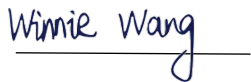


Test report no.: <i>Prüfbericht-Nr.:</i>	CN24KZ3A 002	Order no.: <i>Auftrags-Nr.:</i>	326034308	Page 1 of 9 <i>Seite 1 von 9</i>
Client reference no.: <i>Kunden-Referenz-Nr.:</i>	2161758	Order date: <i>Auftragsdatum:</i>	26.06.2024	
Client: <i>Auftraggeber:</i>	CHONGQING FENGDU NEW MATERIAL CO., LTD <i>Jianqiao industrial Park B, Dadukou District, 400082, Chongqing, P.R. China</i>			
Test item: <i>Prüfgegenstand:</i>	Polymer Composite Material Frame Used in PV Modules			
Identification / Type no.: <i>Bezeichnung / Typ-Nr.:</i>	GFF-SS-3023; GFF-SD-3018; GFF-SD-3023; GFF-SD-3320; GFF-SD-3323			
Order content: <i>Auftrags-Inhalt:</i>	Certificate of conformity			
Test specification: <i>Prüfgrundlage:</i>	2 PfG 2923/11.22 Specification for Polymer Composite Material Frame Used in PV Modules			
Date of sample receipt: <i>Wareneingangsdatum:</i>	29.08.2024			
Test sample no.: <i>Prüfmuster-Nr.:</i>	A003805517-001# ~ A003805517-159#			
Testing period: <i>Prüfzeitraum:</i>	30.08.2024-19.12.2024			
Place of testing: <i>Ort der Prüfung:</i>	TÜV Rheinland (Shanghai) Co., Ltd.			
Testing laboratory: <i>Prüflaboratorium:</i>	TÜV Rheinland (Shanghai) Co., Ltd.			
Test result*: <i>Prüfergebnis*:</i>	Pass			
Created by: <i>geprüft von:</i>	Winnie Wang	Authorized by: <i>genehmigt von:</i>	Andy Hong	
Date: 12.03.2025 <i>Datum:</i>		Issue date: 14.03.2025 <i>Ausstellatum:</i>		
Position / Stellung:	Project Engineer	Position / Stellung:	Authorizer	
Other / Sonstiges: In this report, only test items 5.2, 5.4, 5.5, 5.6, 5.9, 5.13, 5.16, 5.20, 5.21, 5.22 have been done with positive results because the type Jota Solar CL coating material from Jotun Coatings is alternated. And Other tests was referred to the report CN24KZ3A 001.				
Condition of the test item at delivery: <i>Zustand des Prüfgegenstandes bei Anlieferung:</i>		Test item complete and undamaged Prüfmuster vollständig und unbeschädigt		
* 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 * Legende: P(ass) = entspricht o.g. Prüfgrundlage(n) F(ail) = entspricht nicht o.g. Prüfgrundlage(n) N/A = nicht anwendbar N/T = nicht getestet				
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>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>				

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Remarks
Anmerkungen

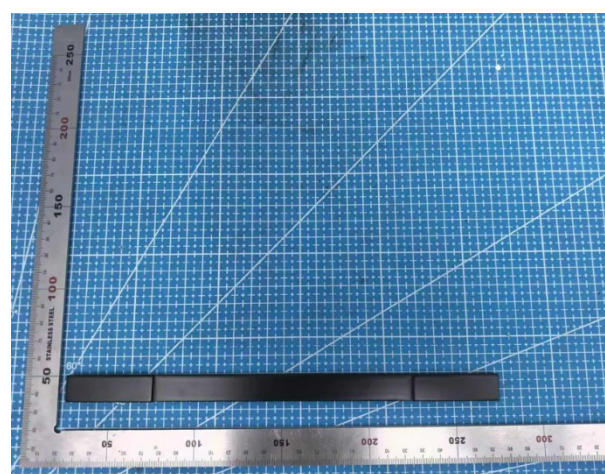
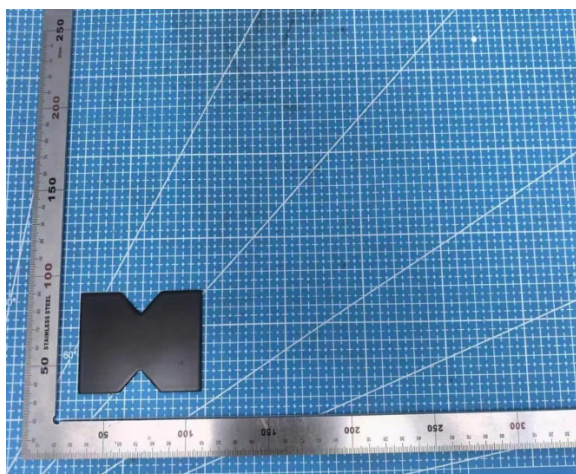
- | | |
|----------|--|
| 1 | <p>The equipment used during the specified testing period was calibrated according to our test laboratory calibration program. The equipment fulfils the requirements included in the relevant standards. The traceability of the test equipment used is ensured by compliance with the regulations of our management system.</p> <p>Detailed information regarding test conditions, equipment and measurement uncertainty is available in the test laboratory and could be provided on request.</p> <p><i>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.</i></p> <p><i>Detaillierte Informationen bezüglich Prüfkonditionen, Prüfequipment und Messunsicherheiten sind im Prüflabor vorhanden und können auf Wunsch bereitgestellt werden.</i></p> |
| 2 | <p>As contractually agreed, this document has been signed digitally only. TÜV 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, TÜV 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.</p> <p><i>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.</i></p> |
| 3 | <p>Test clauses with remark of * are subcontracted to qualified subcontractors and described 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.</p> <p><i>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.</i></p> |
| 4 | <p>The decision rule for statements of conformity, based on numerical measurement results, 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. For additional information to the resulting risk based of this decision rule please refer to ILAC G8:2019.</p> <p><i>Die Entscheidungsregel für Konformitätserklärungen basierend auf numerischen Messergebnissen 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. Zu weiteren Informationen bezüglich des Risikos durch diese Entscheidungsregel siehe ILAC G8:2019.</i></p> |

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Product description
Produktbeschreibung

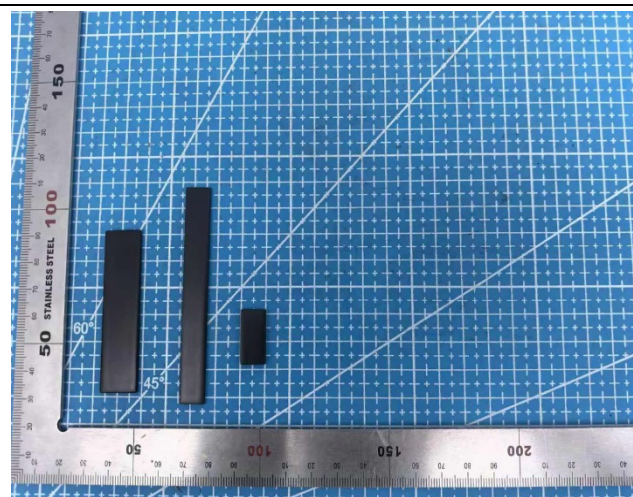
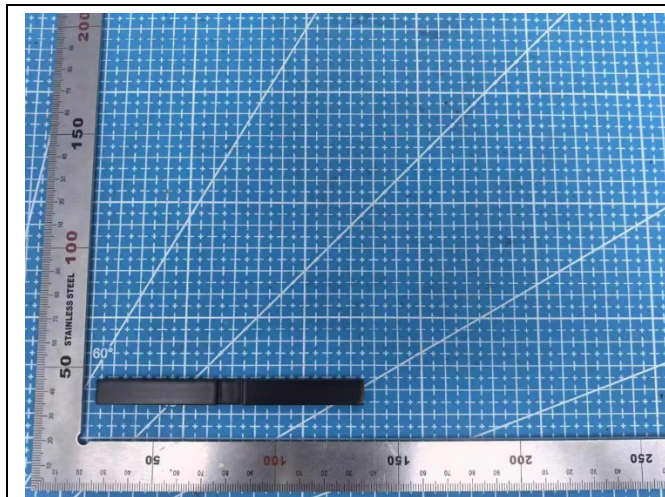
1	Product details <i>Produktdetails</i>	Polymer Composite Material Frame Used in PV Modules
2	Dimensions / Weight <i>Maße / Gewicht</i>	11,7mm(A side) x 30mm(B side) x 23mm(C side) x 5,1mm(notch) for GFF-SS-3023 11,71mm(A side) x 30mm(B side) x 18mm(C side) x 6,2mm(notch) for GFF-SD-3018 11,7mm(A side) x 30mm(B side) x 23mm(C side) x 6,2mm(notch) for GFF-SD-3023 11,71mm(A side) x 33mm(B side) x 20mm(C side) x 6,2mm(notch) for GFF-SD-3320 11,71mm(A side) x 33mm(B side) x 23mm(C side) x 6,2wmm(notch) for GFF-SD-3323
3	Operating elements <i>Bedienelemente</i>	The PV frame consists of shortside, longside and cornerkey
4	Equipment / Accessories <i>Ausstattung / Zubehör</i>	N/A
5	Used materials <i>Verwendete Materialien</i>	Matrix: (15,3%) Fibre: Glass fibre(84,7%) Coating: Jota Solar CL Water-based polyurethane coating material
6	Other <i>Sonstiges</i>	Test sample(s), as well sample information, description, product details and intended usage was provided by customer.
7	Test sample obtaining: <i>Prüfmusterbereitstellung:</i>	☒ Sending by customer ☐ Sampling by TÜV Rheinland Group ☐ others:



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Produktbeschreibung
Product description



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Clause Absatz	Requirements – Tests / Anforderungen - Prüfungen	Measuring results - Remarks / Messergebnisse – Bemerkungen	Result Ergebnis
5	Tests		
5.2	Visual inspection		
5.2.1	Inspection showed no obvious defect, such as cracks, fibre exudation, bubbles, bent and impurities.	No obvious defect.	P ☒ F ☐ N/A ☐ N/T ☐
5.4	Density (acc. to ISO 1183-1)		
5.4.1	The density shall be reported following ISO 1183-1.	2,16g/cm ³	P ☐ F ☐ N/A ☒ N/T ☐
5.5	Hardness (acc. to ASTM D2583-95)		
5.5.1	For the polymer composite material, the barcol hardness test method following ASTM D2583-95 is used to evaluate the property. The hardness shall be reported and shall comply with the datasheet of the manufacturer with an accuracy of ± 10 %.	65,2Hba, more than the the accuracy of +10% declared in user manual.	P ☒ F ☐ N/A ☐ N/T ☐
5.6	Coating thickness (if needed, according to ISO 1463)		
5.6.1	The type of coating material and coating thickness shall be reported and shall comply with the datasheet of the manufacturer with an accuracy of ± 10 %.	30,5um, more than the the accuracy of +10% declared in user manual.	P ☒ F ☐ N/A ☐ N/T ☐
5.9	Mechanical tests		
5.9.1	Tensile strength (according to ISO 527-4 or ISO 527-5)		
	The tensile strength test shall be conducted in the initial phase and after the aging test, the initial force value shall be reported.	See table 1	P ☒ F ☐ N/A ☐ N/T ☐
5.9.2	Bending strength (according to ISO 14125)		
	The bending strength test shall be conducted in the initial phase and after the aging test, the initial force value shall be reported.	See table 1	P ☒ F ☐ N/A ☐ N/T ☐
5.9.3	Impact strength (according to ISO 179-1)		
	The impact strength test shall be conducted in the initial phase and after the aging test, the initial force value shall be reported.	See table 1	P ☒ F ☐ N/A ☐ N/T ☐
5.9.4	Shear strength (according to ASTM D7078/D7078M or ASTM D5379/D5379M, ISO 14130)		

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Clause Absatz	Requirements – Tests / Anforderungen - Prüfungen	Measuring results - Remarks / Messergebnisse – Bemerkungen	Result Ergebnis
	The in-plane shear strength test shall be conducted in the initial phase and after the aging test, the initial force value shall be reported.	See table 1	P ☒ F ☐ N/A ☐ N/T ☐
	The interlaminar shear strength test shall be conducted in the initial phase and after the aging test, the initial force value shall be reported.	See table 1	P ☒ F ☐ N/A ☐ N/T ☐
5.9.5	Compressive strength (according to ISO 14126)		
	The compressive strength test shall be conducted in the initial phase and after the aging test, the initial force value shall be reported.	See table 1	P ☒ F ☐ N/A ☐ N/T ☐
5.13	Matching test between frame and silicone (according to IEC 62790)		
5.13.1	The adhesive material shall be uniform distribution between two composite material coupons. The adhesive area should be 25mm±0,5mm×25mm±0,5mm and thickness is recommend at least 0,5mm, but no more than 2mm thick (see Fig.2). The test method shall refer to clause 5.3.22 of IEC 62790.	40N, 30min No obvious loosen occurred. No cohesive failure or adhesive transfer occurred.	P ☒ F ☐ N/A ☐ N/T ☐
5.16	Weather resistance test (according to IEC 62790)		
5.16.1	After test acc. ISO 4892-series: 2000h at min. 60W/m², 300-400nm, 65°C, 65%RH, cycles: 18 min spraying, 102min drying with relevant lamp no cracks visible	Complied	P ☒ F ☐ N/A ☐ N/T ☐
	The retention rate of tensile strength, bending strength, impact strength, shear strength and compressive strength shall be more than 50% of the initial value measured in item 5.9	See table 1 All retention rates(between intial values and final values) are more than 50%.	P ☒ F ☐ N/A ☐ N/T ☐
5.20	Thermal cycle test (according to IEC 61215-2)		
5.20.1	The test shall be carried out in a climatic chamber. The number of cycles is 200. The transfer time between upper and lower temperatures shall not exceed 100 °C/h. The upper and lower temperatures shall be held for a minimum of 10 min after thermal equilibrium of the specimen is reached.	Complied	P ☒ F ☐ N/A ☐ N/T ☐
	After thermal cycle test, no obvious defect occurred.	No cracks shall occure which could impair normal use.	P ☒ F ☐ N/A ☐ N/T ☐

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Clause Absatz	Requirements – Tests / Anforderungen - Prüfungen	Measuring results - Remarks / Messergebnisse – Bemerkungen	Result Ergebnis
5.20.2	The retention rate of tensile strength, bending strength, impact strength, shear strength and compressive strength shall be more than 50% of the initial value measured in item 5.9	See table 1 All retention rates(between initial values and final values) are more than 50%.	P ☒ F ☐ N/A ☐ N/T ☐
5.21	Damp heat test (according to IEC 61215-2)		
5.21.1	The test shall be carried out in accordance with IEC 60068-2-78 with the following test conditions: – test temperature: maximum working temperature, minimum (+85 ± 2) °C; – relative humidity: (+85 ± 5) %; – test duration: 1 000 h.	Complied	P ☒ F ☐ N/A ☐ N/T ☐
	After damp heat test, no obvious defect occurred.	No cracks shall occur which could impair normal use.	P ☒ F ☐ N/A ☐ N/T ☐
5.21.2	The retention rate of tensile strength, bending strength, impact strength, shear strength and compressive strength shall be more than 50% of the initial value measured in item 5.9	See table 1 All retention rates(between initial values and final values) are more than 50%.	P ☒ F ☐ N/A ☐ N/T ☐
5.22	TC50+Humidity freeze test (according to IEC 61215-2)		
5.22.1	The test shall be carried out in a climatic chamber. The number of cycles is 50. The transfer time between upper and lower temperatures shall not exceed 100 °C/h. The upper and lower temperatures shall be held for a minimum of 10 min after thermal equilibrium of the specimen is reached.	Complied	P ☒ F ☐ N/A ☐ N/T ☐
5.22.2	After TC50, subject the samples to 10 cycles in accordance with Figure 4. The maximum and minimum temperatures shall be within ±2 °C of the specified levels and the relative humidity shall be maintained within ±5 % of the specified value when the temperature is at the maximum value of 85 °C.	Complied	P ☒ F ☐ N/A ☐ N/T ☐
	After TC50+Humidity freeze test, no obvious defect occurred.	No cracks shall occur which could impair normal use.	P ☒ F ☐ N/A ☐ N/T ☐
5.22.3	The retention rate of tensile strength, bending strength, impact strength, shear strength and compressive strength shall be more than 50% of the initial value measured in item 5.9	See table 1 All retention rates(between initial values and final values) are more than 50%.	P ☒ F ☐ N/A ☐ N/T ☐

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ADDITIONAL DOCUMENTATION
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Table 1 Test records of mechanical test

	Values of tensile strength [Mpa]:					Average [Mpa]	Retention [%]
Before ageing	1431,83	1434,92	1372,93	1380,67	1430,75	1410,22	N/A
After TC200	1232,91	1266,71	1216,24	1202,81	1244,10	1232,55	87,40
After damp heat	1319,62	1286,75	1264,85	1247,26	1286,60	1281,02	90,84
After TC50+humidity freeze test	1215,63	1208,26	1238,08	1203,89	1165,34	1206,24	85,54
After Weather resistance test	1405,29	1444,16	1475,91	1458,68	1422,74	1441,36	100,00
	Values of bending strength [Mpa]:					Average [Mpa]	Retention [%]
Before ageing	1599,31	1558,62	1538,75	1557,64	1600,42	1570,95	N/A
After TC200	1388,14	1430,88	1415,01	1418,18	1372,16	1404,87	89,43
After damp heat	1577,10	1537,60	1579,80	1490,50	1509,16	1538,83	97,96
After TC50+humidity freeze test	1183,90	1228,47	1228,38	1190,28	1235,70	1213,35	77,24
After Weather resistance test	1589,11	1528,39	1535,75	1608,07	1556,44	1563,55	99,53
	Values of impact strength [KJ/mm²]:					Average [KJ/mm²]	Retention [%]
Before ageing	588,82	581,24	605,98	597,25	599,35	594,53	N/A
After TC200	633,85	632,99	627,04	628,37	628,65	630,18	100,00
After damp heat	640,25	658,26	656,33	665,09	659,11	655,81	100,00
After TC50+humidity freeze test	559,94	547,73	551,35	528,68	527,83	543,11	91,35
After Weather resistance test	679,93	691,86	647,96	636,13	661,34	663,44	100,00
	Values of in-plane shear strength [Mpa]:					Average [Mpa]	Retention [%]
Before ageing	61,00	59,84	60,60	61,57	60,63	60,73	N/A
After TC200	58,97	57,16	57,31	56,31	56,84	57,32	94,38
After damp heat	59,09	59,87	59,35	58,93	59,79	59,41	97,82
After TC50+humidity freeze test	51,38	48,31	50,59	49,31	51,35	50,18	82,64
After Weather resistance test	58,09	59,12	59,44	59,23	58,29	58,83	96,88
	Values of interlaminar shear strength [Mpa]:					Average [Mpa]	Retention [%]
Before ageing	54,05	55,31	57,15	56,86	55,94	55,86	N/A
After TC200	46,07	48,76	48,52	47,16	47,41	47,58	85,18
After damp heat	51,58	53,85	53,00	52,98	52,14	52,71	94,36
After TC50+humidity freeze test	43,72	49,56	43,51	43,2	43,4	44,68	79,98
After Weather resistance test	56,24	53,57	54,08	54,82	53,98	54,54	97,63
	Values compressive strength [Mpa]:					Average [Mpa]	Retention [%]
Before ageing	989,19	910,38	1023,17	1026,48	954,74	980,79	N/A
After TC200	857,01	844,57	809,18	837,40	821,14	833,86	85,02
After damp heat	676,24	674,87	640,22	717,28	645,69	670,86	68,40
After TC50+humidity freeze test	1016,75	973,95	988,68	845,99	935,28	952,13	97,08
After Weather resistance test	728,15	735,27	750,46	782,73	826,88	764,70	77,97

--- Ende des Prüfberichts / End of Test Report ---

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