# TEST REPORT

**2022US6222**

**DATE OF RECEPTION**
***Date Format: dd/MM/yyyy*** 17/10/2022

**DATE TESTS**
Starting: 28/10/2022
Ending: 02/11/2022

**APPLICANT**

HexArmor
640 Leffingwell Ave NE
US-49505 Grand Rapids
Estados Unidos

Att. Michael Hasler

**IDENTIFICATION AND DESCRIPTION OF SAMPLES**

| Reference by AITEX | Reference by customer | AITEX sample description |
|---|---|---|
| 2022US6222-S01 | 3080 | Glove |

**TESTS CARRIED OUT**

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

Asociación de Investigación de la Industria Textil – C.I.F.: G03182870

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

# RESULTS

## DESCRIPTION OF SAMPLES




**Reference by AITEX:** 2022US6222-S01

**Reference by customer:**

3080

**AITEX sample description:**

According to information supplied by customer:

Style: Heat Transfer Label
Colour Black/Blue/White
Manufacturer HexArmor
Fabric structure laminated material
Weight 0.1mm

**Composition:**

According to information supplied by customer: 100% laminated material

| AITEX Subsamples | Subsample Description |
|---|---|
| 2022US6222-S01.2 | 3080 (Palm side) |
| 2022US6222-S01.3 | - |

# RESULTS

## EXECUTIVE SUMMARY

| | Reference | Test/Standard | Result |
|---|---|---|---|
| **ASTM F2675/F2675M:22e1** | 2022US6222-S01.3 | ELECTRIC ARC TEST (OPEN ARC) GLOVES<br>**ASTM F2675/F2675M:22e1** | * 13,7 CAL/CM$^2$ |

# REQUIREMENT SUMMARY

## ELECTRIC ARC TEST (OPEN ARC) GLOVES

### REQUIREMENT ACCORDING ASTM F2675/F2675M – 22e1

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

# RESULTS

## 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 – 22e1

**Standard deviation**

According to the customer the samples tested include a big label with the logo in the area of the calorimeter, so the arc rating of the base product without the logo could be different than the arc rating obtained in this test report.
According to the standard, the samples shall be tested as a base product, which means that specimens shall be as similar as possible to the finished product but may exclude trims, labels, coatings, or accessories located in the area of the calorimeter (palm or dorsal).

| Test conditions | |
|---|---|
| **Date test.** | 28/10/2022 - 28/10/2022 |
| **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** | 28 |
| **Face test** | Back. |

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**Reference**
2022US6222-S01.3

**Sample type**
Knitted gloves.

**Colour**
Black and yellow.

**Size**
11

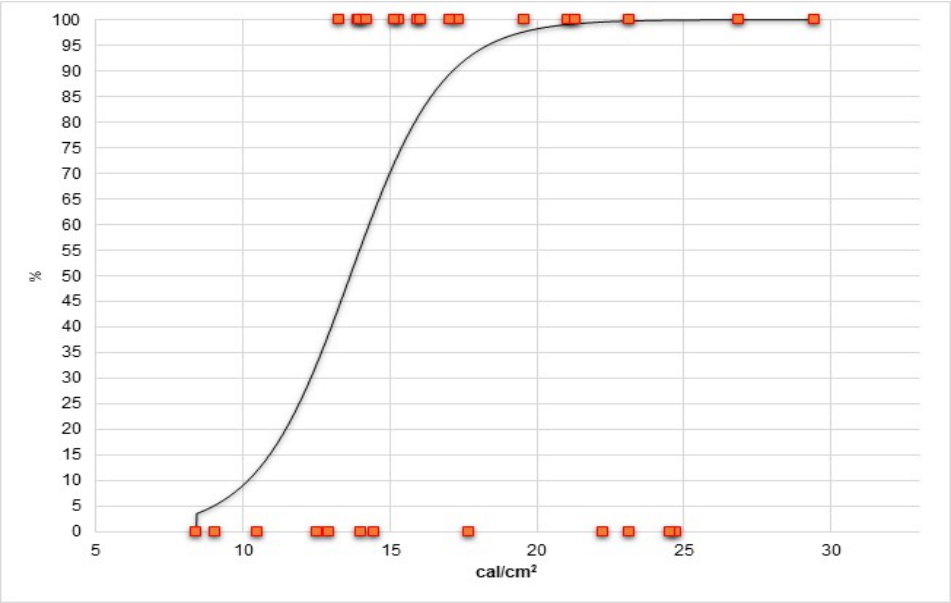
**Composition according to the information supplied by the customer**
Style: Heat Transfer Label  Colour Black/Blue/White
Manufacturer HexArmor
Fabric structure laminated material  Fiber content and percentages 100% laminated material
Weight 0.1mm
Style: Palm Dip  Colour Black
Manufacturer HexArmor
Fabric structure Neoprene palm dip  Fiber content and percentages 100% Neoprene
Weight .1mm
Style Knit Shell  Colour Green
Manufacturer HexArmor Knitted fabric
Fabric structure Aramid/FG knit liner  Fiber content and percentages 66% Aramid, 34% Fiberglass
Weight 13 guage

**Upper and lower thickness samples before tests**
Average, maximum, and minimum thickness was measured over population of 8 gloves
Max: 0,99 mm. – Min: 0,91 mm. – Average: 0,95 mm.

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

| ATPV | 13,7 cal/cm² |
|---|---|

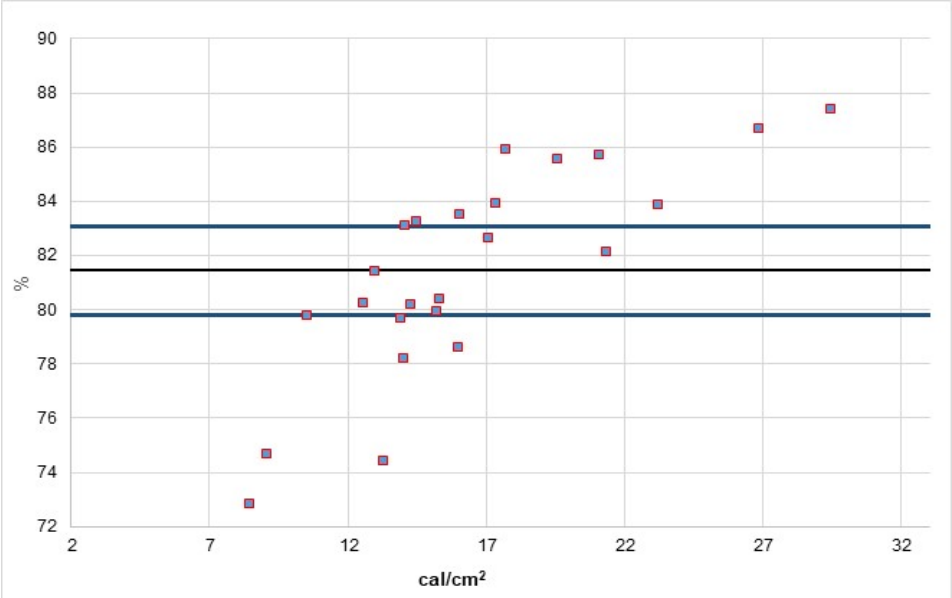



| | |
|---|---|
| ATPV points above | 6 |
| ATPV points 20% | 12 |
| ATPV points below | 5 |
| ATPV points mix zone | 13 |

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**Determination of HAF, confidence Intervals 95%**

| HAF | 81,4 % |
|---|---|




| | |
|---|---|
| % HAF value : | 81,4 |
| Upper Confidence Level %: | 83,1 |
| Lower Confidence Level %: | 79,8 |
| Points above: | 10 |
| Points below: | 7 |
| Points between: | 7 |
| Total Points: | 24 |

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**Summary of measured energy and subjective evaluation:**

| Test | Time (ms) | Cycles 50Hz | Ei cal/cm² | SCD cal/cm² | HAF % | Burn | Break Open |
|---|---|---|---|---|---|---|---|
| 1-A | 224,6 | 11,23 | 12,5 | -0,12 | 80,2 | N | N |
| 1-B | 224,6 | 11,23 | 10,5 | -0,5 | 79,8 | N | N |
| 1-C | 224,6 | 11,23 | 8,4 | -0,38 | 72,9 | N | N |
| 1-D | 224,6 | 11,23 | 9,0 | -0,38 | 74,7 | N | N |
| 2-A | 344,6 | 17,23 | 19,6 | 0,25 | 85,6 | Y | N |
| 2-B | 344,6 | 17,23 | 17,7 | -0,15 | 85,9 | N | N |
| 2-C | 344,6 | 17,23 | 15,3 | 0,4 | 80,4 | Y | N |
| 2-D | 344,6 | 17,23 | 16,0 | 0,91 | 78,6 | Y | N |
| 3-A | 344,8 | 17,24 | 21,0 | 0,49 | 85,8 | Y | N |
| 3-B | 344,8 | 17,24 | 17,3 | 0,23 | 83,9 | Y | N |
| 3-C | 344,8 | 17,24 | 13,3 | 0,9 | 74,4 | Y | N |
| 3-D | 344,8 | 17,24 | 15,2 | 0,46 | 80,0 | Y | N |
| 4-A | 294,8 | 14,74 | 13,9 | 0,31 | 79,7 | Y | N |
| 4-B | 294,8 | 14,74 | 14,0 | -0,24 | 83,1 | N | N |
| 4-C | 294,8 | 14,74 | 14,0 | 0,57 | 78,2 | Y | N |
| 4-D | 294,8 | 14,74 | 14,2 | 0,16 | 80,2 | Y | N |
| 5-A | 484,6 | 24,23 | 29,4 | 1,16 | 87,4 | Y | N |
| 5-B | 484,6 | 24,23 | 26,8 | 1,03 | 86,7 | Y | N |
| 5-C | 484,6 | 24,23 | 21,3 | 1,33 | 82,1 | Y | N |
| 5-D | 484,6 | 24,23 | 23,2 | 1,18 | 83,9 | Y | N |
| 6-A | 297,4 | 14,87 | 16,0 | 0,04 | 83,5 | Y | N |
| 6-B | 297,4 | 14,87 | 14,4 | -0,1 | 83,3 | N | N |
| 6-C | 297,4 | 14,87 | 12,9 | -0,26 | 81,4 | N | N |
| 6-D | 297,4 | 14,87 | 17,1 | 0,42 | 82,6 | Y | N |
| 7-A | 474,8 | 23,74 | 24,7 | -1,2 | 94,8 | N | N |
| 7-B | 474,8 | 23,74 | 23,1 | -1,2 | 95,5 | N | N |
| 7-C | 474,8 | 23,74 | 22,2 | -1,19 | 94,3 | N | N |
| 7-D | 474,8 | 23,74 | 24,5 | -1,18 | 95,0 | N | N |

Remark: Data from shot 7 was performed for the ignition withstand evaluation. According to section 12.5, four samples were exposed at palm to an incident energy level as stated in Table 1. These results are not used for the Arc rating calculation.

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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 |
| 6-A | 0 | N | N | N | Y | Y |
| 6-B | 0 | N | N | N | Y | Y |
| 6-C | 0 | N | N | N | Y | Y |
| 6-D | 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 |
| 7-D | 0 | N | N | N | Y | Y |

Y: Yes N: No

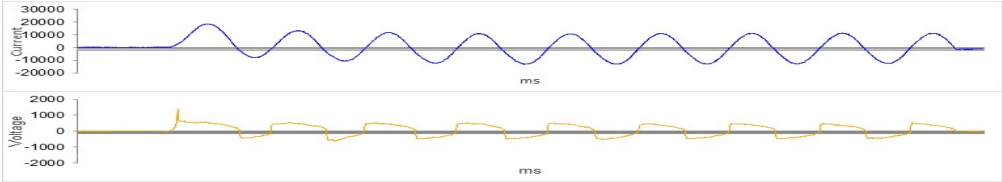
Remark: Data from shot 7 was performed for the ignition withstand evaluation. According to section 12.5, four samples were exposed at palm to an incident energy level as stated in Table 1. These results are not used for the Arc rating calculation.

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**Electrical current and response sensor response:**

**Calibration shot**

**INITIAL CALIBRATION**




| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Ei Panel A** | 9,2 cal/cm² | **Ei Panel B** | 8,0 cal/cm² | **Ei Panel C** | 6,0 cal/cm² | **Ei Panel D** | 6,3 cal/cm² |

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**Shot 1**

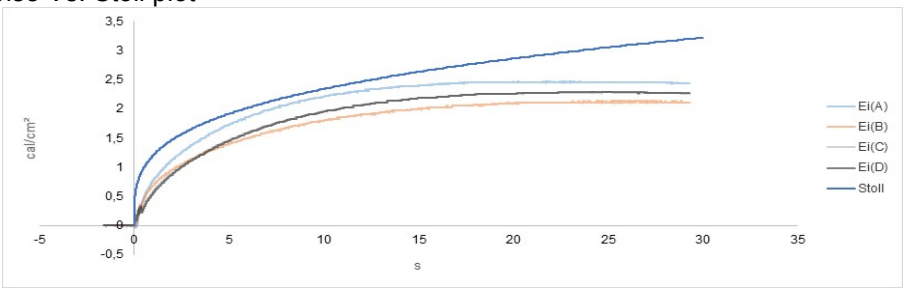
Current Plot



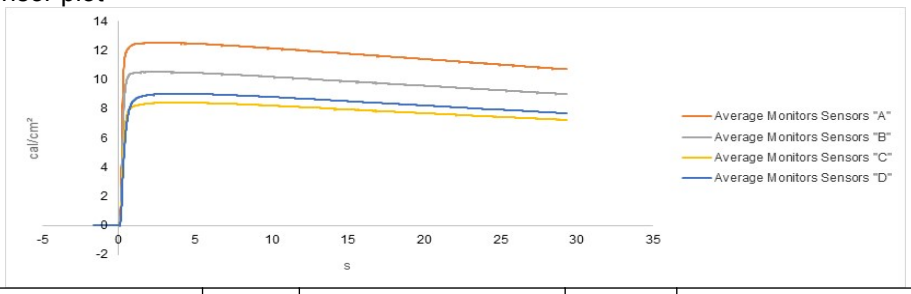

Tension Plot




Panel sensor response Vs. Stoll plot




Average monitor sensor plot




| | | | | | |
|---|---|---|---|---|---|
| **Current Total RMS (kA)** | 8,4 | **Current Peak (kA)** | 18,9 | **Arc Voltage (V)** | 1485,0 |
| **Duration (cycles nº)** | 11,2 | **Duration (ms)** | 224,5 | **Arc Energy (kJ)** | 666,6 |

| sensor response | PANEL A | PANEL B | PANEL C | PANEL D |
|---|---|---|---|---|
| **Ei** | 12,53 cal/cm² | 10,52 cal/cm² | 8,43 cal/cm² | 9,04 cal/cm² |
| **SCD** | -0,12 cal/cm² | -0,50 cal/cm² | -0,38 cal/cm² | -0,38 cal/cm² |
| **HAF** | 80,24 % | 79,78 % | 72,87 % | 74,69 % |

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**Shot 2**

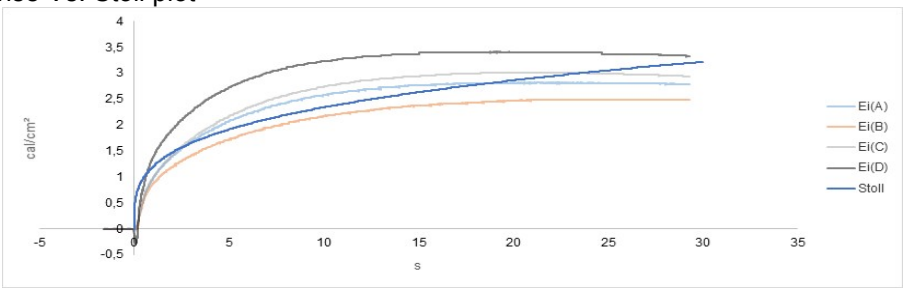
Current Plot



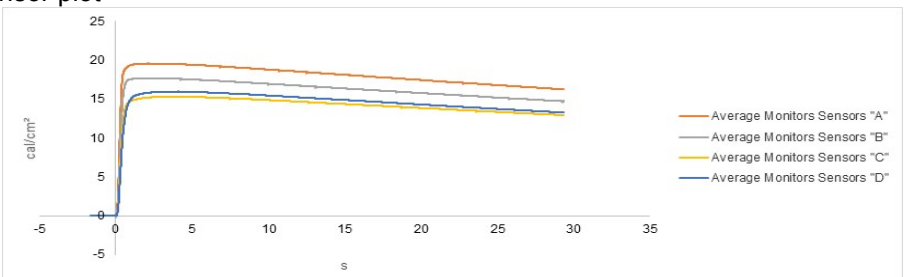

Tension Plot




Panel sensor response Vs. Stoll plot




Average monitor sensor plot




| | | | | | |
|---|---|---|---|---|---|
| **Current Total RMS (kA)** | 8,3 | **Current Peak (kA)** | 18,6 | **Arc Voltage (V)** | 1464,0 |
| **Duration (cycles nº)** | 17,2 | **Duration (ms)** | 344,6 | **Arc Energy (kJ)** | 1098,2 |

| **sensor response** | **PANEL A** | **PANEL B** | **PANEL C** | **PANEL D** |
|---|---|---|---|---|
| **Ei** | 19,57 | 17,68 cal/cm² | 15,31 cal/cm² | 15,96 cal/cm² |
| **SCD** | 0,25 | -0,15 cal/cm² | 0,40 cal/cm² | 0,91 cal/cm² |
| **HAF** | 85,57 % | 85,92 % | 80,42 % | 78,61 % |

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**Shot 3**

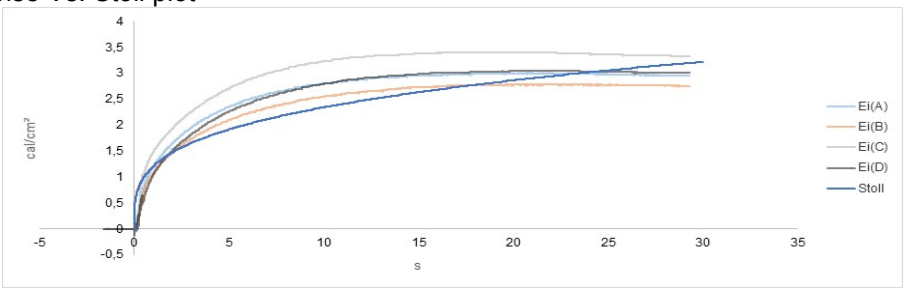
Current Plot



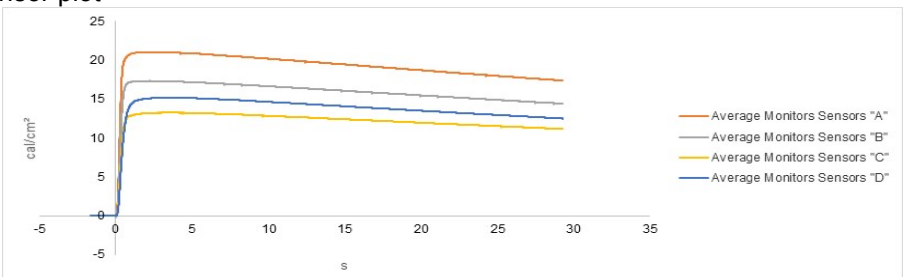

Tension Plot




Panel sensor response Vs. Stoll plot




Average monitor sensor plot




| | | | | | |
|---|---|---|---|---|---|
| **Current Total RMS (kA)** | 8,3 | **Current Peak (kA)** | 18,4 | **Arc Voltage (V)** | 1470,0 |
| **Duration (cycles nº)** | 17,2 | **Duration (ms)** | 344,9 | **Arc Energy (kJ)** | 967,2 |

| sensor response | PANEL A | PANEL B | PANEL C | PANEL D |
|---|---|---|---|---|
| **Ei** | 21,04 cal/cm² | 17,33 cal/cm² | 13,26 cal/cm² | 15,17 cal/cm² |
| **SCD** | 0,49 cal/cm² | 0,23 cal/cm² | 0,90 cal/cm² | 0,46 cal/cm² |
| **HAF** | 85,75 % | 83,92 % | 74,43 % | 79,96 % |

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**Shot 4**

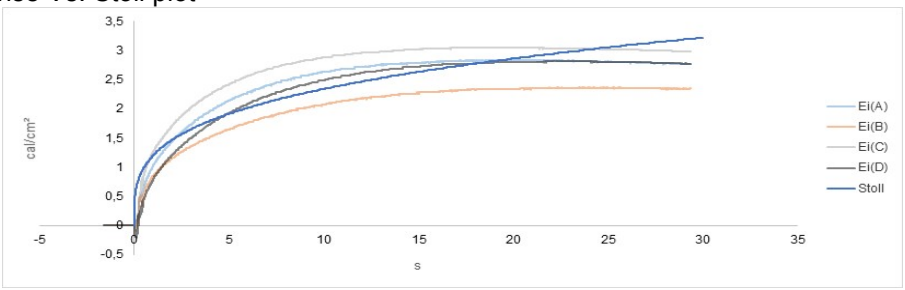
Current Plot



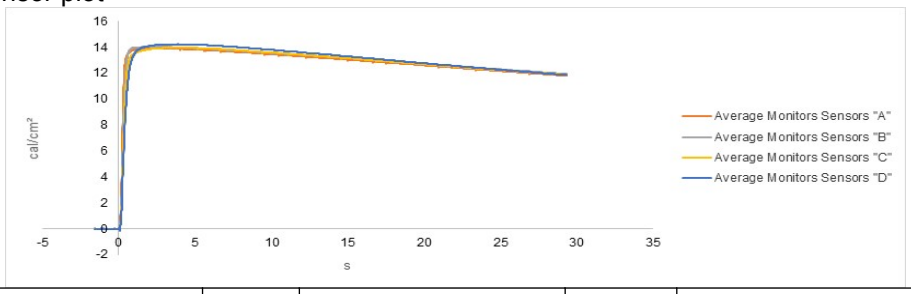

Tension Plot




Panel sensor response Vs. Stoll plot




Average monitor sensor plot




| | | | | | |
|---|---|---|---|---|---|
| **Current Total RMS (kA)** | 8,2 | **Current Peak (kA)** | 18,7 | **Arc Voltage (V)** | 1473,0 |
| **Duration (cycles nº)** | 14,7 | **Duration (ms)** | 294,9 | **Arc Energy (kJ)** | 973,5 |

| sensor response | PANEL A | PANEL B | PANEL C | PANEL D |
|---|---|---|---|---|
| **Ei** | 13,91 cal/cm² | 14,04 cal/cm² | 13,97 cal/cm² | 14,23 cal/cm² |
| **SCD** | 0,31 cal/cm² | -0,24 cal/cm² | 0,57 cal/cm² | 0,16 cal/cm² |
| **HAF** | 79,68 % | 83,11 % | 78,22 % | 80,23 % |

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**Shot 5**

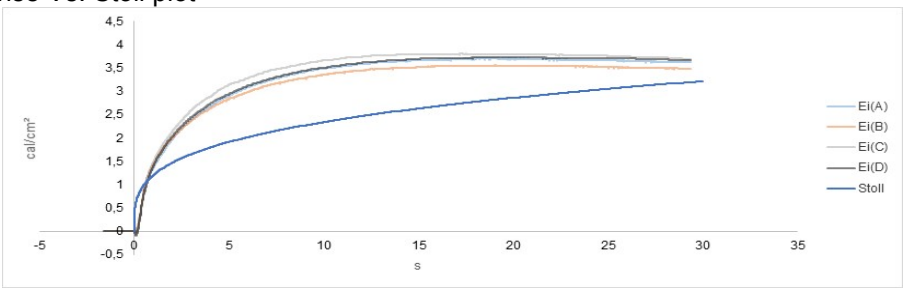
Current Plot



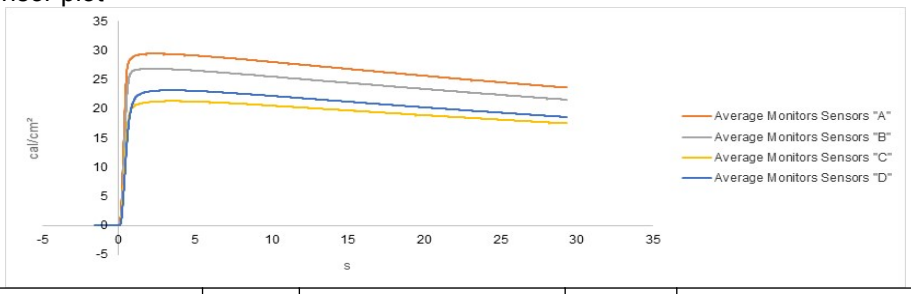

Tension Plot




Panel sensor response Vs. Stoll plot




Average monitor sensor plot




| | | | | | |
|---|---|---|---|---|---|
| **Current Total RMS (kA)** | 8,3 | **Current Peak (kA)** | 18,2 | **Arc Voltage (V)** | 1410,0 |
| **Duration (cycles nº)** | 24,2 | **Duration (ms)** | 484,6 | **Arc Energy (kJ)** | 1591,1 |

| sensor response | PANEL A | PANEL B | PANEL C | PANEL D |
|---|---|---|---|---|
| **Ei** | 29,44 cal/cm² | 26,85 cal/cm² | 21,32 cal/cm² | 23,17 cal/cm² |
| **SCD** | 1,16 cal/cm² | 1,03 cal/cm² | 1,33 cal/cm² | 1,18 cal/cm² |
| **HAF** | 87,43 % | 86,72 % | 82,13 % | 83,91 % |

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**Shot 6**

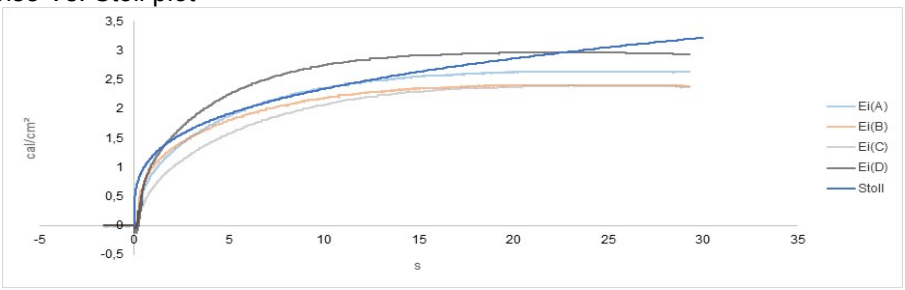
Current Plot



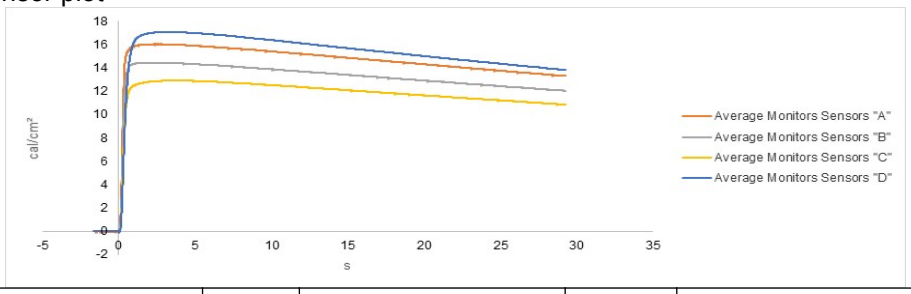

Tension Plot




Panel sensor response Vs. Stoll plot




Average monitor sensor plot




| | | | | | |
|---|---|---|---|---|---|
| **Current Total RMS (kA)** | 8,0 | **Current Peak (kA)** | 18,6 | **Arc Voltage (V)** | 1485,0 |
| **Duration (cycles nº)** | 14,9 | **Duration (ms)** | 297,4 | **Arc Energy (kJ)** | 1013,2 |

| Sensor response | PANEL A | PANEL B | PANEL C | PANEL D |
|---|---|---|---|---|
| **Ei** | 16,03 cal/cm² | 14,45 cal/cm² | 12,93 cal/cm² | 17,07 cal/cm² |
| **SCD** | 0,04 cal/cm² | -0,10 cal/cm² | -0,26 cal/cm² | 0,42 cal/cm² |
| **HAF** | 83,53 % | 83,30 % | 81,44 % | 82,64 % |

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**Shot 7 – Ignition withstand evaluation. Tested at palm.**

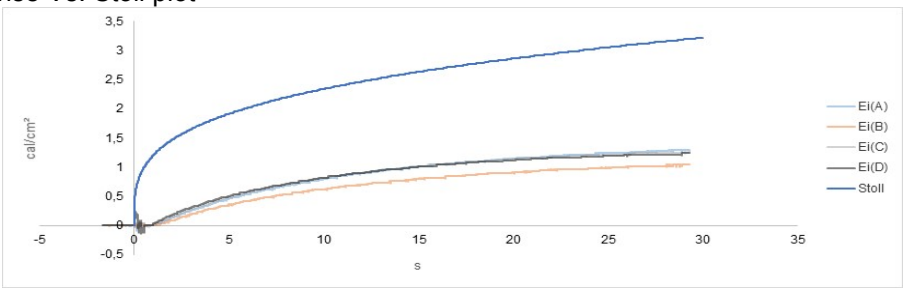
Current Plot



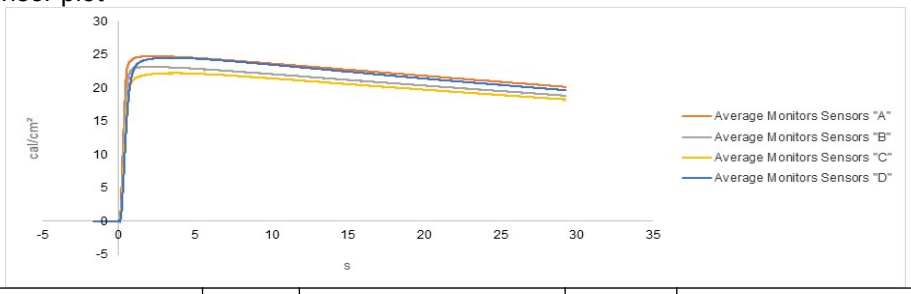

Tension Plot




Panel sensor response Vs. Stoll plot




Average monitor sensor plot



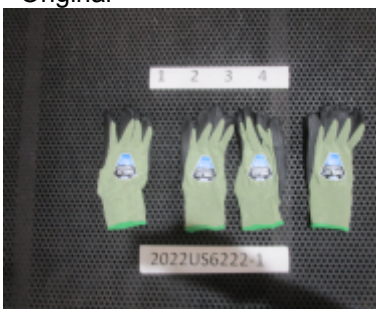

| | | | | | |
|---|---|---|---|---|---|
| **Current Total RMS (kA)** | 8,2 | **Current Peak (kA)** | 18,6 | **Arc Voltage (V)** | 1434,0 |
| **Duration (cycles nº)** | 23,7 | **Duration (ms)** | 474,9 | **Arc Energy (kJ)** | 1580,1 |

| sensor response | PANEL A | PANEL B | PANEL C | PANEL D |
|---|---|---|---|---|
| **Ei** | 24,74 cal/cm² | 23,14 cal/cm² | 22,23 cal/cm² | 24,52 cal/cm² |
| **SCD** | -1,20 cal/cm² | -1,20 cal/cm² | -1,19 cal/cm² | -1,18 cal/cm² |
| **HAF** | 94,79 % | 95,47 % | 94,32 % | 94,96 % |

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**Tested material pictures:**

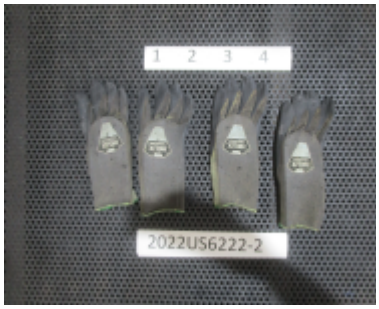
Original




Shot 1




Shot 2




Shot 3




Shot 4




Shot 5




Shot 6




Ignition withstand evaluation.




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**Summary of results:**

| | |
|---|---|
| **ARC RATING (ATPV)** | *13,7 cal/cm² |
| **HAF** | 81,4 % |

*Remark: According to the customer the samples tested include a big label with the logo in the area of the calorimeter, so the arc rating of the base product without the logo could be different than the arc rating obtained in this test report. According to the standard, the samples shall be tested as a base product, which means that specimens shall be as similar as possible to the finished product but may exclude trims, labels, coatings, or accessories located in the area of the calorimeter (palm or dorsal).

After the arc rating calculation for the base product, at least four samples shall be exposed to an incident energy higher than the arc rating, according to section 12.5 – verification of ignition withstand.

Ignition withstand has been verified in samples 7A, 7B, 7C and 7D with incident energies in the range of 20-25 cal/cm². No ignition noted in any sample.

Final product can be assigned with the same arc rating than the base product.

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




Date: 03/11/2022 13:32:26
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