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Kunden-Referenz-Nr.: Client reference no.:	2411166	Auftragsdatum: Order date:	2024-01-30	
Auftraggeber: Client:	Guangdong Lesso Banhao New Energy Technology Group Co., Ltd The 1st and 2nd floors of the workshop in Zone 2, No. 58, Longzhou West Road, Longjiang Town, Shunde District, Foshan City, 528318 Guangdong, P.R. China			
Prüfgegenstand: Test item:	PV module installed on racking system			
Bezeichnung / Typ-Nr.: Identification / Type no.:	575C(HPM)72(182)			
Auftrags-Inhalt: Order content:	Wind load resistance performance test for PV module installed on racking system			
Prüfgrundlage: Test specification:	According to client's requirement			
Wareneingangsdatum: Date of sample receipt:	2024-02-01			
Prüfmuster-Nr.: Test sample no.:	A003655781-001			
Prüfzeitraum: Testing period:	2024-02-02~2024-03-07			
Ort der Prüfung: Place of testing:	See remark on page 2			
Prüflaboratorium: Testing laboratory:	TÜV Rheinland (Guangdong) Ltd.			
Prüfergebnis*: Test result*:	Siehe Sonstiges / See Other			
erstellt von: created by:	genehmigt von: authorized by:			
Datum: Date: 2024-03-14				
Stellung / Position:	Constant Zhao / PE	Ausstellungsdatum: Issue date: 2024-03-15		
Stellung / Position:		Susie Ni / Reviewer		
Sonstiges / Other:	Test result refer to clause 9.			
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
<p>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. <i>This test report only relates to the above mentioned 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></p>				

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Anmerkungen
Remarks

1	<p>Alle eingesetzten Prüfmittel waren zum angegebenen Prüfzeitraum gemäß eines festgelegten Kalibrierungsprogramms 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.</p> <p><i>The equipment used during 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.</i></p>
2	<p>Wie vertraglich vereinbart, wurde dieses Dokument nur digital unterzeichnet. Der TÜV Rheinland hat nicht überprüft, welche rechtlichen oder sonstigen diesbezüglichen Anforderungen für dieses Dokument gelten. Diese Überprüfung liegt in der Verantwortung des Benutzers dieses Dokuments. Auf Verlangen des Kunden kann der TÜV Rheinland die Gültigkeit der digitalen Signatur durch ein gesondertes Dokument bestätigen. Diese Anfrage ist an unseren Vertrieb zu richten. Eine Umweltgebühr für einen solchen zusätzlichen Service wird erhoben.</p> <p><i>As contractually agreed, this document has been signed digitally only. TUV Rheinland has not verified and unable to verify which legal or other pertaining requirements are applicable for this document. Such verification is within the responsibility of the user of this document. Upon request by its client, TUV Rheinland can confirm the validity of the digital signature by a separate document. Such request shall be addressed to our Sales department. An environmental fee for such additional service will be charged.</i></p>
3	<p>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.</p> <p><i>Test clauses with remark of * are subcontracted to qualified subcontractors and described under the respective test clause in the report.</i> <i>Deviations of testing specification(s) or customer requirements are listed in specific test clause in the report.</i></p>
4	<p>Die Entscheidungsregel für Konformitätserklärungen in diesem Prüfbericht basiert auf der "Null-Grenzwert-Regel" und der "Einfachen Akzeptanz" gemäß ILAC G8:2019 und IEC Guide 115:2021, 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.</p> <p><i>The decision rule for statements of conformity in this test report is based on the "Zero Guard Band Rule" and "Simple Acceptance" in accordance with ILAC G8:2019 and IEC Guide 115:2021, 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.</i></p>
	<p>Remark, place of testing: Wind tunnel test laboratory: Nanjing University of Aeronautics and Astronautics No. 29, Yudao Street, Qinhuai District, Nanjing, Jiangsu Province, P.R. China</p> <p>PV module test laboratory: TÜV Rheinland (Suzhou) Co., Ltd. 14# Plant and Northern Half of 10# Plant, Plainvim (Taicang) Industrial Park, No. 525, Lingang South Road, Yuewang, Shaxi Town, Taicang City, Suzhou City, Jiangsu Province, P.R. China</p>

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Produktbeschreibung
Product description

1	Produktdetails <i>Product details</i>	Single glass PV module installed on the racking system with tilt angle 20°
2	Maße / Gewicht <i>Dimensions / Weight</i>	L*W*H 1) Single glass PV module with type 575C(HPM)72(182): 2278*1134*35 mm 2) Racking system Front post: U41x72x2.5, L=563 mm Back post: U41x72x2.5, L=1079 mm Diagonal beam (main beam): U41x72x2.5, L=2000 mm Purlin: U41x72x2.5, L=1366 mm Diagonal brace: U41x41x2.0, L=870 mm Back tie rod: U41x41x2.0, L=1300 mm End clamp: L=60 mm, H=30 mm
3	Bedienelemente <i>Operating elements</i>	N/A
4	Ausstattung / Zubehör <i>Equipment / Accessories</i>	N/A
5	Verwendete Materialien <i>Used materials</i>	PV module type: Mono cells, Single glass Racking system: Front post: Q235B Back post: Q235B Diagonal beam (main beam): S350GD+ZM275 Purlin: S350GD+ZM275 Diagonal brace: S350GD+ZM275 Back tie rod: S350GD+ZM275 End clamp: AL6063-T5
6	Sonstiges <i>Other</i>	N/A
7	Prüfmusterbereitstellung: <i>Test sample obtaining</i>	<input checked="" type="checkbox"/> Sending by customer <input type="checkbox"/> Sampling by TÜV Rheinland Group <input type="checkbox"/> others:

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8 Test item and requirement

8.1 Test background and apparatus

This test was carried out in the small test section of NH-2 low-speed wind tunnel laboratory. Wind pressure and wind speed can be read via anemometer installed in the test section. NH-2 low-speed wind tunnel is an all-steel tandem double-test section closed-mouth return wind tunnel, and the main technical properties of the small test section where this test is located are as follows:

- Width x height x length: 3.0 m x 2.5 m x 6.0 m
- Cross-sectional area of the inlet: 7.18 m²
- Maximum wind speed: 90 m/s
- Minimum stable wind speed: 5 m/s
- Mean airflow declination: $\Delta\alpha \leq \pm 0.5^\circ$, $\Delta\beta \leq \pm 0.5^\circ$
- Axial static pressure gradient: $\left| \frac{d\bar{p}}{dx} \right| \leq 0.004 \quad 1/m$
- Turbulence: $\varepsilon \leq 0.1 \sim 0.14\%$
- Speed field coefficient in the model area: $\Delta\mu \leq 0.5\%$

The NH-2 wind tunnel facility is shown in Figure 1.



Figure 1. NH-2 wind tunnel facility

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8.2	<p>Test requirement</p> <p>Assembling the racking system and install PV module in wind tunnel according to client's requirement. The PV module was fixed by end clamps and bolt. The tilt angle to the wind tunnel floor of PV module is 20°. Turn on the wind load resistance performance test facility and conduct the testing with below condition:</p> <ol style="list-style-type: none"> 1. Wind speed: 10m/s, 35m/s, 45m/s and 60m/s, maintained for 5 minutes under first three wind speed and 10 minutes for last wind speed; 2. Wind direction <ol style="list-style-type: none"> a. PV module facing wind (0°); b. PV module back side facing wind (180°); <p>Monitoring whether deformation or vibration occurs during testing and check whether deformation, damage or looseness occurs on test sample after testing.</p> <p>Blow testing conducted on PV module before and after the wind load resistance test:</p> <ul style="list-style-type: none"> - MQT01/MST01 Visual inspection - MQT03/MST16 Insulation test - MQT15/MST17 Wet leakage current test - MQT02/MST03 Maximum power Determination - MST13 Continuity test for equipotential bonding - Electroluminescence test 		
8.3	<p>Test procedure</p> <p>The PV modules conducted with the testing listed in clause 8.2 in module testing laboratory and then delivered to wind tunnel test laboratory to conduct wind load resistance performance as follows:</p> <ol style="list-style-type: none"> 1. Install the test sample in the wind tunnel according to the specification of client; 2. Turn on the wind test facility, gradually adjust the facility to increase the wind speed; 3. Gradually increase the wind speed to 10m/s, 35m/s and 45m/s, maintained 5 minutes for each wind speed; 4. Continuedly increase the wind speed to 60m/s and maintained for 10 minutes; 5. Observe whether deformation, vibration, damage or components falling off occurs on test sample during testing; 6. Turn off the wind test facility, check if visual deformation, loosening or destruction of component detected on test sample; 7. Deliver the PV module to module testing laboratory and repeat the testing listed in clause 8.2. 		

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9	Test result		
9.1	Wind load resistance test		
PV module facing the wind (0°)	Wind direction	Wind speed	Duration Phenomenon
	0	/	All components of the sample are installed.
	10	5 min	No obvious vibration of the PV module detected, and no connection or component damage occurred.
	35 m/s	5 min	No obvious vibration of the PV module detected, and no connection or component damage occurred.
	45 m/s	5 min	Minor indentation of middle part of PV module detected, but no connection or component damage occurred.
	60 m/s	10 min	Obvious indentation of middle part of PV module detected, but no connection or component damage occurred.
Turn off the blower	/	No visual deformation, loosening or destruction of component detected on test sample after testing.	
PV module back side facing the wind (180°)	Wind direction	Wind speed	Duration Phenomenon
	0	/	All components of the sample are installed.
	10	5 min	No obvious vibration of the PV module detected, and no connection or component damage occurred.
	35 m/s	5 min	No obvious vibration of the PV module detected, and no connection or component damage occurred.
	45 m/s	5 min	Minor bulges of middle part of PV module detected, but no connection or component damage occurred.
	60 m/s	10 min	Obvious bulges of middle part of PV module detected, but no connection or component damage occurred.
Turn off the blower	/	No visual deformation, loosening or destruction of component detected on test sample after testing.	
9.2	Visual inspection (accord. to IEC61215-2:2021, Clause 4.1)		
	Item	Nature and position of initial findings	
	Initial test before wind load resistance test	No visual defect	
	Final test after wind load resistance test	No visual defect	

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9.3	Maximum power determination (accord. to IEC61215-2:2021, Clause 4.2)					
Test method		<input checked="" type="checkbox"/> Simulator <input type="checkbox"/> Natural sunlight				
Ambient temperature [°C]		25 ± 2				
Irradiance [W/m ²]		1000 ± 10				
Module temperature [°C]		25 ± 2				
Item	P _{max} [W]	V _{mpp} [V]	I _{mpp} [A]	V _{oc} [V]	I _{sc} [A]	FF [%]
Initial test before wind load resistance test	572.7	43.88	13.053	51.92	13.679	80.6
Final test after wind load resistance test	572.7	43.97	13.024	51.97	13.72	80.3
Supplementary information: -						
9.4	Insulation test (accord. to IEC61730-2:2023, Clause 10.13)					
Maximum system voltage [V _{DC}]		1500				
High voltage applied [V _{DC}]		8000				
Item	R _{iso} [GΩ]	A [m ²]	R _{iso} ·A [GΩ·m ²]			
Initial test before wind load resistance test	10.4	2.58	26.83			
Final test after wind load resistance test	11.2	2.58	20.90			
Supplementary information: Minimum requirement is 0.04 GΩ·m ² for A > 0.1 m ² and 0.4 GΩ for A ≤ 0.1 m ² .						
9.5	Wet leakage current test (accord. to IEC61215-2:2021, Clause 10.15)					
Maximum system voltage [V _{DC}]		1500				
Insulation resistance measured at [V _{DC}]		1500				
Solution resistivity [Ω·cm]		≤ 3500				
Solution temperature [°C]		22 ± 2				
Item	R _{iso} [MΩ]	A [m ²]	R _{iso} ·A [MΩ·m ²]			
Initial test before wind load resistance test	3670	2.58	9468.60			
Final test after wind load resistance test	3350	2.58	8643.00			
Supplementary information: Minimum requirement is 40 MΩ·m ² .						

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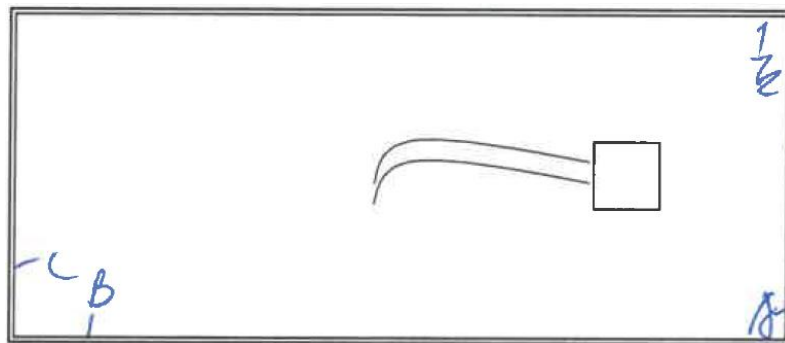
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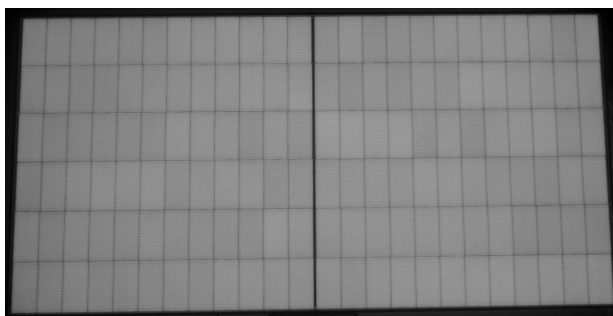
9.6 Continuity test for equipotential bonding (accord. to IEC61730-2:2023, Clause 10.11)

Maximum overcurrent protection rating [A]		25	
Current applied [A]		62.5	
Duration of applied current [min]		2	
Location of designated point for equipotential bonding		See supplementary information	
No. of other conductive parts tested		3	
Item	Measurement point	Max. measured voltage [mV]	Max. calculated resistance [mΩ]
Initial test before wind load resistance test	E-A	77.6	1.24
	E-B	78.3	1.25
	E-C	75.9	1.21
Final test after wind load resistance test	E-A	70.5	1.13
	E-B	68.1	1.09
	E-C	72.3	1.16

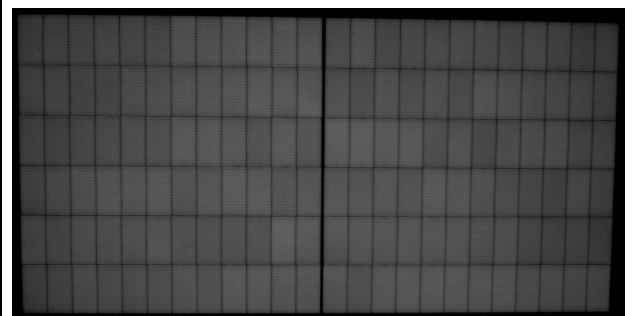
Supplementary information:
Location of measurement point as below:



9.7 Electroluminescence test (accord. to IEC 60904-13: 2018)







Before wind load resistance test



After wind load resistance test

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10	Test photo		
10.1	PV module facing wind (0°)		
			
Before test		After test	
10.2	PV module back side facing wind (180°)		
			
Before test		After test	

*** End of Report ***