Prüfbericht-Nr.: *Test report no.:*	**DE25AL07 002**	**Auftrags-Nr.:** *Order no.:*	30010 3092	Seite 1 von 19 *Page 1 of 19*
Kunden-Referenz-Nr.: *Client reference no.:*	2042170	**Auftragsdatum:** *Order date:*	2025-09-22	
Auftraggeber: *Client:*	LONGi Solar Technologies GmbH (for add. information see page 3			
Prüfgegenstand: *Test item:*	Photovoltaik Module			
Bezeichnung / Typ-Nr.: *Identification / Type no.:*	LR7-54HJBB-490M (representative for various additional module types)			
Auftrags-Inhalt: *Order content:*	Hail impact test with the aim of recommendation/classification for VFK "Hagelregister"			
Prüfgrundlage: *Test specification:*	according to / following VKF - Prüfbestimmung *** "Nr. 25 "Photovoltaik Module" - Version 1.03 (01/11/2016) *following IEC 61215-2 "Terrestrialphotovoltaik modules - Design qualification and type approval - Part 2: Test procedures*			
Wareneingangsdatum: *Date of sample receipt:*	2025-09-02			
Prüfmuster-Nr.: *Test sample no:*	see "List of test samples"			
Prüfzeitraum: *Testing period:*	2025-09-24 – 2025-10-09			
Ort der Prüfung: *Place of testing:*	Am Grauen Stein, 51105 Köln, Cologne			
Prüflaboratorium: *Testing laboratory:*	TÜV Rheinland Solar GmbH			
Prüfergebnis*: *Test result*:*	Siehe Sonstiges / See Other			
geprüft von: *tested by:*	05.11.2025 X Signiert von: Juergen Sommer	**genehmigt von:** *authorized by:*	06.11.2025 X Signiert von: Ulrich Fritzsch	
Datum: *Date:*		**Ausstellungsdatum:** *Issue date:*		
Stellung / Position:	Sachverständige(r)/Expert	**Stellung** / Position:	Sachverständige(r)/Expert	
Sonstiges / *Other:*	Recommendation only; *** VKF (Vereinigung Kantonaler Feuerversicherungen) /// Additional test specifications: - Prüfbestimmung Nr 00a – Allgemeiner Teil A - Version 1.03 (01/03/2018) - Prüfbestimmung Nr 00b – Allgemeiner Teil B - Version 1.01 (01/12/2018) - Beschlusssammlung HSR – formal - Version 31 (11/12/2024) - Beschlusssammlung HSR - technisch - Version 19 (13/09/2018)			
Zustand des Prüfgegenstandes bei Anlieferung: *Condition of the test item at delivery:*	Prüfmuster vollständig und unbeschädigt *Test item complete and undamaged*			

* Legende:	P(ass) = entspricht o.g. Prüfgrundlage(n)	F(ail) = entspricht nicht o.g. Prüfgrundlage(n)	N/A = nicht anwendbar	N/T = nicht getestet
** Legend:*	*P(ass) = passed a.m. test specification(s)*	*F(ail) = failed a.m. test specification(s)*	*N/A = not applicable*	*N/T = not tested*

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.
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.

V05

Anmerkungen
Remarks

A

Alle eingesetzten Prüfmittel waren zum angegebenen Prüfzeitraum gemäß eines festgelegten Kalibierungsprogramms unseres Prüfhauses kalibriert. Sie entsprechen den in den Prüfprogrammen hinterlegten Anforderungen. Die Rückverfolgbarkeit der eingesetzten Prüfmittel ist durch die Einhaltung der Regelungen unseres Managementsystems gegeben.
Detaillierte Informationen bezüglich Prüfkonditionen, Prüfequipment und Messunsicherheiten sind im Prüflabor vorhanden und können auf Wunsch bereitgestellt werden.

The equipment used durinag the specified testing period was calibrated according to our test laboratory calibration program. The equipment fulfils the requirements included in the relevant standards. The traceability of the test equipment used is ensured by compliance with the regulations of our management system.
Detailed information regarding test conditions, equipment and measurement uncertainty is available in the test laboratory and could be provided on request.

B

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C

Prüfklausel mit der Note * wurden an qualifizierte Unterauftragnehmer vergeben und sind unter der jeweiligen Prüfklausel des Berichts beschrieben.
Abweichungen von Prüfspezifikation(en) oder Kundenanforderungen sind in der jeweiligen Prüfklausel im Bericht aufgeführt.

*Test clauses with remark of * are subcontracted to qualified subcontractors and descripted under the respective test clause in the report.*
Deviations of testing specification(s) or customer requirements are listed in specific test clause in the report.

D

Die Entscheidungsregel für Konformitätserklärungen in diesem Prüfbericht basiert auf der "Null-Grenzwert-Regel" und der "Einfachen Akzeptanz" gemäß ILAC GC8:2019 und IEC Guide 115:2023, es sei denn, in der auf Seite 1 dieses Berichts genannten angewandten Norm ist etwas anderes festgelegt oder vom Kunden gewünscht. Dies bedeutet, dass die Messunsicherheit nicht berücksichtigt wird und daher auch nicht im Prüfbericht angegeben wird.

The decision rule for statements of conformity in this test report is based on the “Zero Guard Band Rule” and “Simple Acceptance” in accordance to ILAC GC8:2019 and IEC Guide 115:2023, unless otherwise specified in the applied standard mentioned on Page 1 of this report or requested by the customer. This means that measurement uncertainty is not taken in account and hence also not declared in the test report.

E

Wenn auf dem Bericht kein Akkreditierungshinweis aufgebracht ist, wurde der Bericht nicht im akkreditierten Bereich erstellt und ist folglich auch nicht vom EA MLA abgedeckt. Unabhängig davon wurde der Bericht auf Basis der allgemeinen Regeln der ISO/IEC 17000er Reihe erstellt. Mit "#" gekennzeichnete Prüfungen sind nicht Bestandteil der Akkreditierung D-PL-22040-01-00.

If there is no accreditation notice on the report, the report has not been produced in the accredited area and is consequently not covered by the EA MLA. Regardless of this, the report has been prepared based on the general rules of the ISO/IEC 17000 series. Tests marked with "#" are not covered by the accreditation D-PL-22040-01-00.

F

Revision History

Revision	*Date*	*Nature of changes*	*Page*
001	2025-10-27	Original issue	
002	2025-11-05	Correction of cell dimension / Typing error	3

Produktbeschreibung
Product description

1	**Auftraggeber** *Client*	LONGi Solar Technologies GmbH Bockenheimer Landstrasse 51-53 60325 Frankfurt am Main Germany
2	**Produktdetails** *Product details*	**Allgemeine Informationen ;** General Information based on datasheet

Brand name	LONGi
Type name	LR7-54HJBB-490M
Product category	PV-module
Year of production	2025
Power class [W]	490
Cell technology	Mono
Cell dimension (l / w) [mm]	182.2 / 96 (half-cut)
No. of cells	108
Max. system voltage [V]	1500
Thickness of glazing [mm]	2.0 (front) / 1.6 (back)
Glazing (front)	Heat strengthened, low-reflection white glass
Glazing (back)	Heat strengthened, low-reflection white glass
Frame material	Aluminium
Frame thickness [mm]	30
Dimensionen ; Dimension	
Dimension (l / w / h) [mm]	1800 / 1134 / 30
Gross area [m²]	2.041

3	**Technische Dokumentation** *Technical documentation*	for detailed constructional data see *Technical Datasheet* *"LR7-54HJBB 490~505M" 20250905 BGV02* *issued by LONGi*
4	**Hersteller** *Manufacturer*	LONGi Solar Technologies GmbH
5	**Sonstiges** *Other*	- The tested module type might be also available in different powerclasses. - Further the result is aplicable to additional types; for more details see "*General remarks*" - Mounting: Asymetric (mounting holes / 200 and 325 mm from corner)
6	**Prüfmusterbereit-stellung**: *Test sample obtaining*	☒ Sending by customer ☐ Sampling by TÜV Rheinland Group ☐ others: randomly chosen from existing test batch

Produktbeschreibung
Product description

Sample - Front (example)	Sample - Back (example)
Example of junction box	Example of cells

Absatz *Clause*	**Anforderungen - Prüfungen /** *Requirements - Tests*	**Messergebnisse – Bemerkungen/** *Measuring results - Remarks*	**Ergebnis** *Result*

-	**Result summary table**

Test	Date [DD Month YYYY]		Summary of main test results	—
	Initial (1st)	Final (2nd)		
Insulation test	25 September 2025	02 October 2025	-	P
Wet leakage current test	25 September 2025	02 October 2025	-	P
Performance at STC	01 October 2025	07 October 2025	-	P
Electroluminescence images	01 October 2025	07 October 2025	-	P
Impact resistance	02 October 2025		HW3 with 30 mm ice balls passed	P
Final inspection	09 October 2025		see *Final evaluation*	P

Supplementary information:

- All results are related to the tested sample/s
- According to test procedure the tested PV module is **recommended** to be **classified in HW3**
- No pre-exposure necessary; no relevant plastic parts

	Final evaluation (recommendation of testing laboratory)

In four-eyes principle; by	J. Sommer	U. Fritzsche	—
The acceptance of recommendation and final classification is part of FER (Fachkommision Elementarschutzregister)			
Properties of component	Evaluation of hail withstand		
Water tightness	- - -		
Visual nature / look	HW3		
Mechanics	HW3		
Transmittance	- - -		
Opacity	- - -		

Supplementary information: -

Absatz *Clause*	**Anforderungen - Prüfungen /** *Requirements - Tests*	**Messergebnisse – Bemerkungen/** *Measuring results - Remarks*	**Ergebnis** *Result*

-	**Visual inspection (Initial)**		
Test date [YYYY-MM-DD]		2025-09-25	—
Sample No.	Nature and position of initial findings		
HV2025002370	No relevant visual defects		P
HV2025002371	No relevant visual defects		P
Supplementary information: -			
Type plate (example)			

-	**List of test samples**		
Sample No.	Sample S/N	Remarks / constructional characteristics	—
HV2025002370	LRR010097250500901329	Main test sample	
HV2025002371	LRR010097250500901851	Pre-measured Spare	

Absatz *Clause*	**Anforderungen - Prüfungen /** *Requirements - Tests*	**Messergebnisse – Bemerkungen/** *Measuring results - Remarks*	**Ergebnis** *Result*

-	**Maximum power determination (STC)**								
General; for all following measurements									—
Module temperature [°C]				corrected to 25					
Irradiance [W/m²]				1000					
Initial / Final*									
Test date [YYYY-MM-DD]				2025-10-01 and *2025-10-07					
Sample No.	P_{max} [W]	V_{mpp} [V]	I_{mpp} [A]	V_{oc} [V]	I_{sc} [A]	FF [%]	Degradation** [%]		
HV2025002370	484.2	35.49	13.64	40.62	14.39	82.8	initial		P
	480.7	35.25	13.64	40.38	14.41	82.6	-0.72		
Supplementary information: ** if negative only									

-	**Insulation test (ISO)**					
General; for all following measurements						—
Maximum system voltage [V_{DC}]				1500		
High voltage applied [V_{DC}]			1st	3000		
			2nd	8000		
Insulation resistance measured at [V_{DC}]				1000		
Initial / Final*						
Test date [YYYY-MM-DD]				2025-09-25 and *2025-10-02		
Sample No.	Measured	Area	Result*	Dielectric breakdown		
	[GΩ]	[m²]	[GΩ × m²]	Yes (description)	No	
HV2025002370	1.0	2.04	2.0	-	x	P
	1.0	2.04	2.0	-	x	P
Supplementary information: -						

Absatz *Clause*	**Anforderungen - Prüfungen /** *Requirements - Tests*	**Messergebnisse – Bemerkungen/** *Measuring results - Remarks*	**Ergebnis** *Result*

-	**Wet leakage current test (WL)**			
General; for all following measurements				—
Insulation resistance measured at [V_{DC}]		1000		
Solution resistivity [Ω cm]		< 3.500		
Solution temperature [°C]		22 ± 3		
Initial / Final*				
Test date [YYYY-MM-DD]		2025-09-25 and *2025-10-02		
Sample No.	Measured	Area	Result	
	[MΩ]	[m²]	[MΩ × m²]	
HV2025002370	575	2.04	1173	P
	1000	2.04	2040	P
Supplementary information: -				

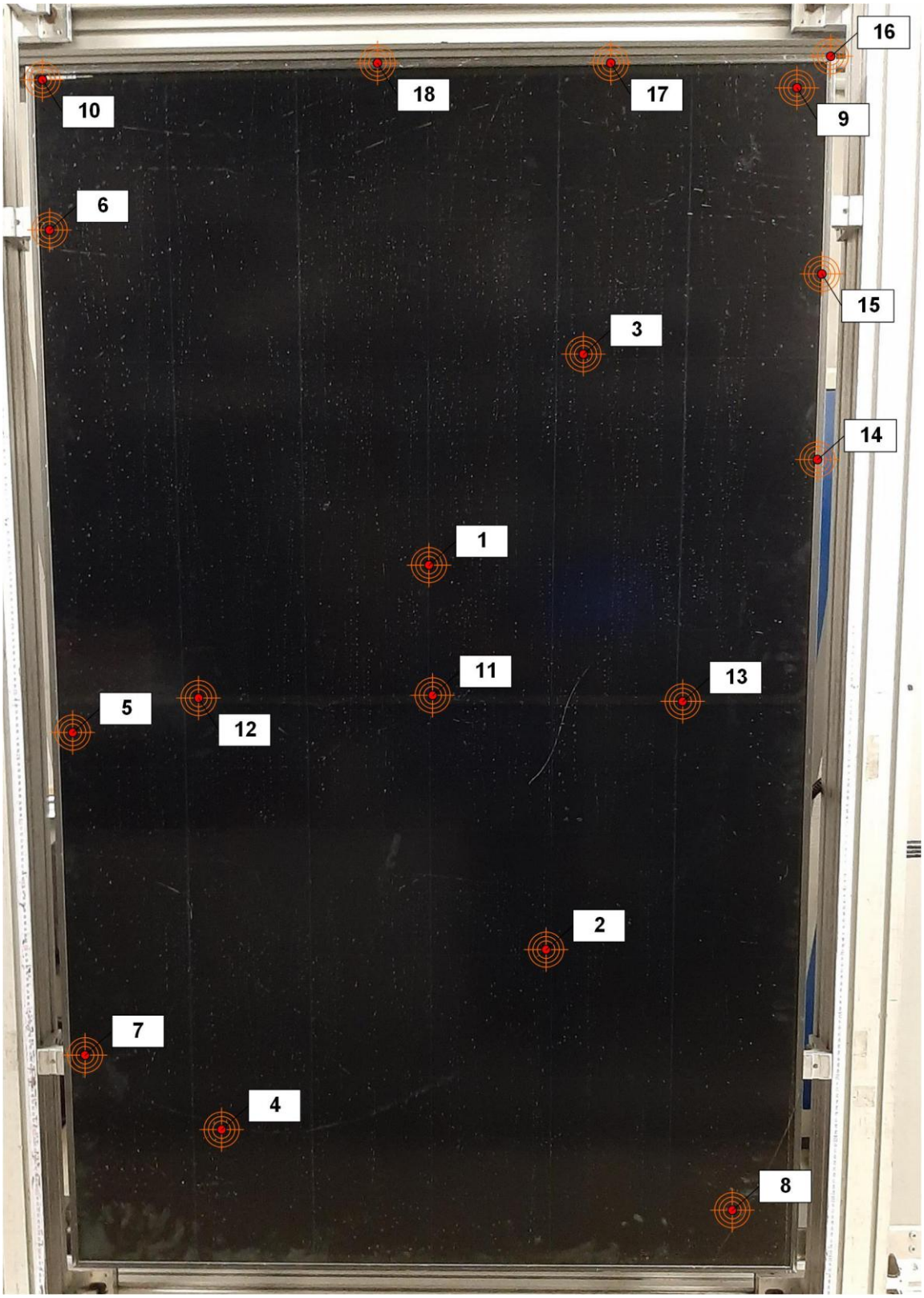
-	**Electroluminescence images (EL)** Analysis of electroluminescence images (see also *Annex : Additional information*)		
Initial / Final*			—
Test date [YYYY-MM-DD]		2025-10-01 and *2025-10-07	
Sample No.	Reverse current applied [A]	Attributes	
HV2025002370	15 (@ 300 ms)	No relevant conspicuousness/findings	
	15 (@ 300 ms)	No additional relevant conspicuousness/findings	
Supplementary information: -			

Absatz *Clause*	**Anforderungen - Prüfungen /** *Requirements - Tests*	**Messergebnisse – Bemerkungen/** *Measuring results - Remarks*	**Ergebnis** *Result*
-	**Impact resistance test (general)**		
Test date [YYYY-MM-DD] Day code	2025-10-02[a]		
Sample-No. ID code	HV2025002370[2370]		
Method used for impact resistance	Nr. 25 "Photovoltaik Module		
Surface conditioning	none		
Sample tilt angle [° from horizontal]	90		
Direction of shoot [°]	0 (horizontal)		
Impact angle [° from sample surface]	90		
Distance (sample to center of v_0-meas.) [mm]	500 to 700		—
Ice ball production [week of the year]	32 (hermetically sealed)		
Storage temperature of ice ball [°C]	-20		
Ambient conditions (mean) [°C and % RH]	[a]23.3 and 47.1		
Diameter of ice ball [mm]	30		
Weight of ice ball (mean) [g]	12.7		
Velocity of ice ball (mean) [m/s]	23.9		
Impact energy (at least) [J]	3.5		

Example of Test Set-up	Measurement of glass-package thickness

Supplementary information:

Absatz *Clause*	**Anforderungen - Prüfungen /** *Requirements - Tests*	**Messergebnisse – Bemerkungen/** *Measuring results - Remarks*	**Ergebnis** *Result*
	Overview of impact positions		



—

Supplementary information: -

Absatz *Clause*	**Anforderungen - Prüfungen /** *Requirements - Tests*	**Messergebnisse – Bemerkungen/** *Measuring results - Remarks*	**Ergebnis** *Result*

-	**Impact resistance test – Result table**								
Sample ID	Impact information					Mass of ball [g]	Velocity of ball [m/s]	Impact energy [J]	—
	Day	No.	Location & description (cells from left bottom [x/y])		IEC***				
	Initial - After initial control measurements (Ice ball diameter = 30 mm)								
2370	a	1	3/11 - 4/12	Over edges of circuit	3	12.34	23.83	*3.50*	P
		2	4/5 - 5/6	Over edges of circuit	4	12.48	23.91	*3.57*	P
		3	5/14 - 5/15	Near interconnects	5	12.53	24.10	*3.64*	P
		4	2/2 - 2/3	Near interconnects	6	12.49	24.02	*3.60*	P
		5	1/9	Edge of module window	2	12.64	24.38	*3.76*	P
		6	1/16	Near mounting position	7	12.60	24.22	*3.70*	P
		7	1/4	Near mounting position	8	12.57	24.19	*3.68*	P
		8	6/1	Far away from other impacts	9	12.69	24.48	*3.80*	P
		9	6/18	Far away from other impacts	10	12.53	24.20	*3.67*	P
		10	1/18	Corner of module window	1	12.71	24.59	*3.84*	P
		11	3/9 - 4/10	Over the junction box	11	12.70	24.52	*3.82*	P
		12	1/9 - 2/10	Over the junction box	11	12.75	24.63	*3.87*	P
		13	5/9 - 6/10	Over the junction box	11	12.67	24.55	*3.82*	P
		14	600 mm from corner	Vertical frame	-	12.52	24.36	*3.71*	P
		15	300 mm from corner	Vertical frame	-	12.49	23.86	*3.56*	P
		16	corner	Tip of frame	-	12.68	24.65	*3.85*	P
		17	300 mm from corner	Horizontal frame	-	12.53	23.91	*3.58*	P
		18	600 mm from corner	Horizontal frame	-	12.67	24.48	*3.80*	P
	Change to final measurement and inspection / additional verification of physical result								—

Supplementary information: *value to low (not valid); **value to high (not valid); ***location acc. to IEC-standard

Absatz *Clause*	**Anforderungen - Prüfungen /** *Requirements - Tests*	**Messergebnisse – Bemerkungen/** *Measuring results - Remarks*	**Ergebnis** *Result*
-	**Final inspection (general)**		
Test date [YYYY-MM-DD]		2025-10-09	—
Sample-No.	Potential problem	Evaluation*/**	
		HW3	
HV2025002370	Technical problems	HW 3 **passed**; with 30 mm NO cracks visible under use of electroluminescence NO power degradation detectable*	P
	Visual problems (distance; > 5 m)	HW 3 **passed**; with 30 mm NO cracks visible ; NO dents visible	P
	Visual problems (near; < 0.5 m)	HW 3 passed; with 30 mm NO cracks visible ; NO dents visible	-
NOTE	Individual additional remarks: All results are related to the tested samples. * referred to measuring uncertainty **see also *Final evaluation* and *Annex : Additional information*		—
Supplementary information: -			

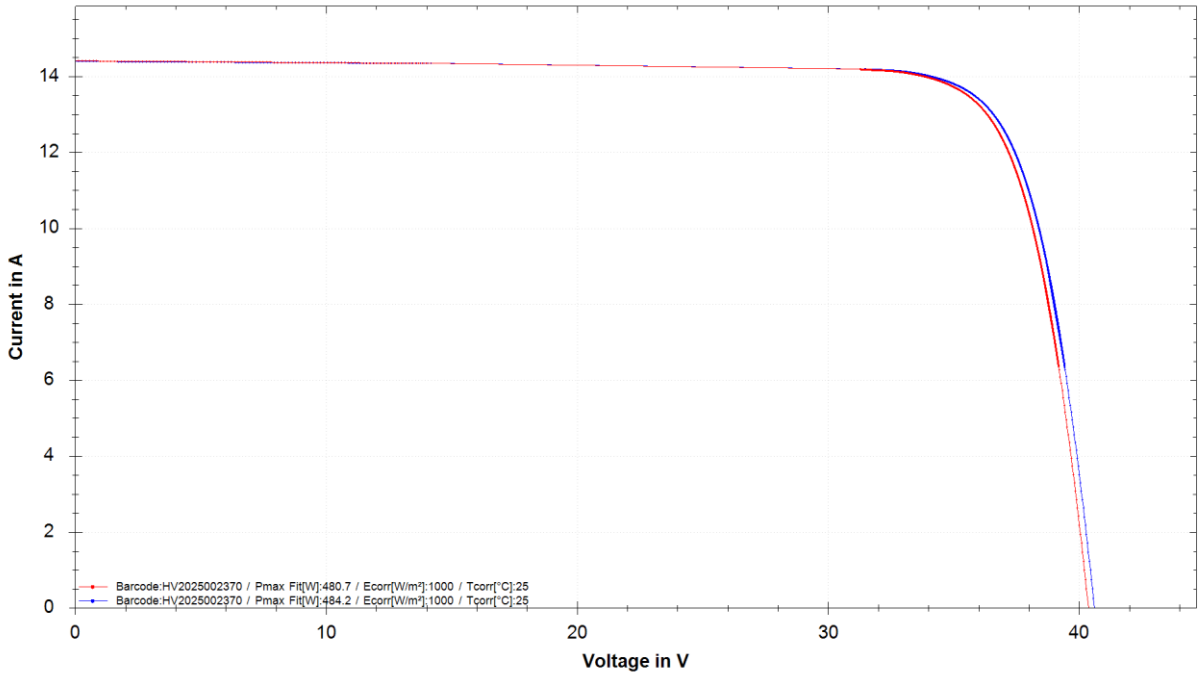
Absatz *Clause*	**Anforderungen - Prüfungen /** *Requirements - Tests*	**Messergebnisse – Bemerkungen/** *Measuring results - Remarks*	**Ergebnis** *Result*
-	**General remarks and subblementary information**		
	Measuring uncertainties		—
	All results only refer to the test samples that were subjected to testing. The extended total measuring uncertainty for velocity, weight and performance is: u (k=2) ≤ ± 2.5 %		

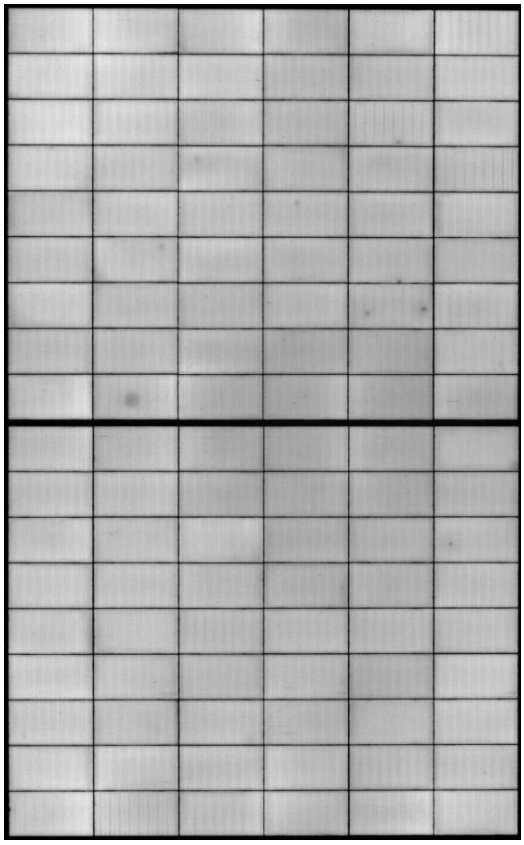
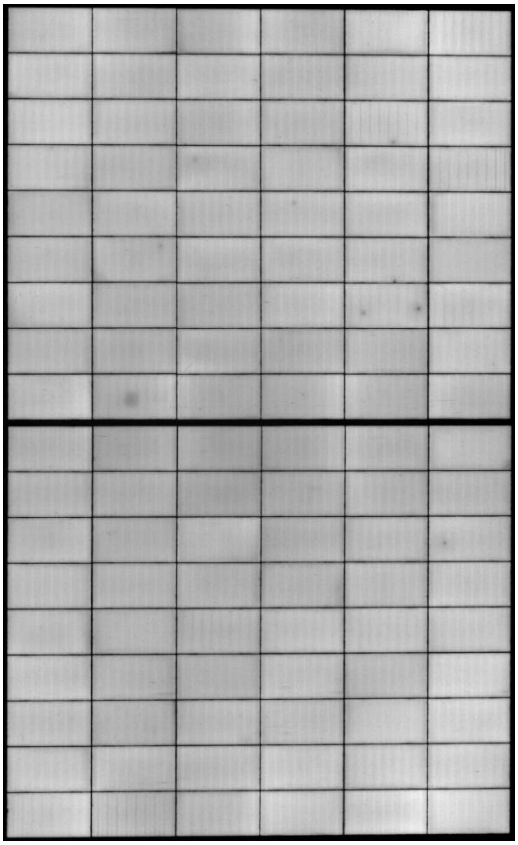
Related test reports / certificates / documents		
The construction of the tested samples is documented in the relevant report valid in conjunction with the IEC certificate.		—
Document no.	Certificate no.	
Test report CN23DWS9 025, *incl. Annexes* *issued by TÜV Rheinland*	*PV 50602768 0014* *issued by TÜV Rheinland*	
Technical data sheets *"LR7-54HJBB 490~505M" issued by LONGi*		

Others - The result of the tested sample is also equivalent to:	
Main Types	
• **LR7-54HJBB-xxxM** **tested type** ○ power classes 490 - 505 W (108 cells) ○ glass package (2.0 + 1.6 mm) ○ cells (mono / half-cut) ○ frame color (black) ○ backside glazing (black meshed) ○ encapsulation color (transparent) ○ frame thickness (30 mm) ○ maximum system voltage (1500 V_{DC}) ○ dimension (1800 x 1134 mm)	
The recommendation ***"HW3"*** **is aplicable to the various power ranges** of above listed main types and endings.	

Absatz *Clause*	**Anforderungen - Prüfungen /** *Requirements - Tests*	**Messergebnisse – Bemerkungen/** *Measuring results - Remarks*	**Ergebnis** *Result*
-	**Annex: Additional information**		

IV-curve and Electroluminescence image - *for 30 mm Hail Impact (initial / final)*

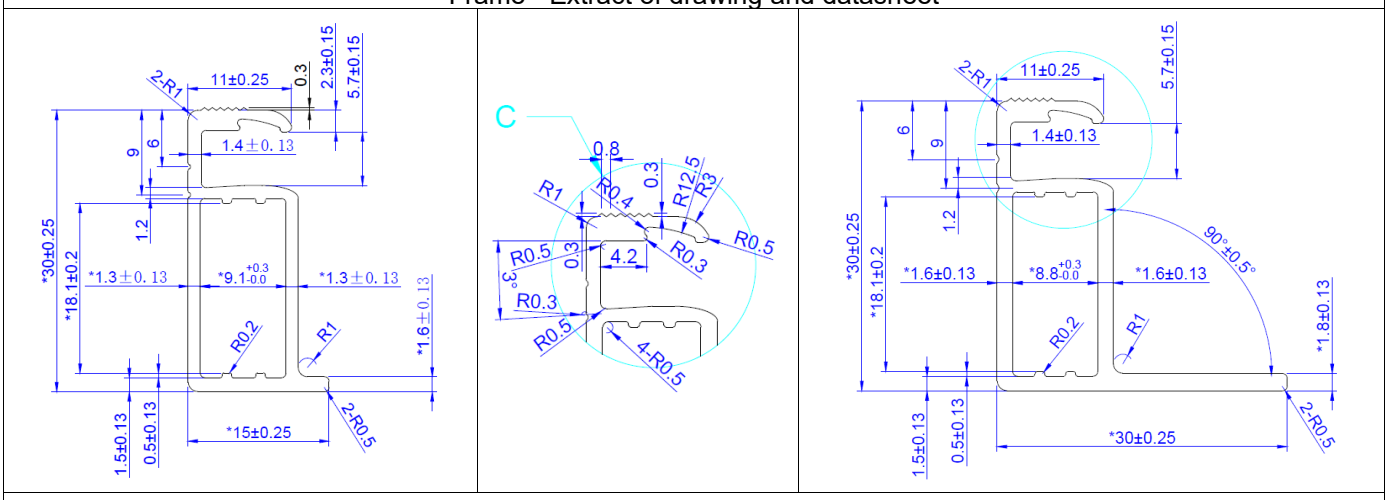


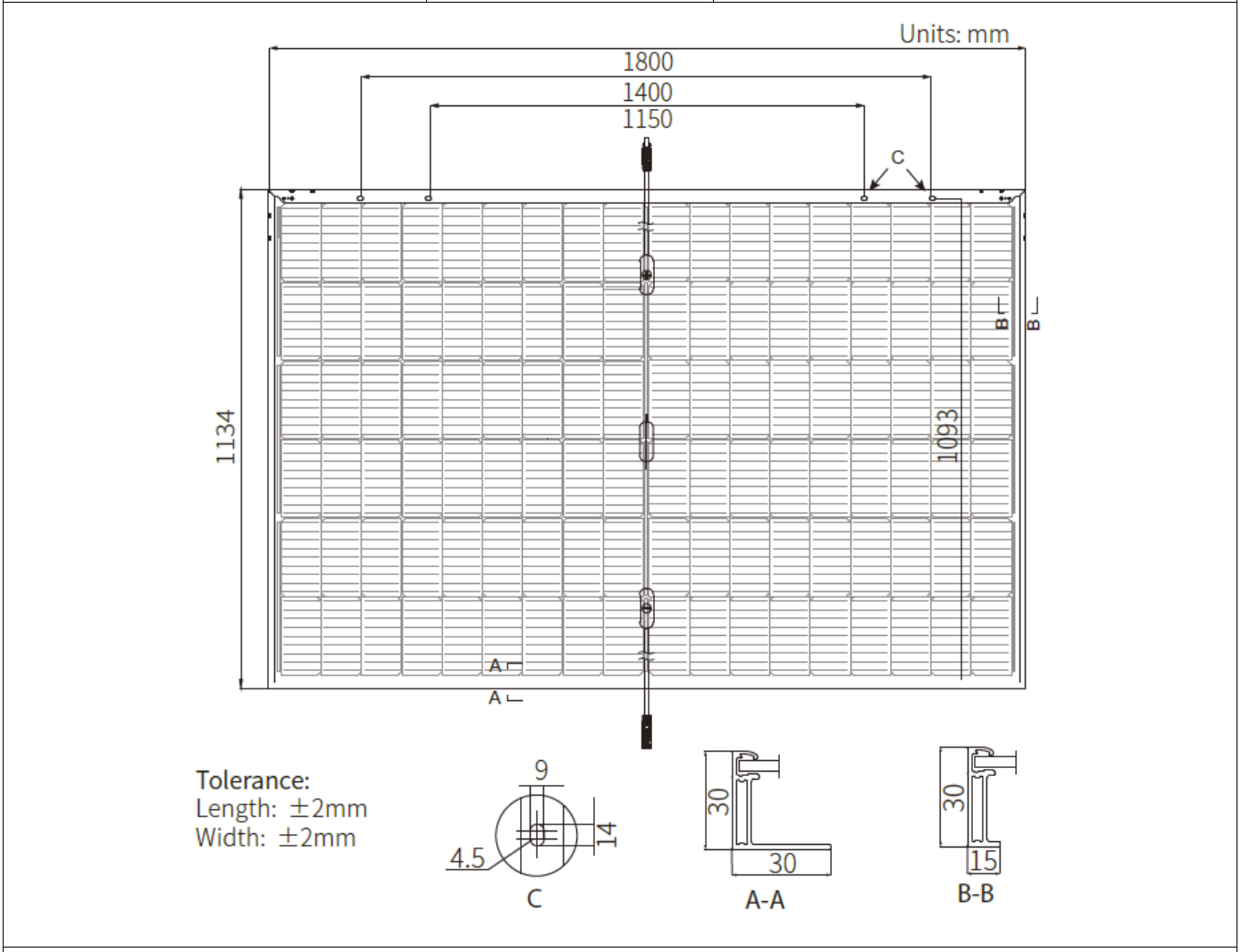
initial	*final*
	

Supplementary information: -

Absatz *Clause*	**Anforderungen - Prüfungen /** *Requirements - Tests*	**Messergebnisse – Bemerkungen/** *Measuring results - Remarks*	**Ergebnis** *Result*
-	**Annex: Additional information**		

Frame - Extract of drawing and datasheet

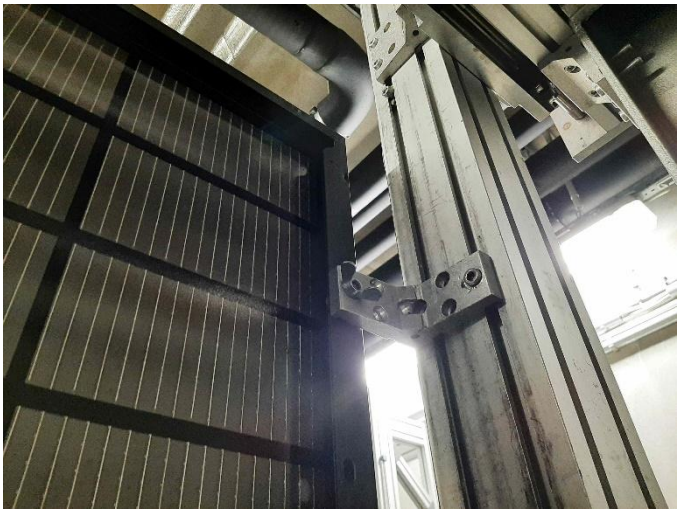


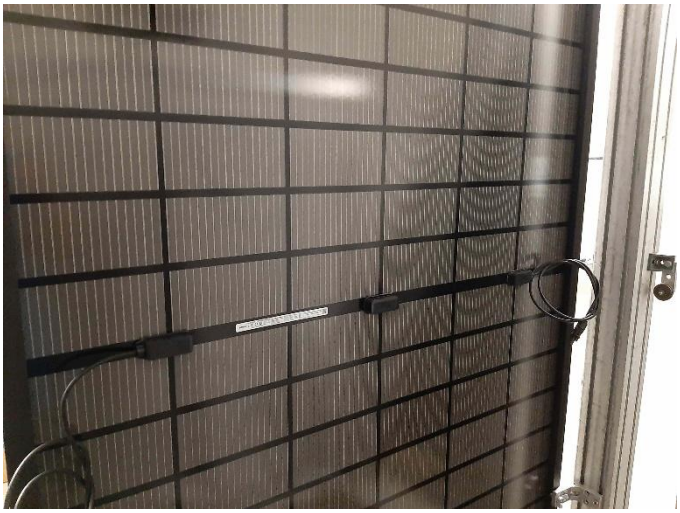


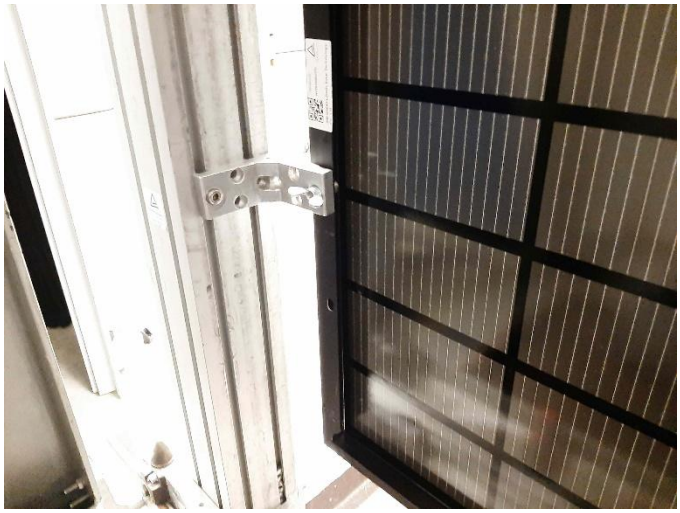
Supplementary information: -

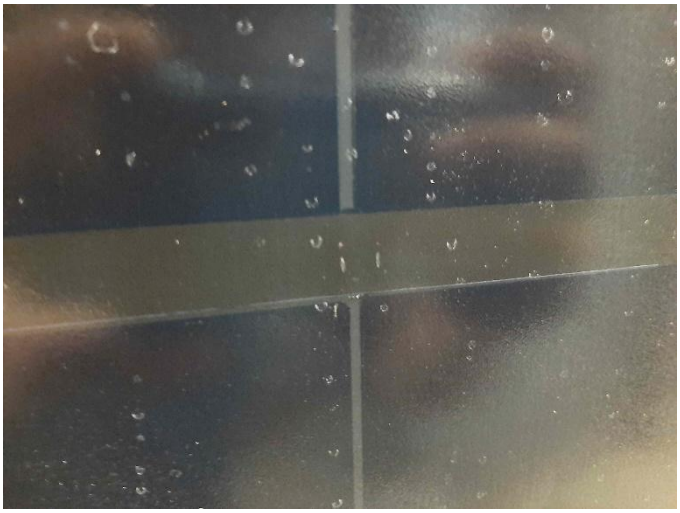
Absatz *Clause*	Anforderungen - Prüfungen / *Requirements - Tests*	Messergebnisse – Bemerkungen/ *Measuring results - Remarks*	Ergebnis *Result*
-	**Annex: Additional photo documentation**		

Test Set-up (example)



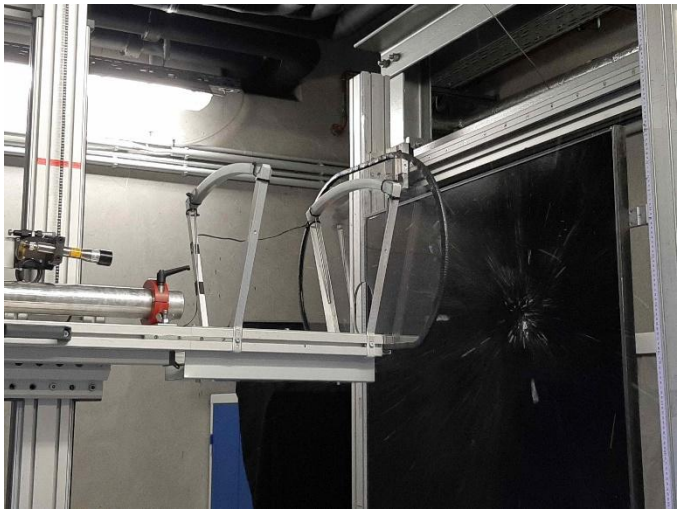
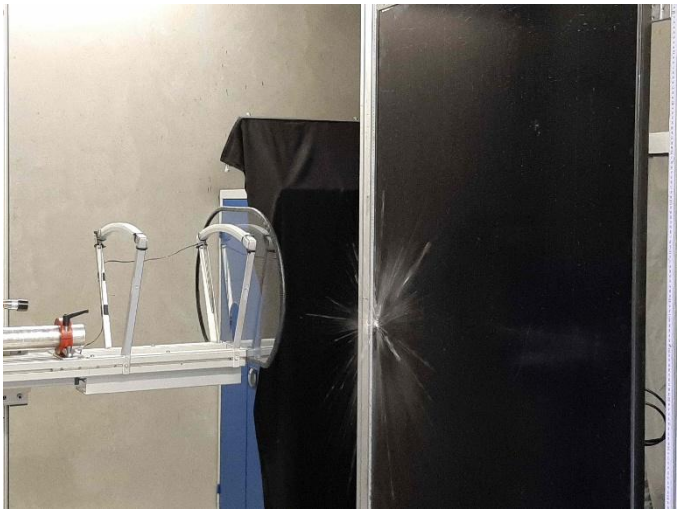






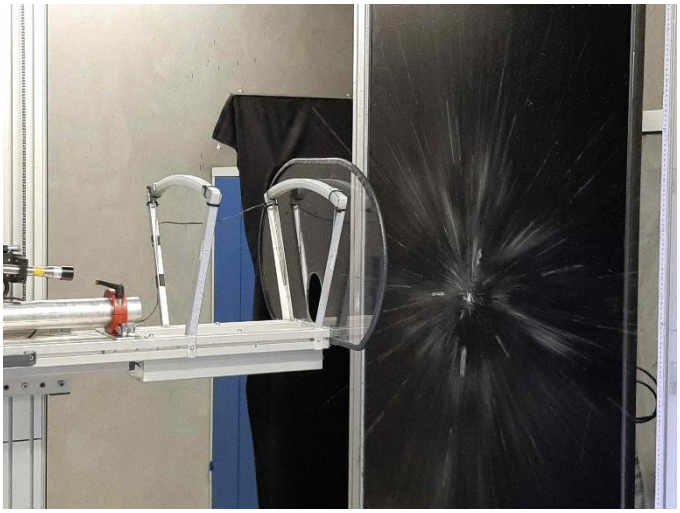
Absatz *Clause*	Anforderungen - Prüfungen / *Requirements - Tests*	Messergebnisse – Bemerkungen/ *Measuring results - Remarks*	Ergebnis *Result*
-	**Annex: Additional photo documentation**		

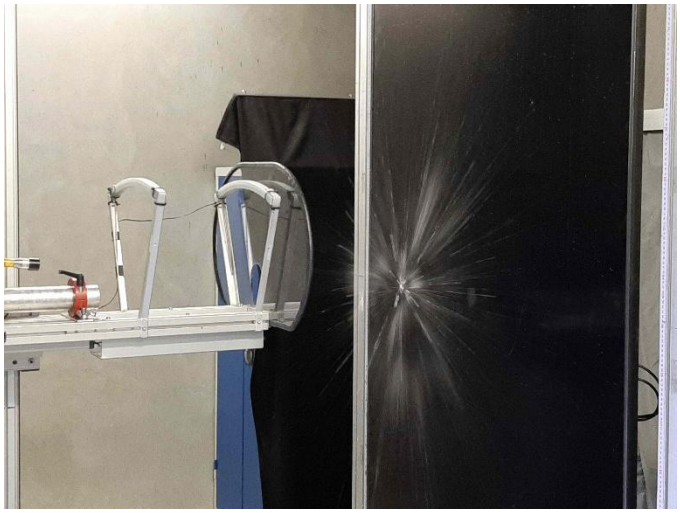
Example of Impacts on Module (30 mm)

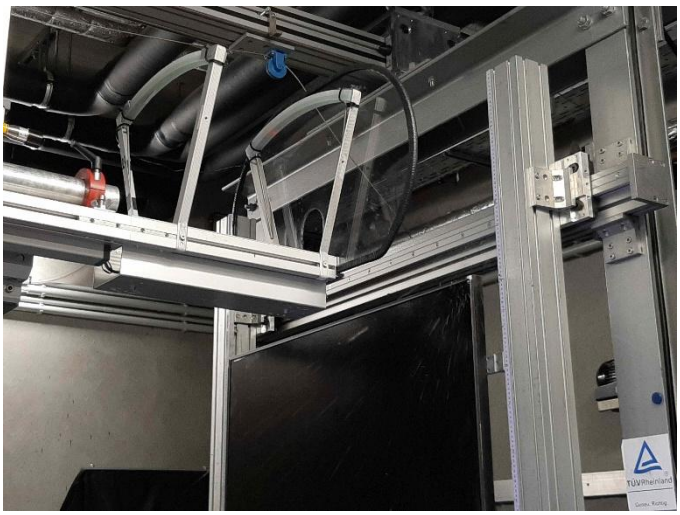
Absatz *Clause*	**Anforderungen - Prüfungen /** *Requirements - Tests*	**Messergebnisse – Bemerkungen/** *Measuring results - Remarks*	**Ergebnis** *Result*
-	**Annex: Additional photo documentation**		

Example of Impacts on Module (30 mm)





Example of Impacts on Frame (30 mm)



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