


# Quality Assurance Report

Ref:  TÜVRheinland® Report 21276144\_001

## Report Brief:

This test was requested by the Fire Services to demonstrate that, once activated into shut-down mode, the IMO FireRaptor would sustain solar panel isolation at zero volts even when exposed to an open flame with an incremental temperature increase to above 700°C (in accordance with DIN EN 60695-11-3) and eventual destruction of the unit.

24<sup>th</sup> July 2017

<b>Prüfbericht-Nr.:</b> <i>Test Report No.:</i>	<b>21276144_001</b>	<b>Auftrags-Nr.:</b> <i>Order No.:</i>	<b>3227705</b>	Seite 1 von 5 <i>Page 1 of 5</i>	
<b>Kunden-Referenz-Nr.:</b> <i>Client Reference No.:</i>	<b>42441 / 24.07.2017</b>	<b>Auftragsdatum:</b> <i>Order date:</i>	<b>24.07.2017</b>		
<b>Auftraggeber:</b> <i>Client:</i>	<b>IMO Precision Controls Ltd.</b> 1000 North Circular Road, London , GB				
<b>Prüfgegenstand:</b> <i>Test item:</i>	<b>FireRaptor Rapid Shutdown System Unit</b>				
<b>Bezeichnung / Typ-Nr.:</b> <i>Identification / Type No.:</i>	<b>FRS-01</b>				
<b>Auftrags-Inhalt:</b> <i>Order content:</i>	<b>Part Testing according to manufacturer's test procedure</b>				
<b>Prüfgrundlage:</b> <i>Test specification:</i>	<b>No Test specification used</b>				
<b>Wareneingangsdatum:</b> <i>Date of receipt:</i>	<b>24.07.2017</b>				
<b>Prüfmuster-Nr.:</b> <i>Test sample No.:</i>	<b>A000169404-001 to-004</b>				
<b>Prüfzeitraum:</b> <i>Testing period:</i>	<b>02.08.2017 – 03.08.2017</b>				
<b>Ort der Prüfung:</b> <i>Place of testing:</i>	<b>PV-Labor Köln</b>				
<b>Prüflaboratorium:</b> <i>Testing laboratory:</i>	<b>TÜV Rheinland LGA Products GmbH</b>				
<b>Prüfergebnis*:</b> <i>Test result*:</i>	<b>Siehe Sonstiges / See Other</b>				
<b>geprüft von / tested by:</b> 		<b>kontrolliert von / reviewed by:</b> 			
<b>04.08.2017</b>	<b>Marco Klose / Expert</b>	<b>04.08.2017</b>	<b>Martin Hessenmüller / Expert</b>		
<b>Datum</b> <i>Date</i>	<b>Name / Stellung</b> <i>Name / Position</i>	<b>Unterschrift</b> <i>Signature</i>	<b>Datum</b> <i>Date</i>	<b>Name / Stellung</b> <i>Name / Position</i>	<b>Unterschrift</b> <i>Signature</i>
<b>Sonstiges / Other:</b> This report consists of 6 pages test report and 16 pages of photodocumentation, the report documents the result of a manufacturer's declared test procedure on the above mentioned test sample. There was no "Pass" or "Fail" criteria applied. For more information see page 4.					
<b>Zustand des Prüfgegenstandes bei Anlieferung:</b> <i>Condition of the test item at delivery:</i>		<b>Prüfmuster vollständig und unbeschädigt</b> <i>Test item complete and undamaged</i>			
* Legende: 1 = sehr gut      2 = gut      3 = befriedigend      4 = ausreichend      5 = mangelhaft P(ass) = entspricht o.g. Prüfgrundlage(n)      F(ail) = entspricht nicht o.g. Prüfgrundlage(n)      N/A = nicht anwendbar      N/T = nicht getestet					
Legend: 1 = very good      2 = good      3 = satisfactory      4 = sufficient      5 = poor P(ass) = passed a.m. test specification(s)      F(ail) = failed a.m. test specification(s)      N/A = not applicable      N/T = not tested					
<b>Dieser Prüfbericht bezieht sich nur auf das o.g. Prüfmuster und darf ohne Genehmigung der Prüfstelle nicht auszugsweise vervielfältigt werden. Dieser Bericht berechtigt nicht zur Verwendung eines Prüfzeichens.</b> <i>This test report only relates to the a. m. test sample. Without permission of the test center this test report is not permitted to be duplicated in extracts. This test report does not entitle to carry any test mark.</i>					

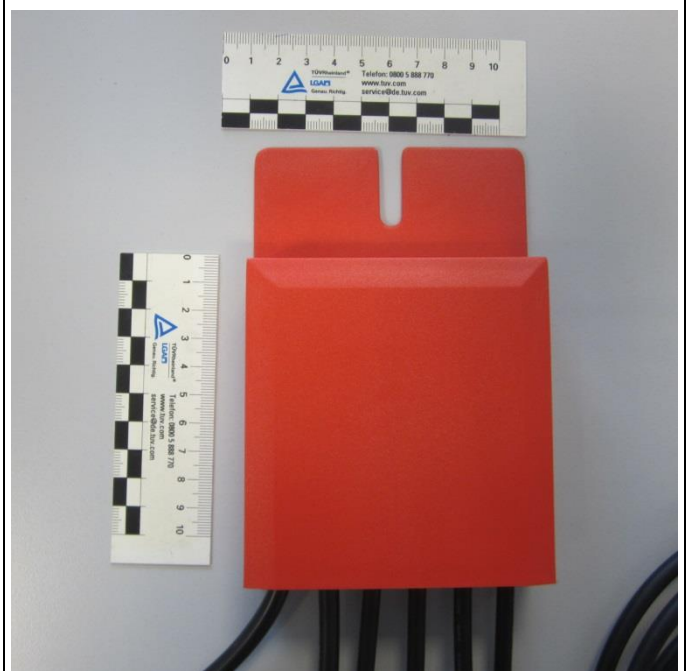


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**Produktbeschreibung**  
**Product description**

<p><b>1 Produktdetails</b> <i>Product details</i></p>	<p>Type: FRS-01 FireRaptor Unit</p> <p>DC Power Supply: 24VDC suitable for up to 20 FireRaptor units (40 panels)</p> <p>Maximum Input Power: 700W (350W per panel)</p> <p>Maximum Input Voltage: 150V (75V per panel)</p> <p>Maximum Input Current: 12A</p> <p>Maximum System Voltage: 1500V</p> <p>Operating Temperature: -30°C to +95°C</p> <p>IP Class Protection: &gt;IP68 (designed to comply with NEMA 4X)</p>
<p><b>2 Maße / Gewicht</b> <i>Dimensions / Weight</i></p>	<p>Weight (without cables) : 300g</p> <p>Panel Cable Length : 120mm</p> <p>String &amp; Signal Cable Length : 1800mm</p>
<p><b>3 Bedienelemente</b> <i>Operating elements</i></p>	<p>FRS-ESW1 ; FRS-ESW2</p> <p><i>During the test FRS-ESW1 was used.</i></p>
<p><b>4 Ausstattung / Zubehör</b> <i>Equipment / Accessories</i></p>	<p>See Installation Guide</p>
<p><b>5 Verwendete Materialien</b> <i>Used materials</i></p>	<p>N/A</p>
<p><b>6 Sonstiges</b> <i>Other</i></p>	<p>For photodocumentation see 21276144_001_atm1</p>



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Absatz	<b>No Test specification used</b>	Messergebnisse - Bemerkungen	Bewertung
Clause	Anforderungen - Prüfungen / <i>Requirements - Tests</i>	<i>Measuring results - Remarks</i>	<i>Evaluation</i>

--	<p><b>Part Testing according to manufacturer test procedure</b></p>
--	<p><u>Description of test procedure:</u></p> <ol style="list-style-type: none"> <li>1. Power up the unit such that it passes power through.           <p><i>Processing:</i>            A DC source with 60V<sub>dc</sub> was connected to the PAN +/- connection without any load on the STG +/- connection. An open circuit was applied.            In this state the 24V<sub>dc</sub> from the "FRS-ESW1" unit was activated on the PWR IN connection.</p> </li> <li>2. Perform a shutdown thereby stopping power through the unit           <p><i>Processing:</i>            For stopping power through the unit the pushbutton switch on the "FRS-ESW1" was pressed.</p> </li> <li>3. Increase the temperature to such a level that the unit will in effect be destroyed           <p><i>Processing:</i>            The device under test was exposed to a 500 W flame based to the DIN EN 60695-11-3.            The time period of flame influence and pausing duration on the test sample changed during the test. See also table 1 for detailed information.</p> </li> <li>4. During this temperature cycle monitor the power to ensure that at no time does the unit allow power through.           <p><i>Processing:</i>            Diagram 1 documents following voltages during the test:</p> <ul style="list-style-type: none"> <li>- 60 V<sub>dc</sub> source on <b>PAN +/-</b></li> <li>- Output <b>STG +/-</b></li> <li>- Connection <b>PWR IN</b></li> </ul> </li> </ol>

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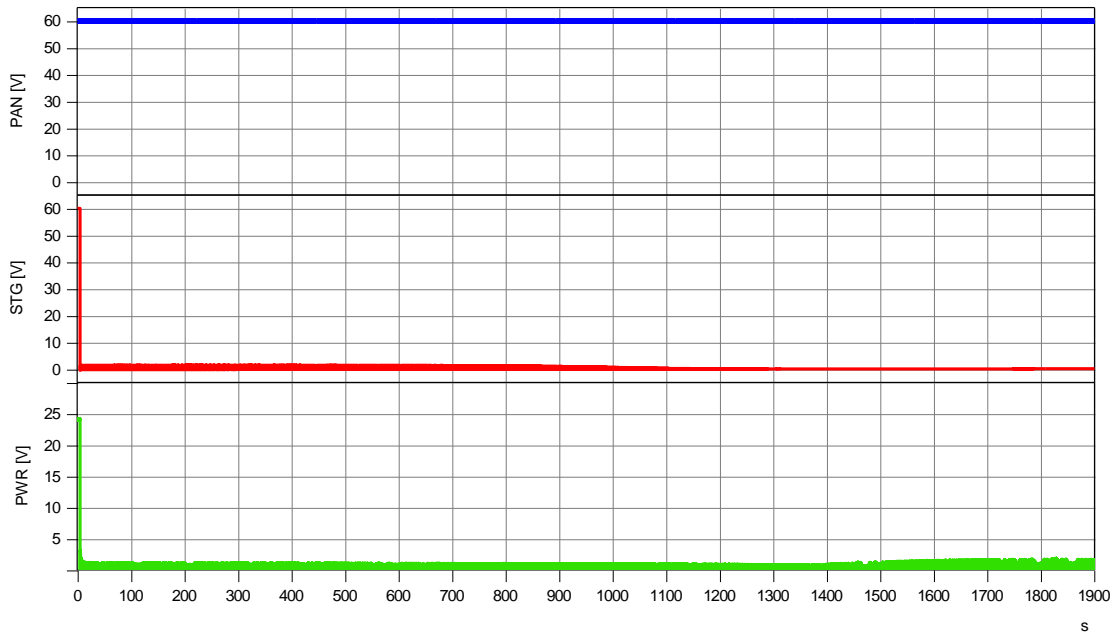
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Absatz	<b>No Test specification used</b>	Messergebnisse - Bemerkungen	Bewertung
Clause	Anforderungen - Prüfungen / Requirements - Tests	Measuring results - Remarks	Evaluation

Table 1:

Remark	t <sub>1</sub> [s]	t <sub>2</sub> [s]	surface temperature [°C]	flame influence duration [s]
PWR on	0	5	26 (at starting point)	--
PWR off	5	1900	26	--
flame influence 1	10	35	120	25
flame influence 2	135	160	140	25
flame influence 3	190	215	150	25
flame influence 4	235	260	250	25
flame influence 5	290	315	250	25
flame influence 6	350	375	230	25
flame influence 7	410	445	230	35
flame influence 8	490	525	230	35
flame influence 9	560	605	220	45
flame influence 10	630	675	220	45
flame influence 11	690	750	220	60
flame influence 12	800	1900	--	1100

Diagram 1:



Remark:

- Test procedure stopped at 1900 seconds, due to destroyed unit. See also picture 25 of photo documentation (21276144\_001\_atm1).
- During the test (between 5 seconds and 1900 seconds) the output STG was not active.

**FOTO-DOKUMENTATION**  
**PHOTO-DOCUMENTATION**

Bild / Picture 1: FRS-ESW1



Bild / Picture 2: FRS-ESW1





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**FOTO-DOKUMENTATION**  
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Bild / Picture 3: FRS-ESW1

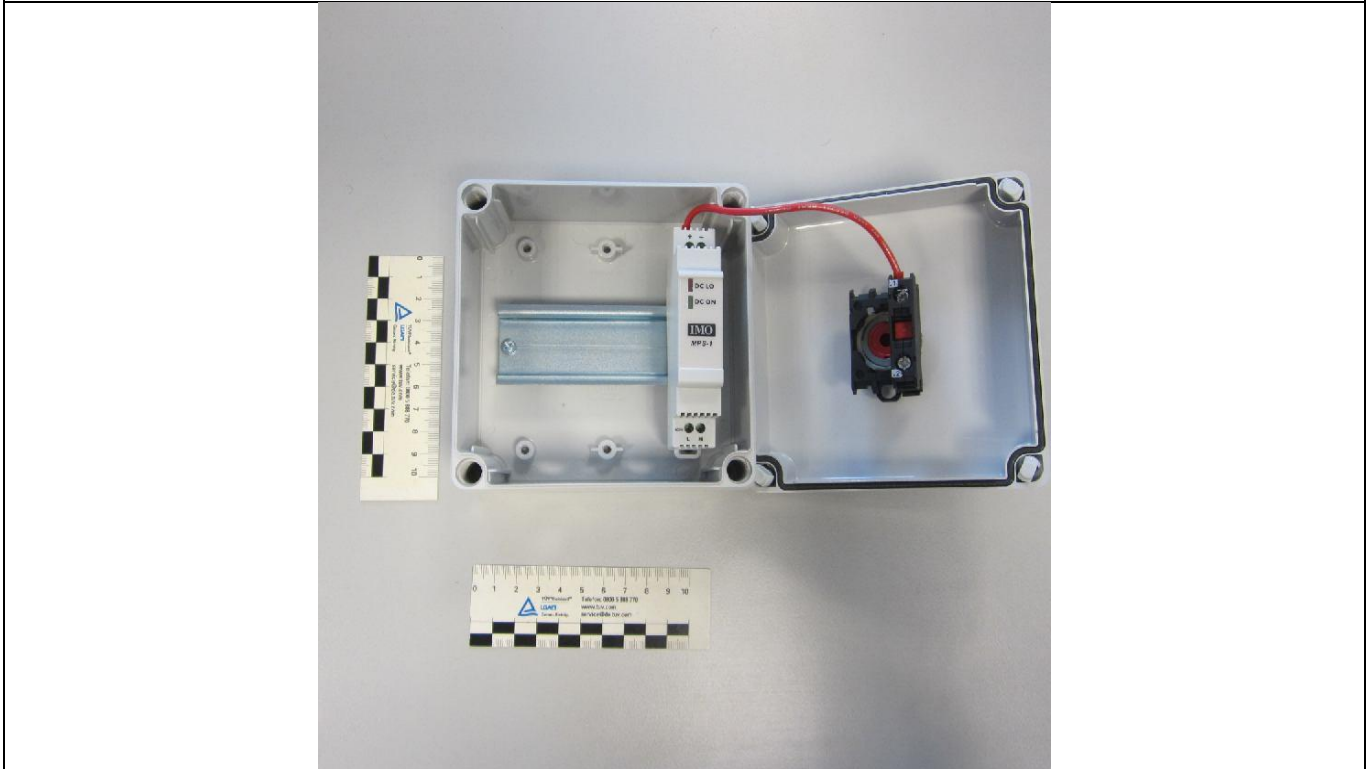


Bild / Picture 4: FRS-ESW1





**FOTO-DOKUMENTATION**  
**PHOTO-DOCUMENTATION**

Bild / Picture 5: FRS-01

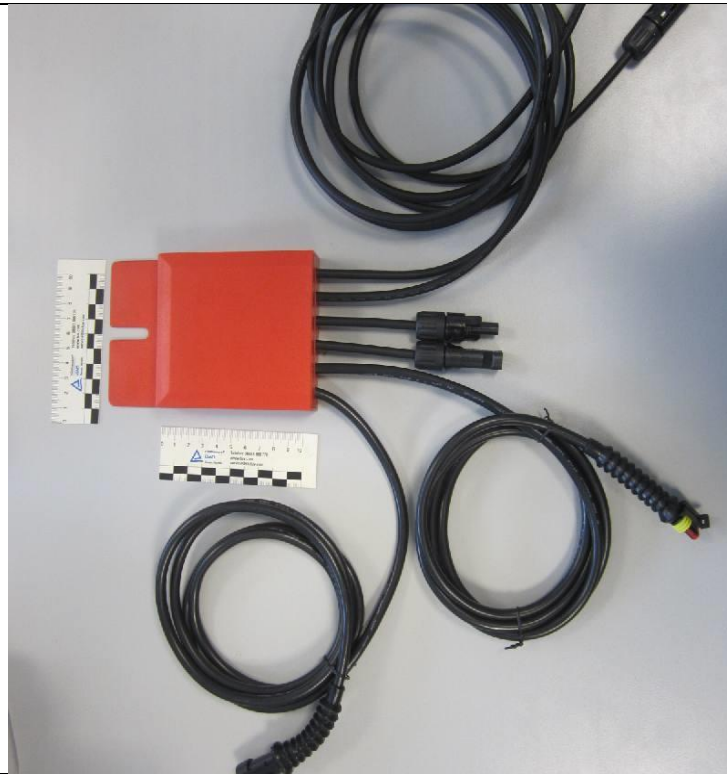
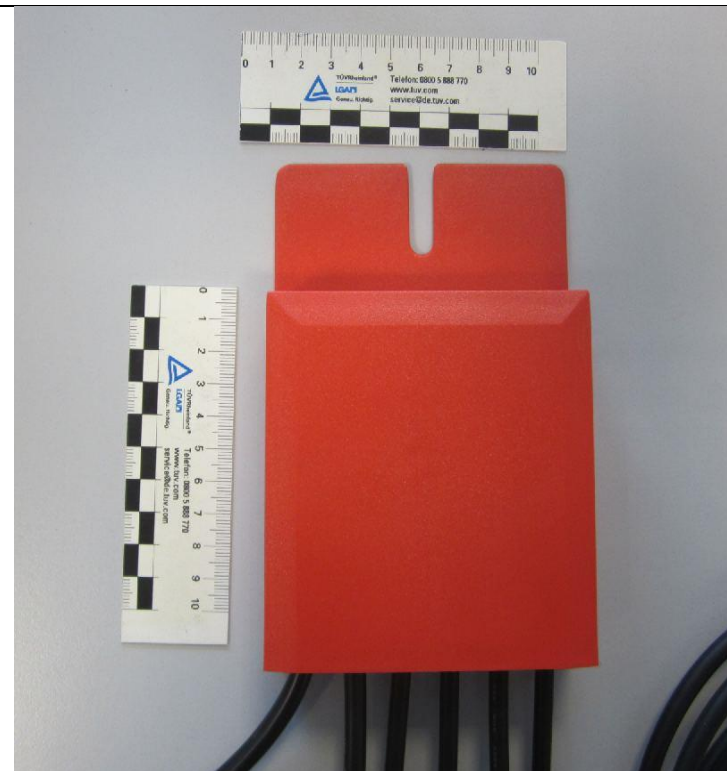


Bild / Picture 6: FRS-01



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**FOTO-DOKUMENTATION**  
**PHOTO-DOCUMENTATION**

Bild / Picture 7: FRS-01



Bild / Picture 8: FRS-01



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**FOTO-DOKUMENTATION**  
**PHOTO-DOCUMENTATION**

Bild / Picture 9: FRS-01



Bild / Picture 10: FRS-01





**FOTO-DOKUMENTATION**  
**PHOTO-DOCUMENTATION**

Bild / Picture 11: Test setup in burning chamber

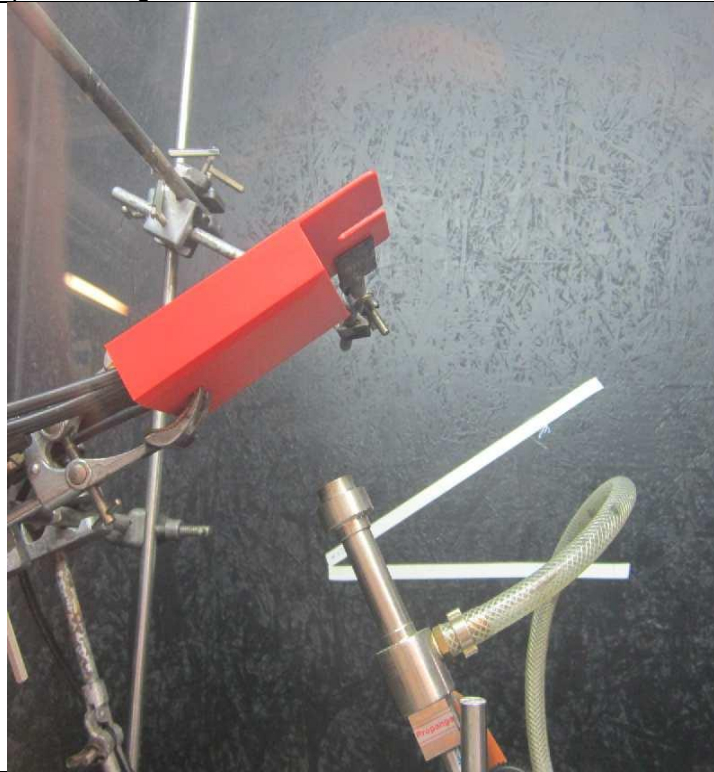
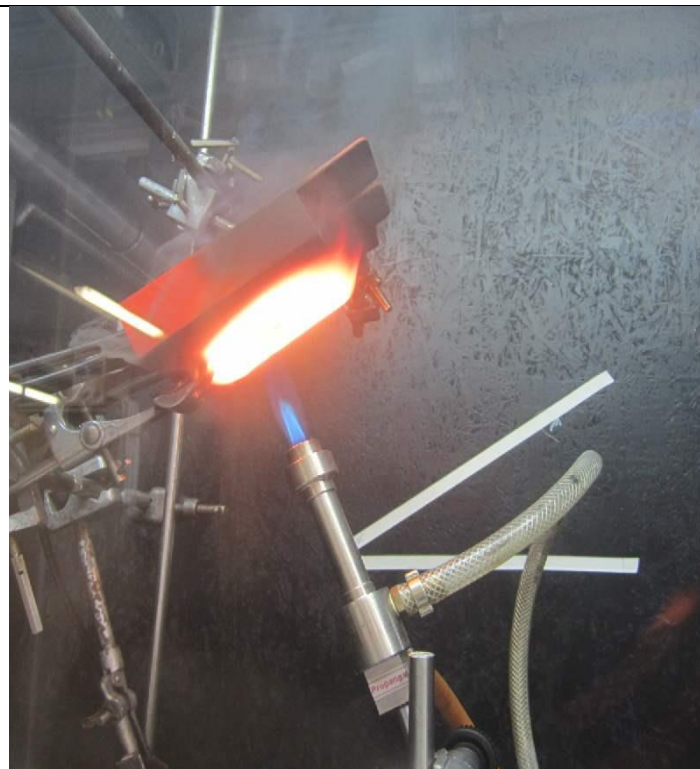


Bild / Picture 12: Fist flame influence



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**FOTO-DOKUMENTATION**  
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Bild / Picture 13:

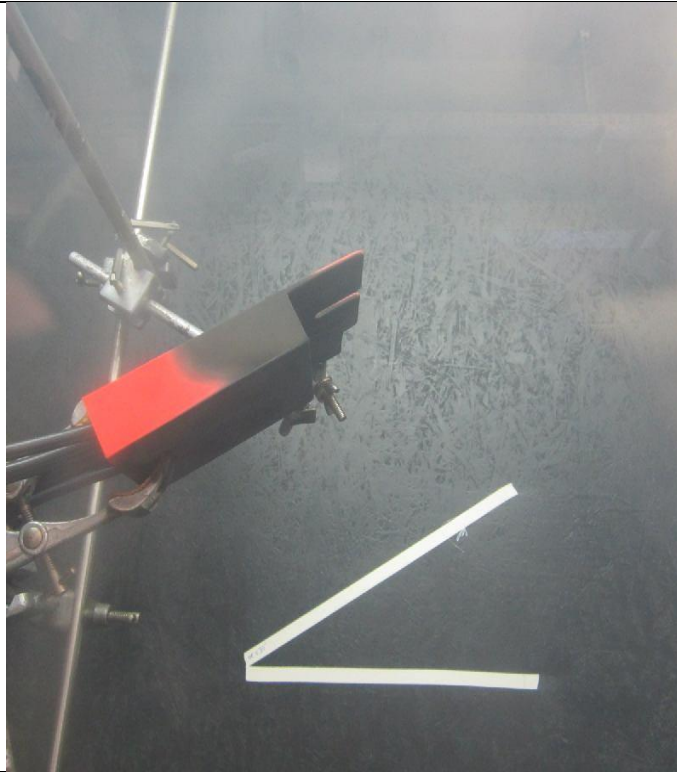
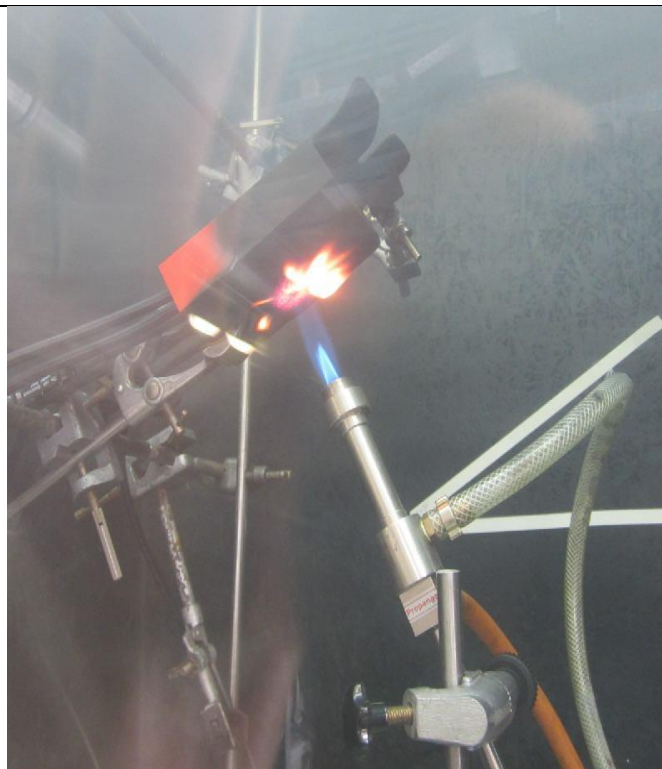


Bild / Picture 14:



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**FOTO-DOKUMENTATION**  
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Bild / Picture 15:

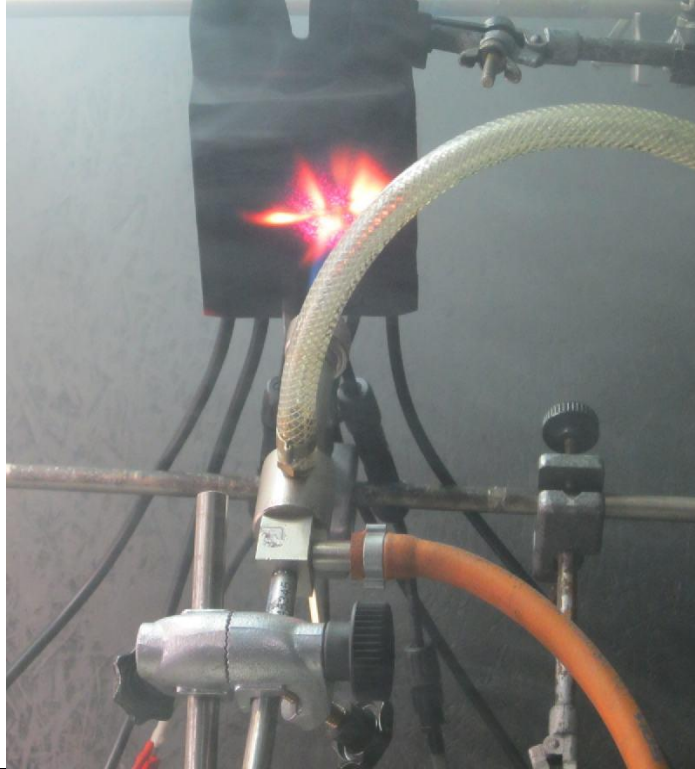
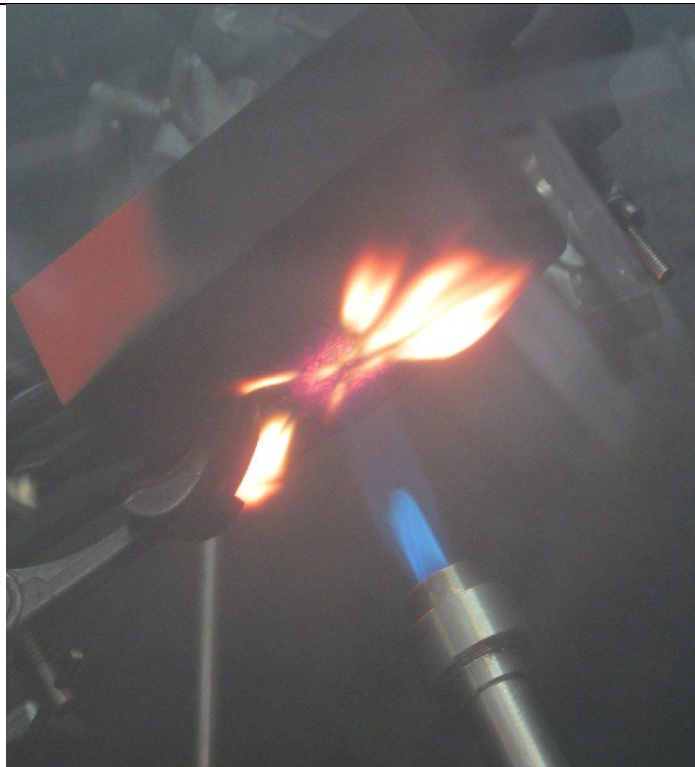


Bild / Picture 16:





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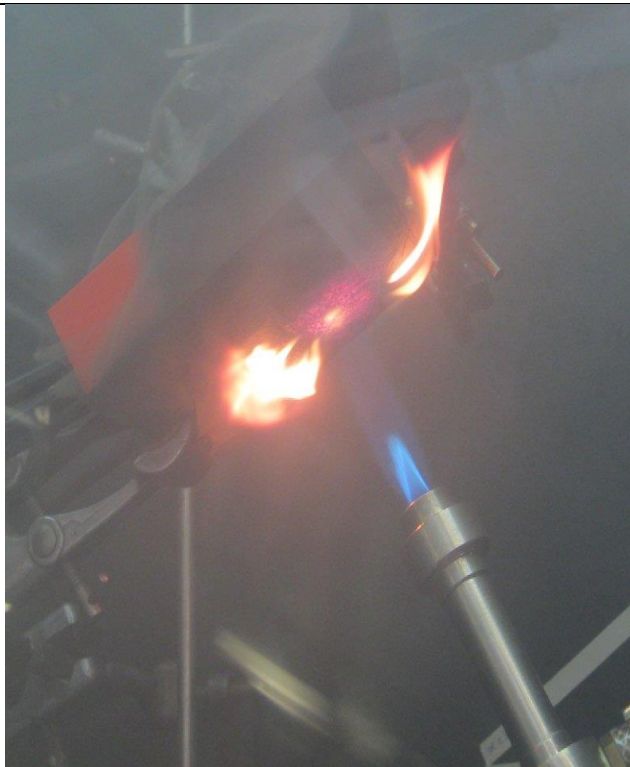
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**FOTO-DOKUMENTATION**  
**PHOTO-DOCUMENTATION**

Bild / Picture 17:



Bild / Picture 18:



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**FOTO-DOKUMENTATION**  
**PHOTO-DOCUMENTATION**

Bild / Picture 19:

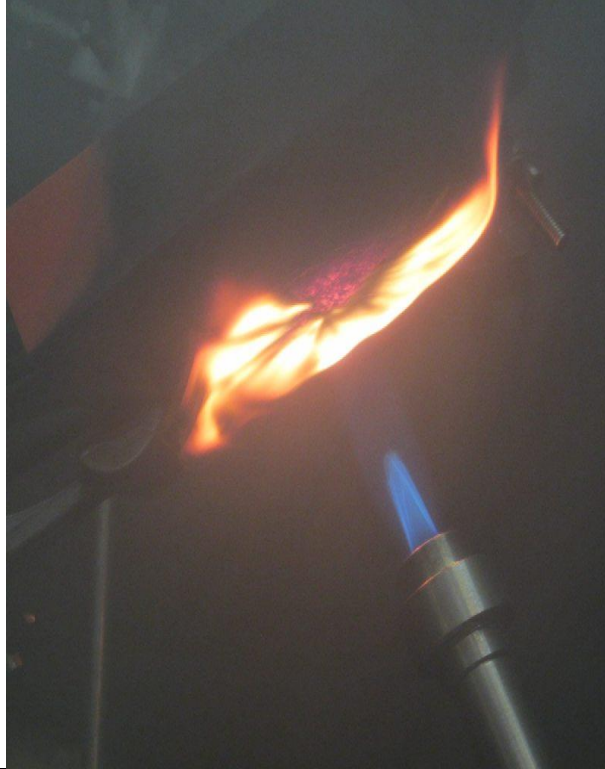


Bild / Picture 20:



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**FOTO-DOKUMENTATION**  
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Bild / Picture 21:

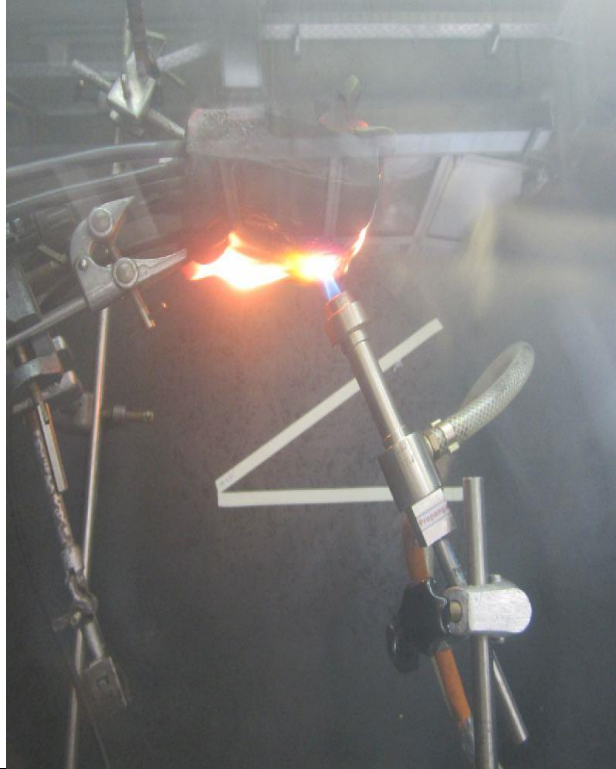
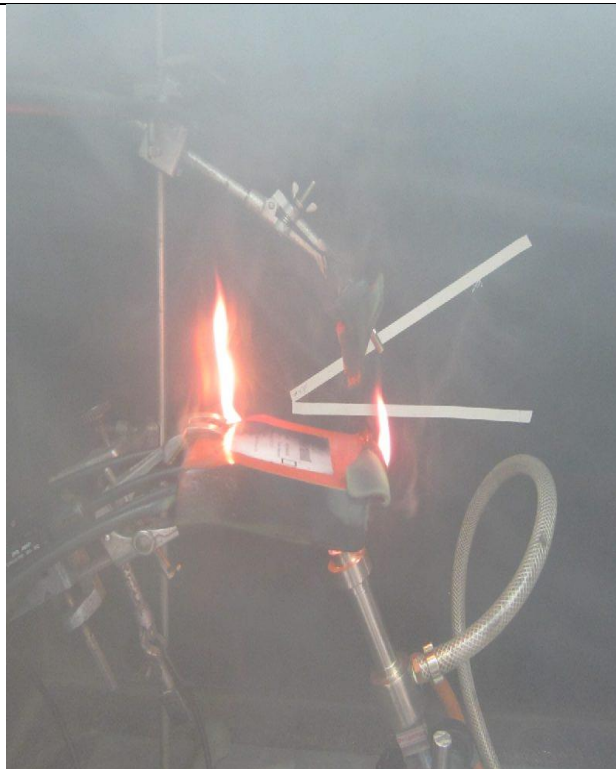


Bild / Picture 22:



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**FOTO-DOKUMENTATION**  
**PHOTO-DOCUMENTATION**

Bild / Picture 23:

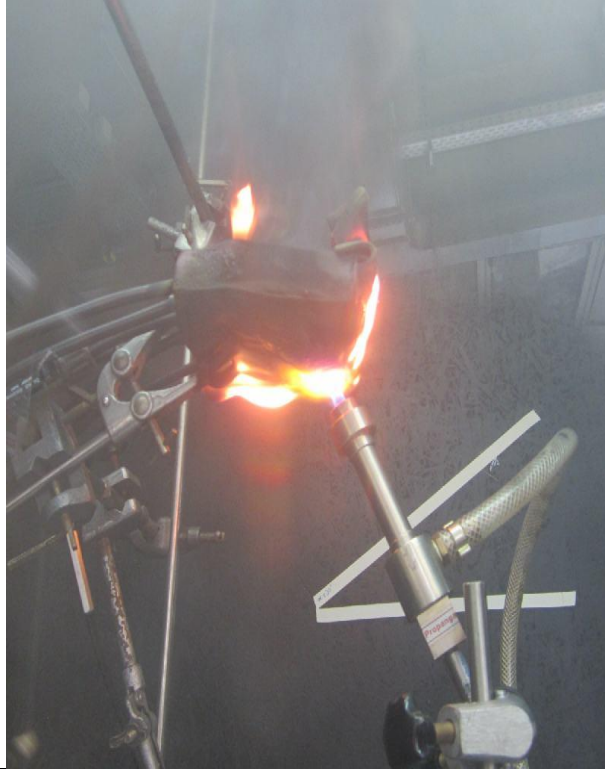
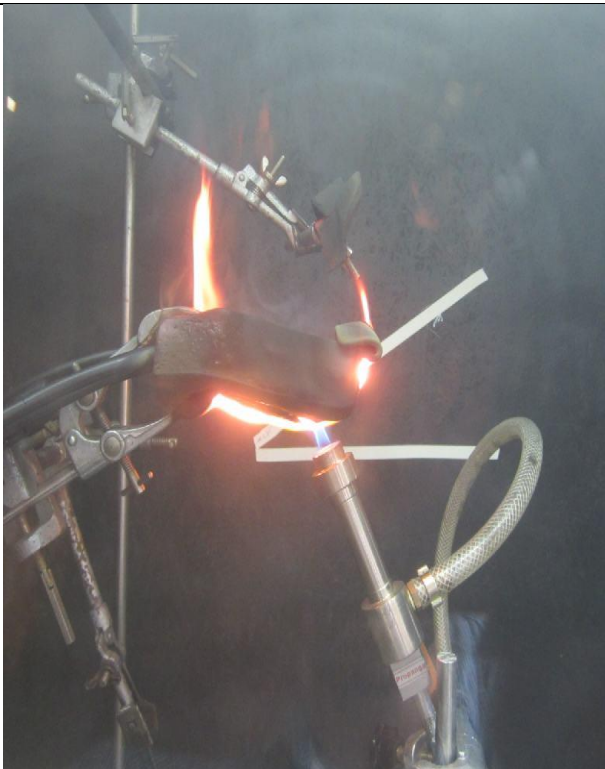


Bild / Picture 24:





**FOTO-DOKUMENTATION**  
**PHOTO-DOCUMENTATION**

Bild / Picture 25: FRS-01 shortly before the end of the test

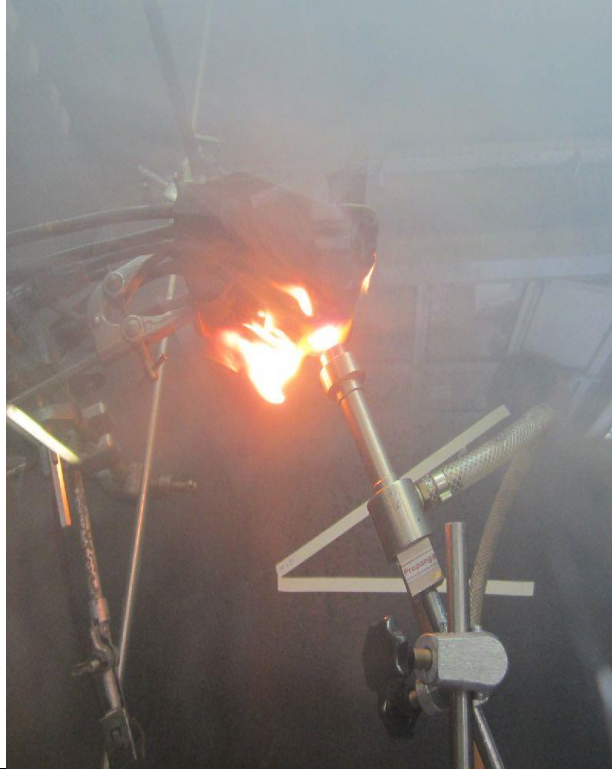


Bild / Picture 26: FRS-01 at the end of the test



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**FOTO-DOKUMENTATION**  
**PHOTO-DOCUMENTATION**

Bild / Picture 27: FRS-01 at the end of the test



Bild / Picture 28: FRS-01 at the end of the test





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**FOTO-DOKUMENTATION**  
**PHOTO-DOCUMENTATION**

Bild / Picture 29: FRS-01 at the end of the test



Bild / Picture 30: FRS-01 at the end of the test



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**FOTO-DOKUMENTATION**  
**PHOTO-DOCUMENTATION**

Bild / Picture 31: FRS-01 at the end of the test

