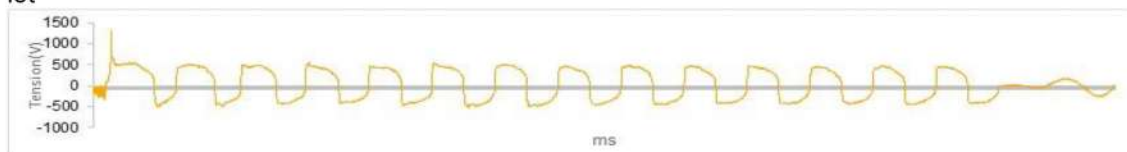
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Shot 4

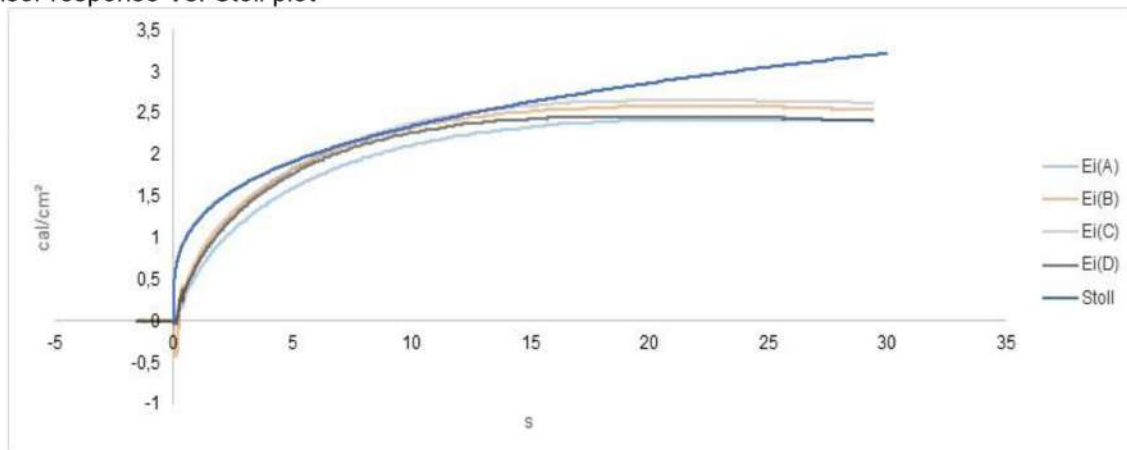
Current Plot



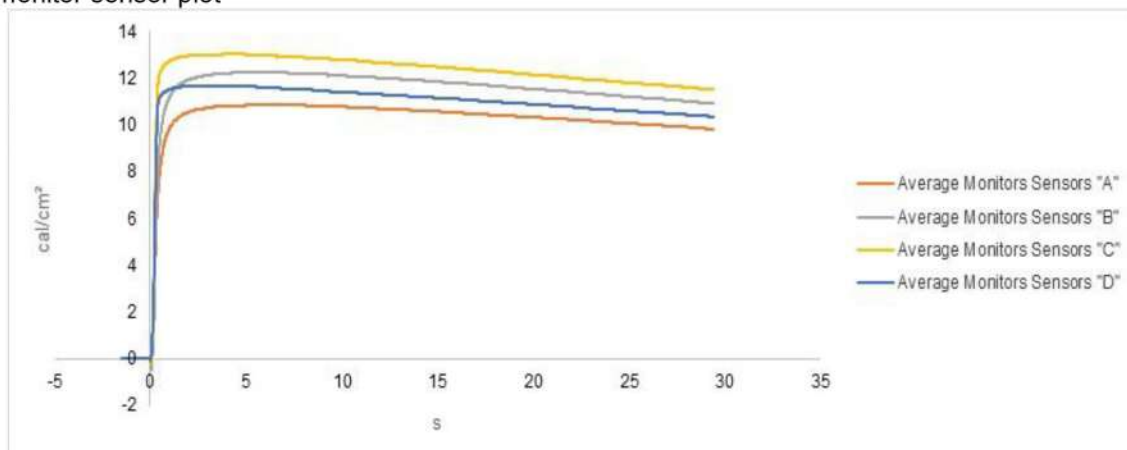
Tension Plot



Panel sensor response Vs. Stoll plot



Average monitor sensor plot



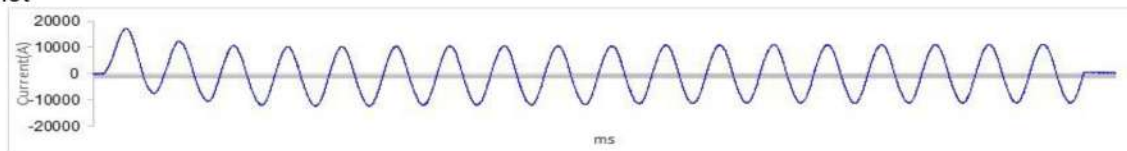
Current Total RMS (kA)	7,7	Current Peak (kA)	17,4	Arc Voltage (V)	1314,0
Duration (cycles n°)	15,4	Duration (ms)	308,9	Arc Energy (kJ)	817,8

sensor response	PANEL A	PANEL B	PANEL C	PANEL D
Ei	10,85 cal/cm ²	12,25 cal/cm ²	13,03 cal/cm ²	11,68 cal/cm ²
SCD	-0,22 cal/cm ²	-0,01 cal/cm ²	0,04 cal/cm ²	-0,06 cal/cm ²
HAF	77,70 %	78,96 %	79,61 %	78,96 %

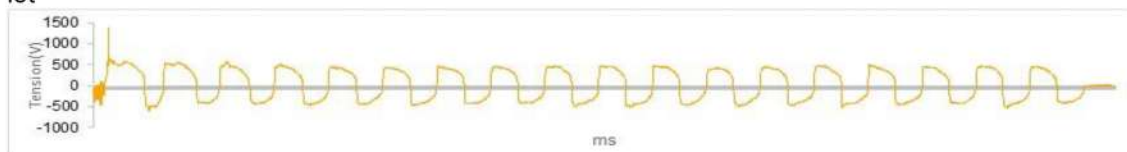
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Shot 5

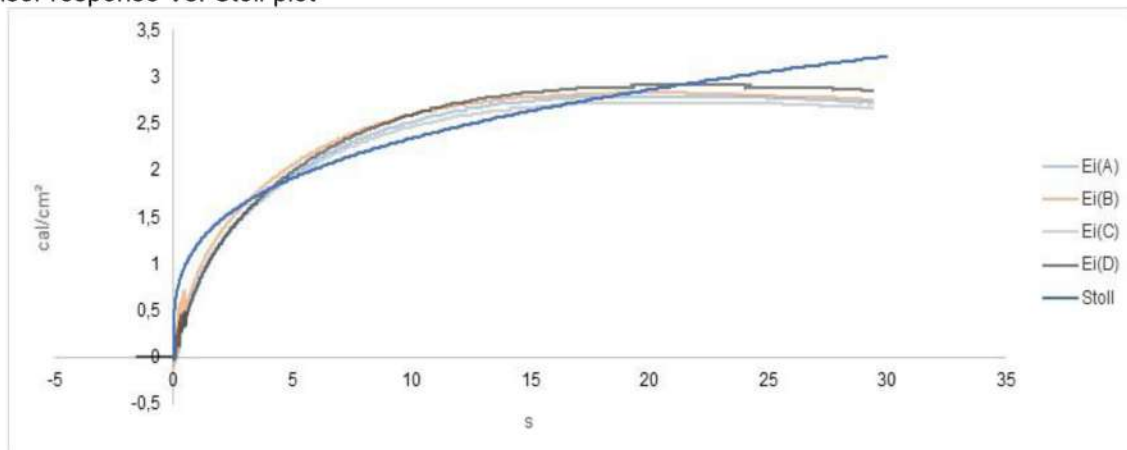
Current Plot



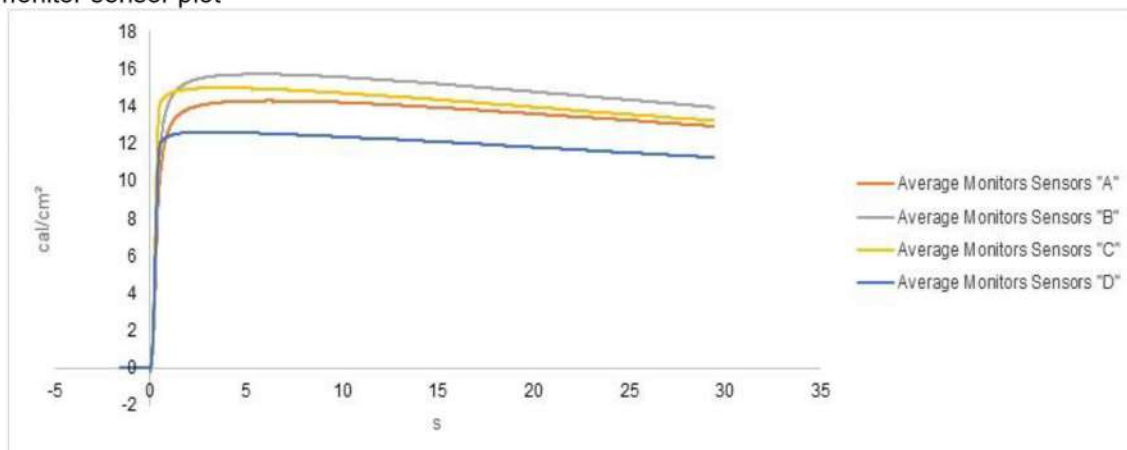
Tension Plot



Panel sensor response Vs. Stoll plot



Average monitor sensor plot

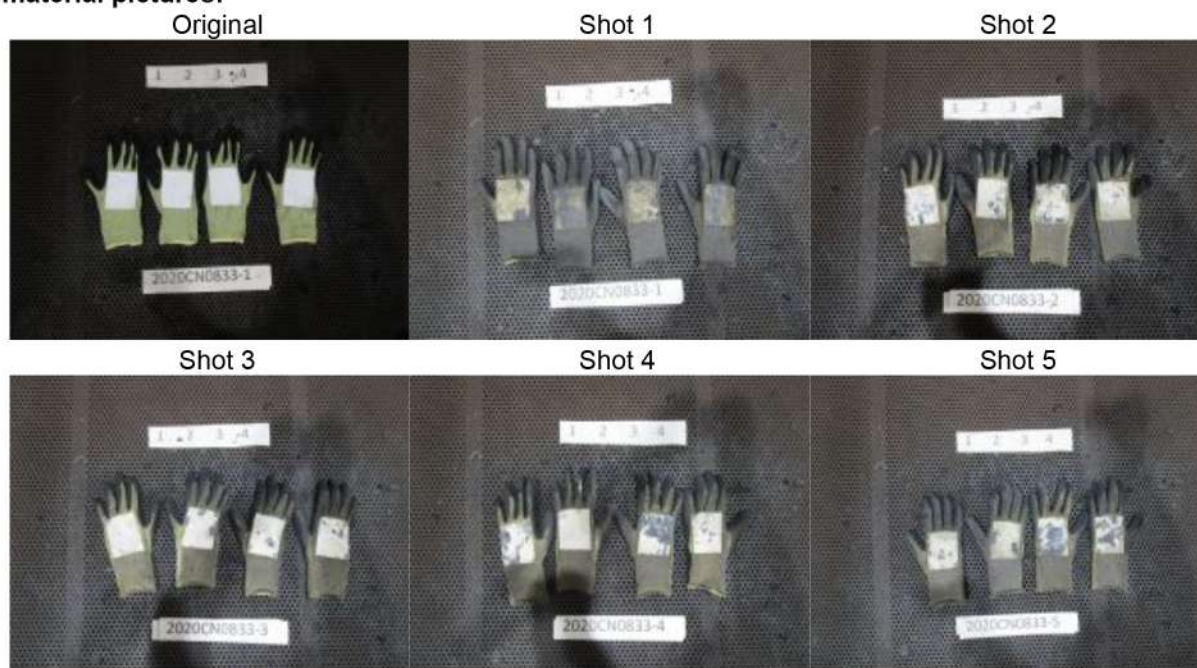


Current Total RMS (kA)	8,0	Current Peak (kA)	17,3	Arc Voltage (V)	1371,0
Duration (cycles n°)	18,2	Duration (ms)	363,4	Arc Energy (kJ)	1036,7

sensor response	PANEL A	PANEL B	PANEL C	PANEL D
Ei	14,29 cal/cm ²	15,71 cal/cm ²	14,99 cal/cm ²	12,63 cal/cm ²
SCD	0,19 cal/cm ²	0,26 cal/cm ²	0,13 cal/cm ²	0,26 cal/cm ²
HAF	80,49 %	82,00 %	81,84 %	76,98 %

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Tested material pictures:



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Summary of results:

ARC RATING (ATPV)	12,4 cal/cm ²
HAF	80,4 %

Arc Flash PPE category according to standard NFPA70E Edition 2018 Table 130.7 (C) (16) - Personal Protective Equipment (PPE)

PPE Category	Minimum Arc Rating (cal/cm²)
1	4
2	8
3	25
4	40

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Lucia Martinez
Head of PPE and Ballistics department

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