

Testing Report

Client Company Name : TANGSHAN HAITAI NEW ENERGY TECHNOLOGY CO LTD
Product Type : PHOTOVOLTAIC MODULES
Product Model : HTM545DMH5-72(1500)
Test Laboratory : National Energy Testing Research Institute (Tianjin) Co., Ltd
Test Location : No. 5, Jianfu Industry Park, Xiqing Economy & Technology Development Zone, Tianjin
Project Number : 4790352786
Report Date : 2022-09-30



Report No: 4790352786
Report Date: 2022-09-30



Client Information		
Company Name	TANGSHAN HAITAI NEW ENERGY TECHNOLOGY CO LTD	
Address	No. 88, Haomen Road, Yutai Industrial Zone, Yutian County, Tangshan City, Hebei, China	
Test Laboratory/Location		
☐ UL or Affiliate		☒ Subcontract Lab
Company Name	National Energy Testing Research Institute (Tianjin) Co., Ltd	
Location	No. 5, Jianfu Industry Park, Xiqing Economy& Technology Development Zone, Tianjin	
Report Information		
Report Number	4790352786	
Report Date [YYYY-MM-DD]	2022-09-30	
Standard References	UL 61730-2, Photovoltaic (PV) Module Safety Qualification - Part 2: Requirements for Testing, Edition 1, Revision Date 11/20/2020 IEC TS 60904-13, Photovoltaic devices – Part 13: Electroluminescence of photovoltaic modules, Edition 1, Issue Date 08/2018	
Product Information		
Product Type	Photovoltaic Modules	
Product Model	HTM545DMH5-72(1500)	
Project handler		
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Signature, date [YYYY-MM-DD]	<i>Jerry Kan Jason You</i>	2022-09-30/2022-09-30
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Approved By		
Printed Name, function	Ellie Wu	Engineering Manager
Signature, date [YYYY-MM-DD]	<i>Ellie Wu</i>	2022-09-30

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Abbreviations used in the report:

Pmax	– Maximum power
Vmp	– Maximum power voltage
Imp	– Maximum power current
Isc	– Short circuit current
Voc	– Open circuit voltage
FF	– Fill factor
STC	– Standard Test Conditions [25°C, 1000W/m ²]
N/A	– not apply to the object

Appendixes of this report:

No.	Appendix Name
1	Appendix1 – Product pictures
2	Appendix2 – Product nameplate label
3	Appendix3 – State of uncertainty
4	Appendix4 – Bill of material of the test sample
5	Appendix5 – Test equipment information

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1. Test Sample Description

1.1. Sampling Procedure

All the sample were selected and provided by client, UL LLC did not select the sample[s], determine whether the sample[s] was representative of production samples, witness the production of the test sample[s], nor were we provided with information relative to the formulation or identification of component materials used in the test sample[s].

1.2. Sample General Information

Manufacturer:		TANGSHAN HAITAI NEW ENERGY TECHNOLOGY CO LTD						
Electrical Ratings:								
Module Model	Voc [V DC] /Tolerance	Isc [A DC] /Tolerance	Pmax [W]/Tolerance	Vmp [V DC]	Imp [A DC]	Maximum system voltage [V DC]	Maximum Over-Current Protection Rating [A DC]	Dimension [mm]
HTM545DM H5-72(1500)	49.68/±3%	13.71/±4%	545	41.18	13.24	1500	30	2285*1134* 30

1.3. Sample Identification

Sample No.	Date Received [YYYY-MM-DD]	Product Identification	Type/Model
220705002	2022-07-26	HTD3E3112140044	HTM545DMH5-72(1500)

See the others sample information in appendix 1 and 2.

2. Testing

Test program:

Test No.	Test Item	Standard references, clause
1	Visual inspection	UL 61730-2, Edition 1, Issue Date 12/04/2017, Clause 10.2
2	Maximum power determination	UL 61730-2, Edition 1, Issue Date 12/04/2017, Clause 10.4
3	Electroluminescence test	IEC TS 60904-13, Edition 1, Issue date 2018-08, Clause 5.3
4	Insulation test	UL 61730-2, Edition 1, Issue date 12/04/2017, Clause 10.13
5	Wet leakage current test	UL 61730-2, Edition 1, Issue date 12/04/2017, Clause 10.14
6	Continuity test of equipotential bonding test	UL 61730-2, Edition 1, Issue date 12/04/2017, Clause 10.11
7	Static mechanical load test	UL 61730-2, Edition 1, Issue date 12/04/2017, Clause 10.23
8	Visual inspection after Static mechanical load test	UL 61730-2, Edition 1, Issue Date 12/04/2017, Clause 10.2
9	Maximum power determination after Static mechanical load test	UL 61730-2, Edition 1, Issue Date 12/04/2017, Clause 10.4
10	Electroluminescence test after Static mechanical load test	IEC TS 60904-13, Edition 1, Issue date 2018-08, Clause 5.3
11	Insulation test after Static mechanical load test	UL 61730-2, Edition 1, Issue date 12/04/2017, Clause 10.13
12	Wet leakage current test after Static mechanical load test	UL 61730-2, Edition 1, Issue date 12/04/2017, Clause 10.14
13	Continuity test of equipotential bonding test after Static mechanical load test	UL 61730-2, Edition 1, Issue date 12/04/2017, Clause 10.11

...

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Overview of test items for test sample:

The table below is provided to establish correlation of sample numbers to test numbers.

Sample No.	Test No.
220705002	1~13

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2.1 Visual Inspection (initial)

Test procedure: reference to UL 61730-2, Edition 1.0, Issue Date 12/04/2017, Clause 10.2.

Humidity [%RH]	57	Ambient [°C]	25.6
Tested by	Wen Zhihui	Test Date [YYYY-MM-DD]	2022-08-29

Table 1: Visual inspection [initial]		
Sample No.	Nature and position of findings – comments or attach photos	Critical [Yes/No]
220705002	No finding	No
Supplementary information: N/A		

Results

The sample[s] ~~did~~ [did not] show any critical visual defect.

2.2 Maximum Power Determination (initial)

Test procedure: reference to UL 61730-2, Edition 1.0, Issue Date 12/04/2017, Clause 10.4.

Humidity [%RH]	56	Ambient [°C]	24.0
Tested by	Wen Zhihui	Test Date [YYYY-MM-DD]	2022-08-29

Table 2: Maximum power determination [initial]									
Light source				☒ Simulator			☐ Natural sunlight		
Sample No.	Side	Voc [V]	Isc [A]	Pmax [W]	Vmp [V]	Imp [A]	FF [%]	Tmod [°C]	Irradiance [W/m²]
220705002	Front	49.84	13.59	540.112	41.31	13.08	79.76	24.8	1000
	Rear	49.13	9.72	387.936	41.33	9.39	81.21	24.6	1000
Supplementary information: N/A									

Results

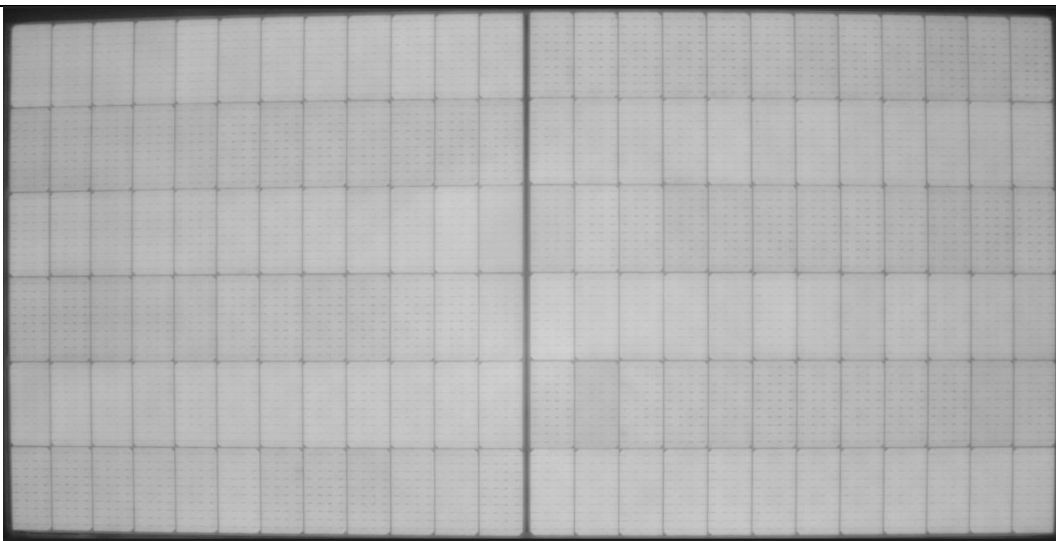
The IV curve ~~did~~ [did not] show any kink or other unusual characteristic.

2.3 Electroluminescence test (initial)

Test procedure: reference to IEC TS 60904-13, Edition 1.0, Issue date 2018-08, Clause 5.3.

Humidity [%RH]	56	Ambient [°C]	24.2
Tested by	Wen Zhihui	Test Date [YYYY-MM-DD]	2022-08-29

Table 3: Electroluminescence test [Initial]

Sample No.	Nature and position of findings – comments or attach photos
220705002	

2.4 Insulation test (initial)

Test procedure: reference to UL 61730-2, Edition 1.0, Issue date 12/04/2017, Clause 10.13.

Humidity [%RH]	57	Ambient [°C]	25.5
Tested by	Wen Zhihui	Test Date [YYYY-MM-DD]	2022-08-29

Table 4: Insulation test [initial]				
Sample No.	Test voltage applied [V _{DC}]	1500		Test voltage applied [V _{DC}]
	Module area [m ²]	Measured resistance [MΩ]	Required resistance [MΩ]	Dielectric breakdown
				Yes [description]/No
220705002	2.59	41600	15.44	No
Supplementary information: N/A				

Results

For modules with an area greater than 0.1 m²:

The measured insulation resistance ~~[was]~~ [was not] less than 15.44 megohms.

There ~~[was]~~ [was no] indication of dielectric breakdown during the test.

There ~~[was]~~ [was no] indication of surface tracking during the test.

2.5 Wet leakage current test (initial)

Test procedure: reference to UL 61730-2, Edition 1.0, Issue date 12/04/2017, Clause 10.14.

Humidity [%RH]	57	Ambient [°C]	25.5
Tested by	Wen Zhihui	Test Date [YYYY-MM-DD]	2022-08-29

Table 5: Wet leakage current test [initial]			
Solution temperature [°C]	22.7	Solution resistivity [Ω/cm]	2376
Test Voltage applied [V, DC]	1500		
Sample No.	Measured resistance [MΩ]	Module area [m²]	Required resistance [MΩ]
220705002	27500	2.59	15.44
Supplementary information: N/A			

Results

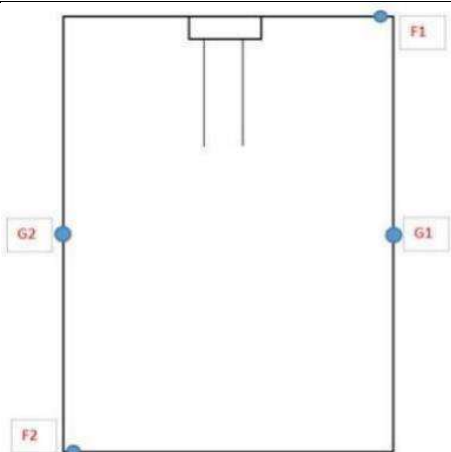
For modules with an area greater than 0.1 m²:

The measured insulation resistance ~~was~~ [was not] less than 15.44 megohms.

2.6 Continuity test of equipotential bonding (initial)

Test procedure: reference to standard UL 61730-2, Edition 1.0, Issue date 12/04/2017, Clause 10.11.

Humidity [%RH]	57	Ambient [°C]	25.5
Tested by	Wen Zhihui	Test Date [YYYY-MM-DD]	2022-08-29

Table 6: Continuity test of equipotential bonding [Initial]			
Maximum over-current protection rating [A DC]	30		
Current applied [A DC]	75		
Location of designated grounding point and accessible point on conductive components of the PV module			
			
G1, G2: Designated point for equipotential bonding F1, F2: Conductive point of the PV module			
Sample No.	Test point	Voltage dropped [V DC]	Resistance [Ω]
220705002	G1 to G2	0.3254	0.00434
	G1 to F2	0.2318	0.00309
	G2 to F1	0.2563	0.00342
Supplementary information: The resistance was calculated from the applied current and the resulting voltage drop measured at the connection points of the PV module [e. g. frame].			

Results

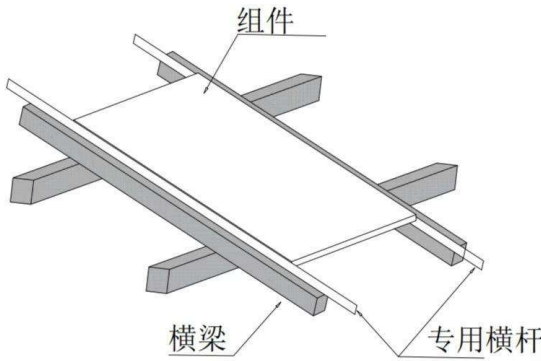
The resistance between the selected exposed conductive component and other conductive components of the PV module [was] ~~[was not]~~ less than 0.1 Ω .

2.7 Static mechanical load test

Test procedure: reference to UL 61730-2, Edition 1.0, Issue date 12/04/2017, Clause 10.23.

Humidity [%RH]	53	Ambient [°C]	26.1
Tested by	Wen Zhihui	Test Date [YYYY-MM-DD]	2022-08-30

Table 7: Static mechanical load test

Sample No.	220705002		
Design load (front side/ back side)	2400/1600	Safety factors	1.5
Mounting method	Clamp		
			
Load applied to	front side	back side	
Mechanical load [Pa]	3600	2400	
First cycle time (start/end)	9:41/10:41	10:55/11:55	
Intermittent open-circuit (yes/no)	no	no	
Second cycle time (start/end)	13:13/14:13	14:32/15:32	
Intermittent open-circuit (yes/no)	no	no	
Third cycle time (start/end)	15:50/16:50	17:08/18:08	
Intermittent open-circuit (yes/no)	no	no	
Supplementary information: N/A			

2.8 Visual inspection after static mechanical load test

Test procedure: reference to UL 61730-2, Edition 1.0, Issue Date 12/04/2017, Clause 10.2.

Humidity [%RH]	55	Ambient [°C]	25.6
Tested by	Wen Zhihui	Test Date [YYYY-MM-DD]	2022-08-31

Table 8: Visual inspection after static mechanical load test

Sample No.	Nature and position of initial findings – comments or attach photos	Critical [Yes or No]
220705002	No finding	No
Supplementary information: N/A		

Results

The samples ~~did~~ [did not] show any critical visual defect.

2.9 Maximum power determination after static mechanical load test

Test procedure: reference to UL 61730-2, Edition 1.0, Issue Date 12/04/2017, Clause 10.4.

Humidity [%RH]	55	Ambient [°C]	24.8
Tested by	Wen Zhihui	Test Date [YYYY-MM-DD]	2022-08-31

Table 9: Maximum power determination after static mechanical load test									
Light source				☒ Simulator ☐ Natural sunlight					
Sample No.	Side	Voc [V]	Isc [A]	Pmax [W]	Vmp [V]	Imp [A]	FF [%]	Tmod [°C]	Irradiance [W/m²]
220705002	Front	49.84	13.59	540.112	41.31	13.08	79.76	24.8	1000
	Rear	49.13	9.72	387.936	41.33	9.39	81.21	24.6	1000
Supplementary information: N/A									

Results

The IV curve ~~did~~ [did not] show any kink or other unusual characteristic.

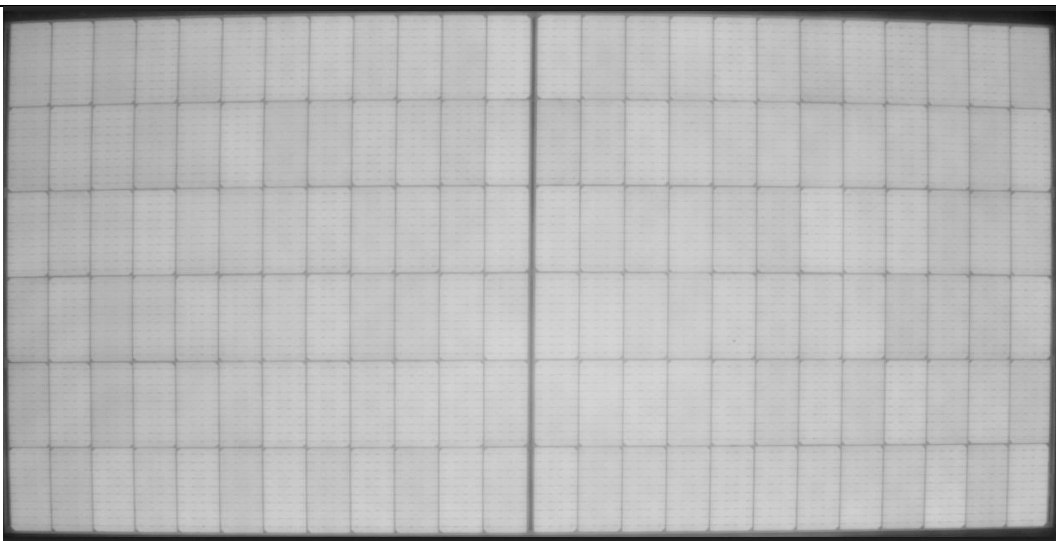
Degradation [%] compared to Mechanical load test					
Sample No.	Voc	Isc	Pmax	Vmp	Imp
220705002	-0.16%	-0.27%	-0.54%	-0.22%	-0.32%

2.10 Electroluminescence test after static mechanical load test

Test procedure: reference to IEC TS 60904-13, Edition 1.0, Issue date 2018-08, Clause 5.3.

Humidity [%RH]	55	Ambient [°C]	24.8
Tested by	Wen Zhihui	Test Date [YYYY-MM-DD]	2022-08-31

Table 10: Electroluminescence test [Initial]

Sample No.	Nature and position of findings – comments or attach photos
220705002	

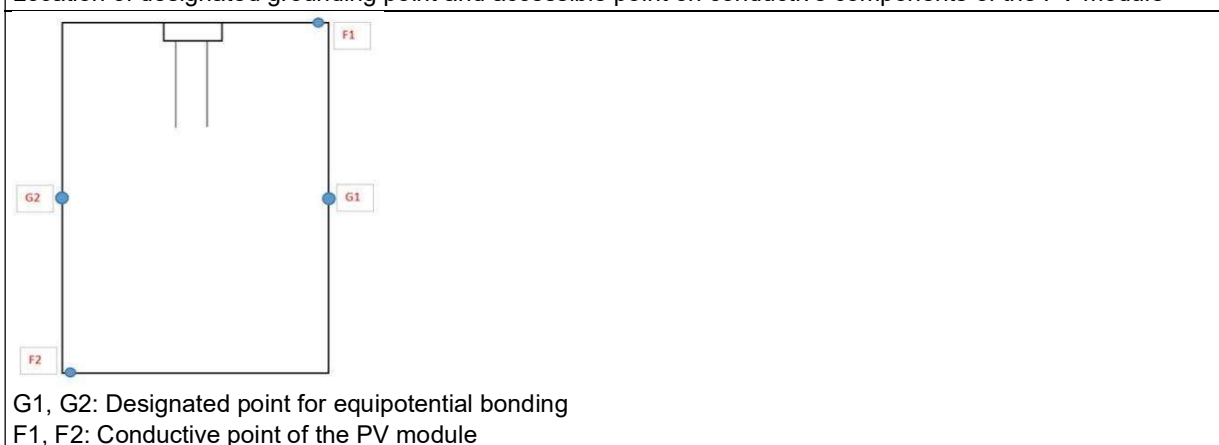
2.11 Continuity test of equipotential bonding after static mechanical load test

Test procedure: reference to UL 61730-2, Edition 1.0, Issue Date 12/04/2017, Clause 10.11.

Humidity [%RH]	55	Ambient [°C]	25.8
Tested by	Wen Zhihui	Test Date [YYYY-MM-DD]	2022-08-31

Table 11. Continuity test of equipotential bonding after static mechanical load test

Maximum over-current protection rating [A DC]	30
Current applied [A DC]	75
Location of designated grounding point and accessible point on conductive components of the PV module	



Sample No.	Test point	Voltage dropped [V DC]	Resistance [Ω]
220705002	G1 to G2	0.3513	0.00468
	G1 to F2	0.2476	0.00330
	G2 to F1	0.2386	0.00318

Results

The resistance between the selected exposed conductive component and other conductive components of the PV module [was] ~~[was not]~~ less than 0.1 Ω .

2.12 Insulation test after static mechanical load test

Test procedure: reference to UL 61730-2, Edition 1.0, Issue Date 12/04/2017, Clause 10.13.

Humidity [%RH]	55	Ambient [°C]	25.8
Tested by	Wen Zhihui	Test Date [YYYY-MM-DD]	2022-08-31

Table 12: Insulation test after static mechanical load test					
Test voltage applied [V DC]		1500	Test voltage applied [V DC]		8000
Sample No.	Measured resistance [MΩ]	Module area [m²]	Required resistance [MΩ]	Dielectric breakdown	
				Yes [description]/No	
220705002	41800	2.59	15.44	No	
Supplementary information: N/A					

Results

For modules with an area greater than 0.1 m²:

There ~~was~~ [was no] indication of dielectric breakdown during the test.

There ~~was~~ [was no] indication of surface tracking during the test.

The measured insulation resistance ~~was~~ [was not] less than 15.44 megohms.

2.13 Wet leakage current test after static mechanical load test

Test procedure: reference to UL 61730-2, Edition 1.0, Issue Date 12/04/2017, Clause 10.14.

Humidity [%RH]	55	Ambient [°C]	25.8
Tested by	Wen Zhihui	Test Date [YYYY-MM-DD]	2022-08-31

Table 13: Wet leakage current test after static mechanical load test			
Solution temperature [°C]	22.5	Solution resistivity [Ω/cm]	2343
Test Voltage applied [V, dc]	1500		
Sample No.	Measured resistance [MΩ]	Module area [m²]	Required resistance [MΩ]
220705002	25600	2.59	15.44
Supplementary information: N/A			

Results

For modules with an area greater than 0.1 m²:

The measured insulation resistance [~~was~~] [was not] less than 15.44 megohms.

Appendix1 – Product pictures

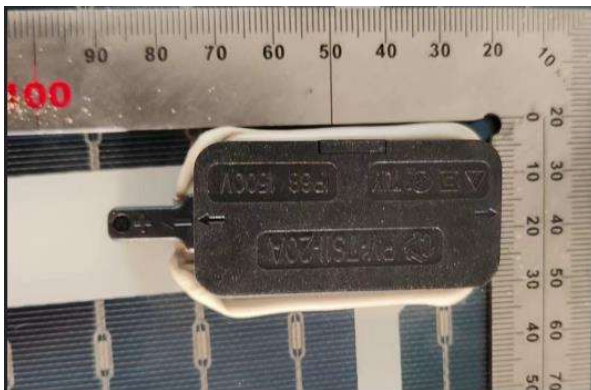
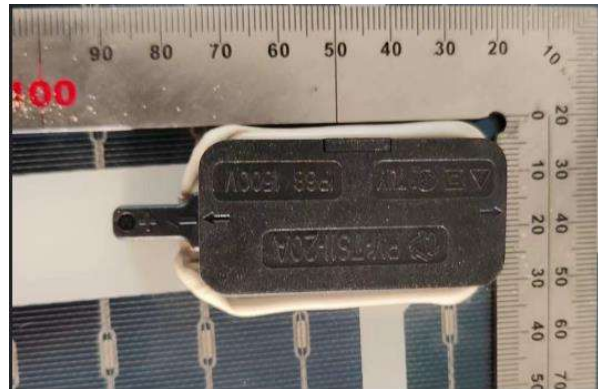
Front View



Back View



Junction box



Connectors



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Appendix2 – Product nameplate label



Appendix3 - State of uncertainty

Expanded measurement uncertainty statement for Maximum power measurement:

Isc	Voc	Imp	Vmp	Pmp
2.7%	1.5%	2.3%	1.4%	2.5%

k = 2.

The expanded measurement uncertainty resulting from the standard measurement uncertainty multiplied with a factor k=2 is specified, denoting the deviations of the measurement value within a probability of 95%.

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Appendix4 - Bill of material of the test sample

Not provided by Client.

Appendix5 - Test equipment information

Inst. ID No.	Instrument Type	Test Number, Test Title or Conditioning	Last Cal. Date [YYYY-MM-DD]	Next Cal. Date [YYYY-MM-DD]
CITC-022	Hygrothermograph	1、 3、 6、 7、 8、 9、 10、 13	2022-07-29	2023-07-28
CITC-012	Digital illuminometer	1、 8	2022-07-29	2023-07-28
CITC-019	digital caliper	1、 8	2022-07-29	2023-07-28
CITC-021	Tapeline	1、 8	2022-07-29	2023-07-28
CITC-025	Hygrothermograph	2、 4、 5、 11、 12	2022-07-29	2023-07-28
CITC-062	Standard module	2、 9	2021-11-10	2022-11-09
CITC-001	Solar Simulator	2、 9	2022-08-20	2023-08-19
CITC-030	clock	7	2022-07-29	2023-07-28
CITC-017	Current continuity monitor	6、 13	2022-07-29	2023-07-28
CITC-044	torque wrench	7	2022-07-29	2023-07-28
CITC-027	electronic platform scale	7	2022-07-29	2023-07-28
CITC-028	DC regulated power supply	3、 10	2022-07-29	2023-07-28
CITC-010	Safety tester	4、 5、 6、 11、 12、 13	2022-07-29	2023-07-28
CITC-013	Conductivitymeter	6、 13	2022-07-29	2023-07-28
CITC-029	Secondchronograph	7	2022-07-29	2023-07-28
CITC-043	Digital display thermometer	6、 13	2022-07-29	2023-07-28

Remark: during testing and measurements no equipment out of calibration.

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END OF REPORT