Product Service

TEST REPORT

PPP 59029A Rev. 01

TUV SUD Test Report for photovoltaic (PV) module mounting systems

Report No.: Date of issue: Project handler:	70.407.23.657.02-00 2023.09.28 JinYu Li
Testing laboratory: Address: Testing location:	TUV SUD Certification and Testing(China)Co.,Ltd.Shanghai Branch No.151 Heng Tong Road,Shanghai 200070,P.R.China Shanghai AIM Fluid Technology CO. ,LTD 3rd Floor, Building 12, 1333 Jiangnan Avenue, Changxing Town, Chongming District,Shanghai Changzhou HuaYang Inspection and Testing Technology Co., Ltd Building 6, NO.9 West Taihu Road, Wujin Economic Development Zone, Changzhou, Jiangsu, China
Client: Client number: Address: Contact person:	Global Tax Refund Holdings Company Limited. 122730 6/F Manulife Place 348 Kwun Tong Road 999077 Kowloon HONG KONG. Zhou Guoyang
Standard:	This TUV SUD test report form is based on the following requirements: PPP 59029A:2013 Rev. 1:2018-01
TRF number and revision:	PPP 59029A:2013 Rev. 1:2018-01
TRF originated by:	TUV SUD Product Service, Mr./Mrs. Neko Ding *(product specialist)*
Copyright blank test report:	This test report is based on the content of the standard (see above). The test report considered selected clauses of the a.m. standard(s) and experience gained with product testing. It was prepared by TUV SUD Product Service.TUV SUD Group takes no responsibility for and will not assume liability for damages resulting from the reader's interpretation of the reproduced material due to its placement and context.
General disclaimer:	This test report may only be quoted in full. Any use for advertising purposes must be granted in writing. This report is the result of a single examination of the object in question and is not generally applicable evaluation of the quality of other products in regular production.
Scheme: Non-standard test method: National deviations:	☒ TUV Mark ☐ without certification ☐ GS Mark ☐ NRTL Mark ☐ EU-Directive ☒ No ☐ Yes, see details under Summary of testing No
Number of pages *(Report)*: Number of pages *(Attachments)*:	26 Pages CDF(6 PAGES)
Compiled by:	Li JinYu *(Printed Name and Signature)* Li Jinyu 2023.10.07
Approved by:	Liu XingXing *(Printed Name and Signature)* Liu Xingxing 2023.10.07

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Test sample:	Photovoltaic (PV) Mounting System
Type of test object:	N/A
Trademark:	SunLit
Model and/or type reference:	MSH-01A, MSH-01B, MSH-02A, MSH-02B, MSH-01C
Rating(s):	Details see characteristic data
Manufacturer:	Ningbo Lasen Intelligent Technology Co., Ltd. Honrock railway Transportation Equipment Co., Ltd. DATU (TIANJIN) MACHINERY CO., LTD
Manufacturer number:	107122/122696/122702
Address:	No.268 AnjuRoad, Xiaogang, Beilun 315806 Ningbo City, Zhejiang PEOPLE'S REPUBLIC OF CHINA. Laoshan Beizhai Gouya Industry Park 266000 Qingdao PEOPLE'S REPUBLIC OF CHINA. East side of Luming Lake brand 3 kilometers north of Qingzhou town Qingxian county 062650 Cangzhou city, Hebei province PEOPLE'S REPUBLIC OF CHINA
Sub-contractors/ tests (clause):	N/A
Name:	N/A
Order description:	☒ Complete test according to TRF
	☐ Partial test according to manufacturer's specifications
	☐ Preliminary test
	☐ Spot check
	☐ Others:
Date of order:	2023-07-24
Date of receipt of test item:	2023-07-24
Date(s) of performance of test:	2023-07-24~2023-09-18
Test item particulars:	
Purpose of the product: photovoltaic (PV) module mounting systems for use to support the PV module Installation	

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Characteristic data: See the CDF
Attachments:
General remarks: *"(see remark #)" refers to a remark appended to the report.* *"(see appended table)" refers to a table appended to the report.* *Throughout this report **a comma** is used as the decimal separator.* *The test results presented in this report relate only to the object tested.* *This report shall not be reproduced except in full without the written approval of the testing laboratory.*

Summary of testing:

MSH-01A, MSH-01B, MSH-02A, MSH-02B, MSH-01C mounting system was used in European market, accordingly the loads were calculated acc. to EN 1991-1-1-2002,EN 1991-1-3-2002,EN 1991-1-4-2002,EN 1990-2002,The risk of product was estimated based on PPP 59029A:2013.Main test on MSH-01A, MSH-02A. other types for contruct check.

Remark: The handrail is not evaluated in this report.

☐ deviation(s) found

☒ no deviations found

If additional information is necessary, please provide

Copy of marking plate:

Picture of the product:

See the CDF for details

Name and address of factory (ies) *(only if certification is provided)*:

Ningbo Lasen Intelligent Technology Co., Ltd.
No.268 AnjuRoad, Xiaogang, Beilun 315806 Ningbo City, Zhejiang PEOPLE'S REPUBLIC OF CHINA.(107122)
Honrock railway Transportation Equipment Co., Ltd.
Laoshan Beizhai Gouya Industry Park 266000 Qingdao PEOPLE'S REPUBLIC OF CHINA.(122696)
DATU (TIANJIN) MACHINERY CO., LTD
East side of Luming Lake brand 3 kilometers north of Qingzhou town Qingxian county 062650 Cangzhou city, Hebei province PEOPLE'S REPUBLIC OF CHINA (122702)

Possible test case verdicts:

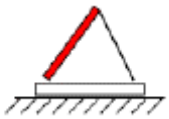
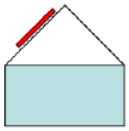
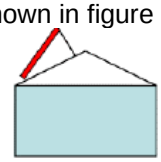
test case does not apply to the test object:	N/A (not applicable / not included in the order)
test object does meet the requirement:	P (Pass)
test object does not meet the requirement:	F (Fail)

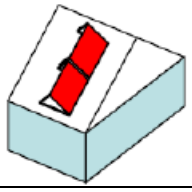
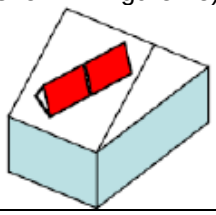
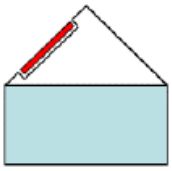
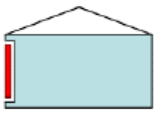
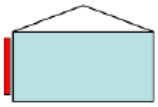
Possible suffixes to the verdicts:

suffix for detailed information for the client:	C (Comment)
suffix for important information for factory inspection:	M (Manufacturing)

The following documents and verifications are to be submitted by the client for each mounting system to be tested:			
1	**General safety requirements**		P
1.1	**Sharp Corners and edges** All the touchable corners and edges during installation and nomal maintainence shall be rounded (in general with a radius of at least 2 mm) and present no harzard to the operators.		P
1.2	**Squeeze and shear point** The width of accessible openings (except for drawers and doors and its hinges, but including the gap between handle and other parts of the setup) should be maximum 8 mm wide or must have a width of more than 25 mm. There should be no squeeze and shear points.		P
1.3	**Material** The materials used must be tested to verify their suitability for use.		P
1.3.1	For the manufacture of products only materials, which in the course of proper use can withstand the physical and chemical stresses which occur, may be used.	SUS304, AL6005-T5	P
1.3.2	Surface without cracks, scars, folding, linen stripes, bubbles and inclusions.		P
1.4	Corrosion resistance		P
1.4.1	Salt spray tests There are exception use corrosion-resistant or corrosion-resistant materials that are resistant to atmospheric and climatic influences. During assembly of different metallic materials is to pay attention to potential differences and possible galvanic corrosion, in which case proper precautions should be taken as by insulating layers. All parts made of metal as well as functional hardware that are visible in their normal position of use must be corrosion resistant in accordance with DIN EN ISO 9227. Coating： at least 96h hot-galvanised steel：at least 168h Electrophoresis： at least 168h		P
1.4.2	UV-resistance Loading bearing parts shall not be made of plastic. Otherwise special UV testing shall be performed, e.g. 5000 hours UV testing according to DIN EN ISO 4892-3.		N/A
1.5	Design working life		P

Clause	Requirement + Test	result – Remark	Verdict
1.5.1	Design working life is defined as the minimum number of years for which a PV module is assumed in design to be used for its intended purpose with required maintenance but without major structural repair being necessary. To be verified by manufacturers declaration.		—
1.5.2	The energy payback time for the system (example calculation for 1 kW peak) from having a prepare site to PV module installation, energy payback time shall be less than 3 years. To be verified based on clause 1.5.1.		—
2	**Installation instructions** The manufacturer or importer shall prepare extensive and detailed installation instructions for each system, including site preparation to mounting and fixation of the PV modules. For entire system solutions (power generation & racking systems), electrical installation instructions including the inverter must be included. The following criteria will be assessed in this order:		—
2.1	Design (ÖNORM M7778:2011, clause 4)		P
2.1.1	Basically the rules of building physics (tightness, insulation, ventilation, climate conditions) and the static structural design (stability) should be observed in the planning of thermal solar collectors and photovoltaic modules and in new construction as well for subsequent assembly The functionality of the roof must be ensured. The load introduction points and line lead through the roof must be watertight with rainproof roofing as well as roof sealing. Any penetration in the sub-roof area shall be performed in accordance with ÖNR 22219-2 and ÖNORM B 4119 Thermal solar collectors and photovoltaic modules must be including their main parts and the needs of the installation set at the planning stage. This includes the coordination of the execution of the individual system components. Execution, sequence, and detailed solutions must be coordinated. NOTE A sub-roof is recommended for installation of solar roof according to ÖNR 22219-2.		P

Clause	Requirement + Test	result – Remark	Verdict
2.1.2	Slipping snow and ice underneath the roof covering must not be damaged. All measures must be taken to prevent ice or slipping off the snow and stay under the eaves ways, entrances, public areas, but also structures such as canopies, winter gardens or balconies, these institutions through the establishment of a protective device or roofs without damage. Energy extraction areas and its attachment must - except for separate verification - either as a lifeline, lifting points or inspection points are used. Any inspection and safety devices should be performed according to ÖNR 22219-1 and ÖNORM B 3417. For care and maintenance arrangements must be made (e.g. permanently installed roof walkways, ladders, lifting points), which provide a risk-free care and maintainance and do not damage the roof. Solar panels, the function of the roofing or waterproofing membrane to take in the roof installation must be able to perform all the functions of the rest of the roof.		P
2.1.3	elevated flat roof installation (as shown in figure 1a) 		N/A
	Roof installation, parallel to the roof (as shown in figure 1b); 		N/A
	elevated roof installation parallel to the ridge (as shown in figure 1b); 		N/A

Clause	Requirement + Test	result – Remark	Verdict
	elevated roof installation, normal to the ridge (east-west roof) (as shown in figure 1d); 		N/A
	elevated roof installation, obliquely to the ridge (as shown in figure 1e); 		N/A
	Roof installation (where the solar system is integrated into the roof and the roof rain cover included) (as shown in figure 1f) 		N/A
	Facade installation, intergrated in the facade (as shown in figure 1g); 		N/A
	Facade installation, set in front of the façade (as shown in figure 1h); 		P
	bonded installation;		P
	free installation.	Mounting bracket	P
2.2	**Roofing**		P

Clause	Requirement + Test	result – Remark	Verdict
2.2.1	（ÖNORM M7778:2011, clause 5.3） A direct implementation into the roof has to be made rain-proof and must not restrict (eg Module holder with base plate, plumber engineered Eindeckplatte, funnel enclosure with metal roofs, mounting on rails systems according strips roofs with standing seam) the efficiency of the roofing. When mounted directly to the roof covering (eg standing seam by seam clamps) the load transfer through the fasteners ensure the roofing is durable. In addition, any temperature-related length changes of the underlying coverage are not obstructed / restricted.		P
2.2.2	（ÖNORM M7778:2011, clause 5.4） If module holder (fasteners) is used in waterproofing, a load-bearing attachment to the substructure and a waterproof connection of the fitting are sure. Ballast elements must be mounted securely in position, they may not damage the waterproofing and the functionality does not restrict. The requirements of ÖNORM B 2220 and B 7220 are complied with.		P

Clause	Requirement + Test	result – Remark	Verdict
2.2.3	Fastener （ÖNORM M7778:2011, clause 5.5） The attachment of thermal solar collectors and photovoltaic modules is normally depending on installation type (according to Section 3, Section 4 and Section 5) and roof covering, for example, by: - Module holder with a roof covering is adapted to the base plate, - Solar hanger or plumber engineered Eindeckplatten, - Saddle Clamps or support plates (for standing seam roofs and system) - Ballast elements (on solid flat roofs) and - Similar fasteners. The carrying capacity of all fasteners shall be demonstrated by calculation or by testing in accordance with Appendix a. In the case of subsequent mounting is in any case a double standing seam roofs itemization to perform with special reference to the position and sustainability of Exemplary.		P
2.3	Prefabricated accessories for roofing-Installations for roof access -Walkways, treads and steps （if applicable） (EN 516:2006)		N/A
2.3.1	Testing （EN 516:2006, clause 8）		N/A

Clause	Requirement + Test	result – Remark	Verdict
2.3.1.1	Static test （EN 516:2006, clause 8.1） 1) Number of specimens Each test shall be made once each on three different specimens. All specimens shall pass the tests. 2) Step test The specimens shall be tested when fastened to a simulation of the load-bearing roof construction in each of the following positions: a) at the lowest possible roof slope (αmin) and with the load at the edge of the platform adjacent to the roof, b) at the greatest possible roof slope (αmax) and with the load at the edge of the platform farthest from the roof, and c) in addition, for walkways and treads, in the centre between the supports or at the most unfavourable position. The test specimens shall be fastened to the simulation of the load-bearing roof construction according to the instructions of the manufacturer. A gradually increasing vertical test load shall be applied through a load-distributing rigid steel plate with a size of 100 mm 100 mm. Measure the deflection at the point of force transmission under a test load of 1,5 kN. The test load is then increased to 1,5 kN x 1,7 = 2,6 kN for a further minute. Under the maximum load of 2,6 kN, the test specimens shall not break and the fastening systems shall not be deformed more than 5 mm. NOTE The value of 1,7 is a safety factor. 3）Test at the anchorage point A test load of $P_1 \leq 10$ kN shall be initiated in usage direction (at the most unfavourable point) for installations for roof access of Class 2 at the point where it is possible to attach personal protective equipment against fall or for restraint. Neither the installation nor the attachment shall be disconnected, and the test load shall be supported safely.		N/A

Clause	Requirement + Test	result – Remark	Verdict
2.3.1.2	Test of the fatigue strength （EN 516:2006, clasue 8.2） Installations for roof access of Class 2 including the fastening systems shall additionally be tested to meet the requirements of 7.2(EN516:2006). Three test specimens shall be submitted to a drop test . The test specimens shall be fixed by their fastening systems to a simulation of the load-bearing roof construction in a position between 70° and 90° from the horizontal. The load and deflection criteria for the drop test shall conform to EN 364. For the test, a hawser laid polyamide lanyard of three strands and of 12 mm diameter according to EN ISO 1140 shall be used. One end of the lanyard shall be attached to the test specimen. At the other end a drop mass of (100 ±1) kg and (200 ±2) mm in diameter shall be fastened. The drop mass shall be suspended at a maximum horizontal distance of 300 mm from the anchorage point of the lanyard and a vertical distance of 500 mm from that point by means of a rapid release device. Release the drop mass which will fall freely through (2 500 ±50) mm before the lanyard arrests the fall. Observe any deformations and deflections of the test specimen and its fastenings, and the test load shall be supported.		N/A
2.3.2	Evaluation of conformity （EN 516:2006, clause 9）		N/A

Clause	Requirement + Test	result – Remark	Verdict
2.3.2.1	General （EN 516:2006, clause 9.1） The conformity of installations for roof access to the requirements of this document and with the stated values (including classes) shall be demonstrated by: -initial type testing, and -factory production control by the manufacturer, including product assessment. Installations for roof access, which differ only in aspects that do not influence the properties required in this document, may be collected into product groups. Providing that an installation for roof access within the group meets the requirements of this document, then all products within the same group shall be assumed to conform. If the same walkway, tread or step fails to conform, then the whole group shall be assumed to have failed to conform to this document. Installations for roof access, which differ only with regard to some properties, may be grouped together for these common properties. Providing that a product within this defined group meets the requirements of this document, then all products within the group shall be assumed to conform for the properties concerned. The properties outside the common group shall be tested product by product, unless included in a group for one or more of these properties.		N/A

Clause	Requirement + Test	result – Remark	Verdict
2.3.2.2	Initial type testing （EN 516:2006, clause 9.2） Initial type testing shall be performed to demonstrate conformity with this document. Tests previously performed in accordance with the provisions of this document (same product, same characteristic(s), test method, sampling procedure, system of attestation of conformity etc.) may be taken into account. In addition, initial type testing shall be performed at the beginning of the production of a new walkway, tread or step type (unless a member of the same group) or at the beginning of a new method of production (where this may affect the stated properties). All characteristics in Clause 7 requiring testing shall be subject to initial type testing. The results of all type tests shall be recorded and held by the manufacturer for at least 10 years after the date of last production of the products to which they apply. Whenever a change occurs in the installations for roof access, the raw material or supplier of components, or the production process (subject to the definition of a group), which would change significantly one or more of the characteristics, the type tests shall be repeated for the appropriate characteristic(s).		N/A
2.4	Prefabricated accessories for roofing- Roof safety hooks （if applicable） (EN 517:2006)		N/A
2.4.1	Testing （EN 517:2006, clause 8）		N/A

Clause	Requirement + Test	result – Remark	Verdict
2.4.1.1	Static load （EN 517:2006, clause 8.1） 1） Number of specimens Each test shall be made once each on three different specimens. All specimens shall pass the tests. 2） Test in the hook base The specimens (roof safety hooks) shall be fastened to the simulation of the load-bearing roof construction according to the instructions of the manufacturer. The test load of 1,5 kN shall be applied within one minute and maintained for a period of five minutes. The deformation shall be measured under the test load of 1,5 kN and shall not deflect more than 5 mm in direction of the force. The test load is then increased to 1,5 kN x 1,7 kN = 2,6 kN for a further minute. In case of the maximum load of 2,6 kN the functioning of the specimen and its fastening shall not be impaired. 3）Test at the anchorage point Apply a static test load of F_{y2} = 10 kN to the anchorage point for protective equipment against falls or for restraint in the direction of use (direction of y-axis) for roof safety hooks. Apply an additional static test load of F_{y2} = 10 kN in the direction of the negative y-axis and in the direction of the x-axis for roof safety hooks of Type B. The test loads in the y-direction and x-direction are applied to different specimens. Neither the roof safety hook nor the fastening shall become loose, and the test load shall be held safely.		N/A

Clause	Requirement + Test	result – Remark	Verdict
2.4.1.2	Test of fatigue strength （EN 517:2006, clasue 8.2） Roof safety hooks shall additionally be tested in accordance with the requirements of 7.3. Three test specimens shall be submitted to a drop test. The test specimens shall be fixed by their fastening systems to a simulation of the load-bearing roof construction in a position between 70° and 90° from the horizontal. The load and deflection criteria of the drop test shall conform to EN 364. For the test, a hawser laid polyamide lanyard of three strands and of 12 mm diameter according to EN ISO 1140 shall be used. One end of the lanyard shall be attached to the anchorage point of the test specimen. At the other end of the lanyard a drop mass of (100 ± 1) kg and (200 ± 2) mm in diameter shall be fastened. The drop mass shall be suspended at a maximum horizontal distance of 300 mm from the anchorage point of the lanyard and a vertical distance of 500 mm from that point by means of a quick release device. Release the drop mass which will fall freely through (2 500 ± 50) mm before the lanyard arrests the fall. Observe any deformations and deflections of the test specimen and its fastenings, and the test load shall be supported safely.		N/A
2.4.2	Evaluation of conformity （EN 517:2006, clasue 9）		N/A

Clause	Requirement + Test	result – Remark	Verdict
2.4.2.1	General （EN 517:2006, clause 9.1） The conformity of roof safety hooks to the requirements of this document and with the stated values (including classes) shall be demonstrated by: --initial type testing; and --factory production control by the manufacturer, including product assessment. Roof safety hooks, which differ only in aspects that do not influence the properties required in this document, may be collected into product groups. Providing that a roof safety hook within the group meets the requirements of this document, then all products within the same group shall be assumed to conform. If the same roof safety hook fails to conform, then the whole group shall be assumed to have failed to conform to this document. Roof safety hooks, which differ only with regard to some properties, may be grouped together for these common properties. Providing that a product within this defined group meets the requirements of this document, then all products within the group shall be assumed to conform for the properties concerned. The properties outside the common group shall be tested product by product, unless included in a group for one or more of these properties.		N/A

Clause	Requirement + Test	result – Remark	Verdict
2.4.2.2	Initial type testing （EN 517:2006, clasue 9.2） Initial type testing shall be performed to demonstrate conformity with this document. Tests previously performed in accordance with the provisions of this document (same product, same characteristic(s), test method, sampling procedure, system of attestation of conformity etc.) may be taken into account. In addition, initial type testing shall be performed at the beginning of the production of a new permanently fixed roof ladder type (unless a member of the same group) or at the beginning of a new method of production (where this may affect the stated properties). All characteristics in Clause 7 requiring testing shall be subject to initial type testing. The results of all type tests shall be recorded and held by the manufacturer for at least 10 years after the date of last production of the products to which they apply. Whenever a change occurs in the installations for roof access, the raw material or supplier of components, or the production process (subject to the definition of a group), which would change significantly one or more of the characteristics, the type tests shall be repeated for the appropriate characteristic(s).		N/A
3	**Load calculation** The static analysis (stability) of the racking system demonstrates the suitability of the system and its safety properties for its particular site. The system's calculated loading limits, the thicknesses of supporting structures, and cantilevers and ballasts are clearly highlighted / displayed.		P
3.1	Permanent actions Gk1 （ÖNORM M7778:2011, clasue 5.2.2.1）	Region: German Angle:90° Permanent effects: 0,12kN/m^2	P

Clause	Requirement + Test	result – Remark	Verdict
	Permanent effects correspond to the net mass of the solar panels, including the mounting structure and other minor components which are permanently available. Characteristic values of effects of the net mass of the structure are given in ÖNORM EN 1991-1-1, ÖNORM B 1991-1-1. Note: authoritative theoretical Report should be provided. Dynamic or inertia effects of self-weight of structural and non-structural members should be taken into account. Actions on attachments for hoisting elements and materials should be determined according to EN 1991-3.		
3.2	**snow actions Qk1** （ÖNORM M7778:2011, clasue 5.2.2.2）		N/A
	Characteristic values of snow loads are given in ÖNORM EN 1991-1-3 and ÖNORM B 1991-1-3: specifically, the standard snow loads on the ground ÖNORM EN 1991-1-3:2006, see Annex A. Exceptional snow loads are not taken into account in Austria. In spandrel roof installation of groups of solar thermal collectors and photovoltaic modules on flat roofs (α ≤ 5 °) of large halls (factory halls, shopping centers and the like from a roof size of 250 m2) for the roof structure (primary structure) is a shape factor of μ1 = 1 , 0. This is the obstruction of Abwehens snow from roofs in comparison to the ground snow load. Note1: authoritative theoretical Report should be provided.		N/A
3.3	**Wind actions Qk2** （ÖNORM M7778:2011, clasue 5.2.2.3）	Region: German Wind pressure: 1459.5 N/m^2 Wind suction: -1135.2 N/m^2 Angle:60º	P

Clause	Requirement + Test	result – Remark	Verdict
	Characteristic values are given in ÖNORM B 1991-1-4 and ÖNORM EN 1991-1-4, especially the fundamental values of the basic wind speed and the corresponding base rate pressure ÖNORM B 1991-1-4:2009, Table A.1 shall be taken. The aerodynamic coefficients for the different types of installation as shown in Figure 1 are given in ÖNORM B 1991-1-4; simplistic following values can be set: - Solar panel integrated in the roof covering (roof member) or in the facade (facade element); The loads are like for roof elements or façade elements according to ÖNORM EN 1991-1-4 and ÖNORM B 1991-1-4 set.		

Clause	Requirement + Test	result – Remark	Verdict
	- Roof mounting parallel to the roof surface, wall mounting set before (parallel to the facade). Depending on the clearance of the solar panel to the roof are set to the following values: - Clear distance> 300 mm: cr = -0.7 / +1.0 - Clear distance ≤ 300 mm: cr = -1.3 / +1.0 Elevated roof installation - - On flat roofs (α <5 °): cr = -1.45 / +1.1 - On steep roofs (east-west roofs, assembly normal to the ridge): cr = -1.6 / +1.6 The values for Aufdachmontagen apply to the control ranges of roofs and walls according to ÖNORM 1991-1-4, in areas with increased Windsogeinwirkungen (Rand, edge, ridge and corner zones), these values increase by 25%. - Free assembly The design is for installation on individual foundations approximated as a freestanding roof according to ÖNORM EN 1991-1-4:2005, Section 7.3 - Simplified procedure for roof mounting parallel to the roof surface, wall mounting set before (parallel to the façade), regardless of location Under the following conditions of static verification according to section 5.1 can be omitted: - Ridge height not exceeding 12 m, - Maximum element size of 2.5 m, - Clear distance of the solar panel to the roof as desired, - Installation in the control area of roofs and walls according to ÖNORM EN 1991-1-4, - Mounting on the roof with 4 connection points with a mean failure load normal to the roof surface on train / pressure as shown in Figure A.1 of 1.6 kN, - Consideration of any bending stress of the fastener. - If necessary, can be made at spandrel roof installation and assembly without a derating for a row standing solar panels according to ÖNORM EN 1991-1-4:2005, Table 7.8. Note: authoritative theoretical Report should be provided.		N/A

Clause	Requirement + Test	result – Remark	Verdict
3.4	**Other actions** （ÖNORM M7778:2011, clasue 5.2.2.4） Other effects, such as net loads and earthquake loads may not be considered for thermal solar collectors, photovoltaic modules and similar constructions.		N/A
3.5	**Combination of actions** The load combinations on the supporting frame should be considered as follows: (1) Load combination controlled by snow load $E1=1.35\times G_{k1}+ 1.5 \times Q_{k1} + 0.6\times 1.5 \times Q_{k2}$ (2) Load combination controlled by wind load $E2=1.35\times G_{k1}+ 0.5\times 1.5 \times Q_{k1} + 1.5 \times Q_{k2}$ (3) Load combination considered only wind load $E3=0.9\times G_{k1}+ 1.5 \times Q_{k2}$ where: Gk1 - Permanent actions Qk1 - snow actions Qk2– Wind actions	$F=2,345KN/m^2$ was used in this report.	P
4	Finite element analysis (FEA method) The structural analysis used to determine action effects from loads shall be in accordance with the principles of structural mechanics. FEA report shall be provided according to the calculated load in clause 3. Safety factor shall be at least 1.5.	Safety facter is 1.5 F(test)= 3,5175KN	P
5	Prototype testing According to the finite element analysis, apply combination load to the product, and then measure the max. stress. Safety factor shall be bigger than 1.5.	The max. stress is 120,75MPa and 132.44MPa which is less than theoretical value and the design strength (250MPa) The max. deflection is 3mm and 4mm which is less than the limited value(4,8mm)	P
6	**Additional System Characteristics** Regarding implementation of the system and other system characteristics.		N/A

Clause	Requirement + Test	result – Remark	Verdict
	The realization, implementation, and handling of the installation totals: (hrs / kW peak) The weights of the materials used totals: (module area / m²) Adjustment on uneven surfacesto let the braket to be suitable for the intended PV modules shall be described.		
7	**Additional test**		N/A
7.1	Mechanical load test according to IEC 61215/ IEC 61646, clasue 10.16		N/A
7.2	Pressure, suction, and shear testing of individual components including force-deformation diagrams and values		N/A
7.3	Verification of fire resistance according to EN 1187 Part 1-4 ☐ EN 60695-2-2 Needle flame test ☐ EN 60695-2-10 Glow wire test ☐		N/A
7.4	Leak proof (water spray) for roof penetration and integration systems according to EN 60529		N/A
7.5	Push and pull tests (For open-space systems)		N/A
7.6	Documentation For the test mark necessary documentations - design with measurement and tolerance data - part list with material data - material proofs -		N/A
8	Marking and user manual		P
8.1	Marking Products conforming to this document shall be clearly, visibly, legibly and indelibly marked, with the following information: -product name; -type designation - applicable Zone -name or identifying mark and address of the manufacturer or authorised representative; -batch No. (including year and month of the manufacturing) ;		P

Clause	Requirement + Test	result – Remark	Verdict
8.2	User manual Extensive and detailed installation instructions for each system, from site preparation to mounting and fixation of the PV modules, must be present. For entire system solutions (power generation & racking systems), electrical installation instructions all the way to the inverter must be included. The following criteria will be assessed in this order:		P
8.2.1	Status, version of the assembly instructions, and information such as the page number and table of contents are provided.		P
8.2.2	General information on system usage and for implementation (complete system, Pre-assembled, modular construction) and a notice to comply with these instructions prior to installation are provided.		P
8.2.3	Information on safety measures with their corresponding basis, and rules and a notice that the installation is to be carried out by trained personnel (2 persons at the construction site, roofing work by roofers, AC / DC wiring by an electrician) are listed.		P
8.2.3.1	Accident prevention regulations of the target country, e.g., German Professional Association, shall be listed in the installation manual, e.g.: BGV A1 - General rules BGV A2 - Power Systems and Equipment BGV C22 - Construction work		P
8.2.3.2	The demands on the supporting structure due to the loads on the structures shall be listed as, e.g.: DIN 1055-4 – Wind loads DIN 1055-5 - Snow and ice-snow loads EN 1991-1-3 Snow loads (Eurocode 1) EN 1991-1-4 Wind loads (Eurocode 1)		P
8.2.3.3	The regulations of the target country, e.g., German Central Association of Roofers (ZVDD) for work on roofs shall be listed.		P

Clause	Requirement + Test	result – Remark	Verdict
8.2.3.4	Only for providers of system solutions (power generation & racking systems) The VDE policies are provided. The VDE Guidelines for parallel operation of individual power generation systems with the grid per the German Utility Company (EVU) are available. DIN VDE 0100 (Part 712) - Erection of low voltage systems is listed. (The listed guidelines must be the complete and current versions in force at the time of testing.)		P
8.2.3.5	The standards for the design and installation of lightning protection, grounding, and bonding shall be listed according to UL 467		P
8.2.3.6	The following calculation standards for the materials shall be listed, e.g.: DIN 4113-1 aluminum structures DIN 18800 steel structures, design and construction		P
8.2.4	Notes to comply with the mounting instructions, warranty conditions and disclaimers are present in the mounting instructions.		P
8.2.5	An overview of the components belonging mounting system (Part No. / Name / BOM) and necessary tools are available in the installation instructions.		P
8.2.6	The instructions for checking the building, the roof and the existing roofing battens for determination of suitability for installation of the mounting system are listed.		P
8.2.7	The instructions include a detailed, illustrated procedure for installation: Determining the overall dimensions of the PV system, installation of roof hooks, horizontal rails, and modules. Only for system solutions: Wiring of the modules, installation of the DC main line, and installation of the inverter		P
8.2.8	Installation details such as torque, required gaps and fixation of the roof hooks (distance to the tiles, wood screws for wooden edges), maximum lengths of the rails, slide protection measures, and compensation methods for uneven surfaces, are present.		P

Clause	Requirement + Test	result – Remark	Verdict
8.2.9	Instructions for setting up lightning and surge protection, as well as bonding and grounding are included.		P
8.2.10	The instructions for ventilation, clearance from the surface of the roof, moisture and fire protection, drainage, and points of particular susceptibility to dirt and moss accumulation are given in the manual. Read phonetically Dictionary - View detailed dictionary 1. noun 2. brick 3. tile		P
8.2.11	Only providers of system solutions (power generation & racking systems) Instructions for connection to the grid, cable positioning, and measures to avoid wire loops are present in the mounting instructions.		P
8.2.12	Notes to comply with the mounting instructions, warranty conditions and disclaimers are present in the mounting instructions.		P

--- End of test report---