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TÜV Rheinland (Shanghai) Co., Ltd
莱茵技术（上海）有限公司
Solar/ Fuelcell Technologies
太阳能/燃料电池技术部门

Test Report 测试报告

Qualification of a Solar Collector in accordance with
太阳能集热器的测试参照标准
EN12975-1:2006+A1:2010 and ISO 9806: 2017

TÜV Report No.:

TÜV 报告编号: 50152939-001

Shanghai /上海, 2018-06-21

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Report-No.: 50152939-001

Qualification of a Solar Collector in accordance with
EN12975-1:2006+A1:2010 and ISO 9806: 2017

Client:客户: Oscar Science & Technology Co., Ltd.
No. 5 Xingda 3 Road, Yongkang,
Zhejiang 321300
P. R. China
TÜV Quotation No. 报价编号: : 52219151
TÜV Order No.: 项目编号: 154304341
Order of: 立项日期: 2018-01-15
Date of Receipt of Test Item:样品接收日期: 2018-01-25
Commencement of Test:测试开始日期: 2018-01-29
TÜV Client No.:客户编号: 671339
Project engineer:项目工程师: Lily Chen +86 (0)21 60814928
Business Field:业务领域: Solar Energy
No of Pages:页数: 19
Appendix:附件: 18 to 19

Summary of collector performance test results: 集热器热效率测试结果:

Manufacturer 生产商 Oscar Science & Technology Co., Ltd.
Brand 品牌 Oscar
Collector type 集热器型号 OS22
Year of manufacture 生产年份 2018
Length 长 1005 mm Absorber area 吸收面积 0.62 m²
Width 宽 715 mm Aperture area 采光面积 0.65 m²
Height 高 60 mm Gross area 总面积 0.72 m²
Weight (empty) 空重 17 Kg
Heat transfer medium 传热介质 Air

Thermal performance for liquid heating collector model 液体传热集热器模型热效率

	Gross area (A _G) 总面积	Aperture area (A _a) 采光面积	Absorber area (A _A) 吸收面积
Conversion factor η_0	0.690	0.764	0.801
Heat transfer coefficient a_1	12.551 W/(m ² K)	13.903 W/(m ² K)	14.575 W/(m ² K)
Temperature dependent heat transfer coefficient a_2	0.033 W/(m ² K ²)	0.037 W/(m ² K ²)	0.038 W/(m ² K ²)

Output power per collector unit 单块集热器的输出功率

		Irradiation 太阳辐射		
m (kg/h)	T _m - T _a in K	400 W/m ²	700 W/m ²	1000 W/m ²
97.2	9.0	167 W	292 W	418 W
126.0	11.8	181 W	317 W	453 W
165.6	12.9	192 W	337 W	481 W

List of Contents 目录

1	Summary of test results 测试概览	4
2	Setting of tasks 任务	5
3	Basis of testing 测试基础	5
4	Sampling 抽样	6
5	Description of the collector construction 集热器基本信息	6
6	Execution and evaluation 测试与评估	9
6.1	Visual inspection 外观检查	9
7	Measuring results of thermal performance testing 热性能测试结果	10
7.1	Pressure drop test 压力降测试	10
7.2	Performance test method according to ISO 9806:2017 chapter 24.2 根据 ISO 9806:2017 第 24.2 章的测试方法	11
7.3	Measuring results of time constant testing 时间常数测试结果	15
7.4	Collector incident angle modifier 集热器入射角修正	16
8	General remarks 总论	17

List of Contents – Appendix

Appendix 1:	Thermal performance test results 热性能测试结果	18
Appendix 2:	Photo documentation 照片文件	19



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1 Summary of test results 测试概览

Qualification of a Solar Collector in accordance with
EN12975-1:2006+A1:2010 and ISO 9806:2017

Manufacturer 生产商 : Oscar Science & Technology Co., Ltd.
No. 5 Xingda 3 Road, Yongkang,
Zhejiang 321300
P. R. China

Brand 品牌 : Oscar

Collector type 集热器型号 : OS22

Test 测试项目	Date 日期		Summary of main test results 主要测试结果信息
	Start 开始	End 结束	
Thermal performance 热效率测试	2018-04-11	2018-05-04	No visual damages

All above listed tests of the standard EN12975-1:2006+A1:2010 and ISO 9806:2017 were passed successfully in accordance with the criteria. 以上所有测试项目已经通过EN12975-1:2006+A1:2010和ISO 9806:2017 标准的相关规定

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Shanghai, 2018-06-21

Project engineer

项目工程师

陈科萍

Lily Chen

Assistant Project Manager

项目副经理

Cai Zhao



2 Setting of tasks 任务

Performance test in accordance with EN12975-1:2006+A1:2010 and ISO 9806:2017 of the Oscar Science & Technology Co., Ltd. collector OS22 should be performed with the aim of Solar Keymark certification.

Oscar Science & Technology集热器 OS22为申请Solar Keymark证书而根据EN12975-1:2006+A1:2010和ISO 9806:2017 标准进行的性能测试.

3 Basis of testing 测试基础

EN12975-1:2006+A1:2010 *“Thermal solar systems and components – Collectors – Part 1: General requirements”*

EN12975-1:2006+A1:2010 太阳能系统和部件 集热器 第一部分：基本要求.

ISO 9806:2017 *“Solar energy-Solar thermal collectors-Test method ”*

ISO 9806:2017 太阳能-太阳能集热器-测试方法.

Solar Keymark – Specific Scheme Rules v30.00 April 2017: *“Specific CEN Keymark Scheme Rules for Solar Thermal Products”*

Solar Keymark -2017年4月 v30.00 的特殊规定：CEN 对于太阳能光热产品的特殊规定.

4 Sampling 抽样

Prototype samples 样机抽样	<input type="radio"/>
Samples from pilot production 实验性产品中抽样	<input type="radio"/>
Samples from serial production 生产线抽样	<input checked="" type="radio"/>
Selection of test samples acc. to Solar Keymark scheme rules 根据 SK 相关规定进行抽样	<input checked="" type="radio"/>

5 Description of the collector construction 集热器基本信息

Manufacturer 生产商	Oscar Science & Technology Co., Ltd.
Brand name 品牌	Oscar
Collector Type 型号	OS22
Category 类型	Flat plate collector
Date of manufacture 生产日期	2018
Serial number 序列号	OS22-20180109-005
Drawing numbers 图纸编号	KJ-4-OS22-00

Collector & construction:

Gross dimensions l x w x t [mm] 总面积尺寸	1005 x 715 x 62 ^①
Aperture dimensions l x w [mm] x no. glazes 采光面尺寸	967 x 677 x 1 ^①
Physical Absorber dimensions l x w [mm] x no. of fins 额定吸热体尺寸	967 x 653 x 1 ^①
Deducting absorber area [m ²] 扣除吸热体面积	0.011 (ventilator) ^①
Gross/ Aperture/ Absorber area [m ²] 总面积/采光面积/吸热体面积	0.72 / 0.65 / 0.62 ^①
Weight empty [kg]空重	17 ^③
Fluid content [l]流体含量	NA

Absorber:吸收体

Construction type 结构类型	Flat plate absorber ^③
Absorber Material 吸热体材料	Aluminum ^③
Absorber thickness [mm] 吸热体厚度	0.70 ^①

- ① Determinate by test laboratory 由测试实验室确认
 ② Reviewed manufacturer information 由厂家审核过的信息
 ③ According to manufacturer information 根据厂家信息



Effective Surface 有效涂层	One side ^③
Surface treatment 表面处理	Painted ^③
Absorptance [] 吸收比	0.91 ^③
Emittance [] 发射比	0.12 ^③

Absorber Piping:吸热体管路

Collector connection type / dimension / numbers 集热器接口/尺寸/数量	Pipe / 122mm / 2 ^②
Header tube material / dimension 流道材料/尺寸	Not part of construction
Riser tube-header / tube-Absorber connection 流道集管/集管-吸热体连接	NA
Riser tube material / $\varnothing_{\text{outer}}$ / thickness / overall length [mm] 集管材质/直径/厚度/长度	NA
Number and Distance [mm] of riser tubes or fins on center position 集管数量以及间距	Not part of construction

Cover:玻璃盖板

Number of covers 数量	1	
Glazing to absorber space 玻璃盖板与吸热体间距	NA	
	Glass 1	Glass 2
Length / width or $\varnothing_{\text{outer}}$ / thickness [mm] 长度/宽度 (或者直径) /厚度	987 / 697 / 3.20 ^①	-
Material / surface and coating 材质/表面处理以及涂层	Glass / structured ^③	-
Transmittance factor [] 透射比	0.914 ^③	-

Casing: 边框 (或者联箱)

Enclosure L x W x T [mm] 边框 (或联箱)	1005 / 715 / 62 ^①
Enclosure material 材质	Aluminum alloy ^③
Enclosure backside material 背板材质	Zinc plate ^③
Frame fastening method 支架固定方式	Crimp connection ^③
Insulation 保温	Primary Material 第一层

- ① Determinate by test laboratory 由测试实验室确认
 ② Reviewed manufacturer information 由厂家审核过的信息
 ③ According to manufacturer information 根据厂家信息



Material 材质	Not part of construction
Thickness [mm]厚度	NA
Material thermal conductivity [W/Km ²] 材料导热系数	NA

Sealing`s: 密封材料

Frame – Cover 边框-盖板	Silicon based ^②
Frame Corner or side caps 边框-端盖	Silicon based ^②
Frame - back sheet 边框-背板	NA
Grommet header tube 端盖-流道	NA
Grommet evacuated tube 联箱-真空管	NA
Evacuated tube closure 真空管端部	NA

Limit values (given by manufacturer): 限值（生产商指定）

Max. operating temperature [°C] 最大操作温度	NA
Maximum operating pressure [kPa] 最大操作压力	60 ^③
Recommended Heat transfer medium 建议换热介质	Air ^③
Recommended operating mass Flow [l/(m ² h)] 建议流量	NA
Tilt angle limits [°] 倾角范围	60 to 90 ^③
Collector mounting 安装	On roof / flat roof / wall ^③
Other limitations 其他限定值	NA

- ① Determine by test laboratory 由测试实验室确认
 ② Reviewed manufacturer information 由厂家审核过的信息
 ③ According to manufacturer information 根据厂家信息



6 Execution and evaluation 测试与评估

6.1 Visual inspection 外观检查

Date 日期	2018-01-29	Tester 测试员	Jinping Yang
Internal barcode no. 内部编号	Serial no. 序列号	Description of defects 缺陷描述	
A000689744-002	OS22-20180109-005	No visual damages	

SOLAR AIR HEATER

- Type of collector OS22
- Coverage room area 50m²
- Gross collector area 0.72m²
- Dimensions of the collector
101x72x6.2cm
- Empty weight of the collector 17kg
- Max. operating pressure:60kPa
- Stagnation temperature, at 1000 W/
m² and 30 °C 139°C
- Manufactured in China
- Manufacturer of collector
Oscar Sci & Tec Co., Ltd.
- Volume of the heat transfer fluid 42L
- Year of manufacture 2018
- Serial number 20180109-005

Fig. 1: test sample label
测试样品标签

7 Measuring results of thermal performance testing 热性能测试结果

7.1 Pressure drop test 压力降测试

Serial no. 序列号	OS22-20180109-005
Date 日期	2018-05-04
Tester 测试员	Yi Zhang

7.1.1 Test conditions 测试条件

Fluid used to pressurize collector 用于施加压力的流体	Air
Average fluid temperature [°C] 流体平均温度	21.2

7.1.2 Test results 测试结果

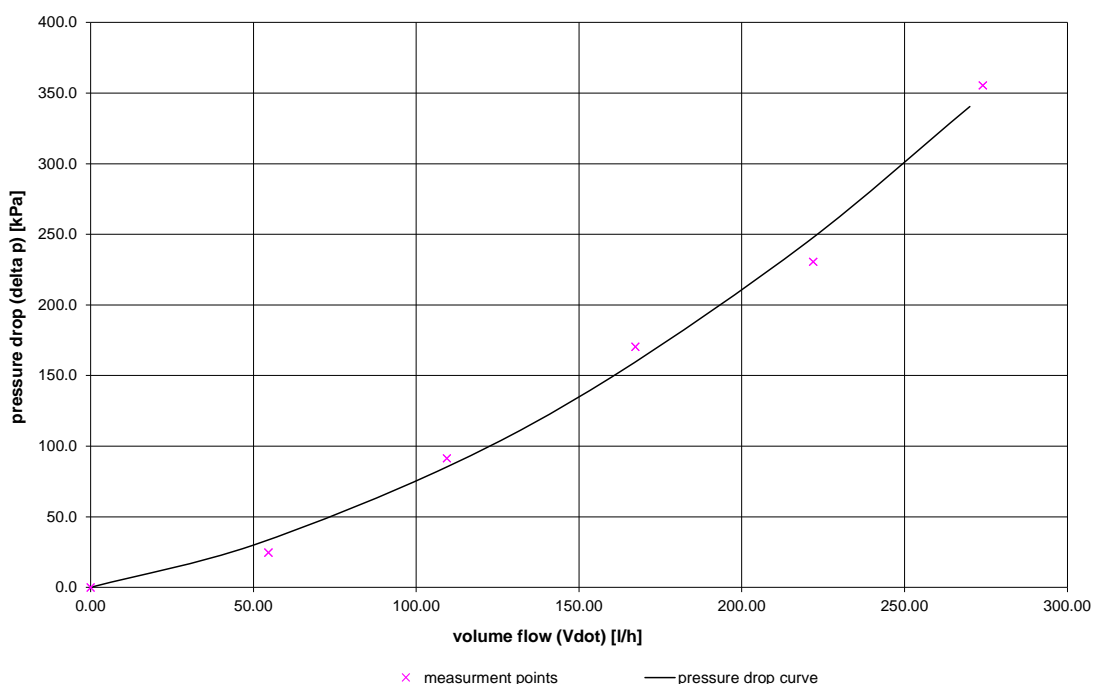


Fig. 2: pressure drop curve 压力降曲线

Function of pressure drop curve 压力降曲线函数	$\Delta p(\dot{V}) = 2.998E-03 \cdot \dot{V}^2 + 4.515E-01 \cdot \dot{V}$
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7.2 Performance test method according to ISO 9806:2017 chapter 24.2

根据 ISO 9806:2017 第 24.2 章的测试方法

outdoor steady state (6.1.4)

室外稳态法

indoor steady state (6.1.5)

室内稳态法

Serial no. 序列号	OS22-20180109-005	
Date (Start/End) 开始/结束日期	2018-04-11	2018-05-04
Tester 测试员	Yi Zhang	

7.2.1 Test conditions 测试条件

Latitude [°] 纬度	30°50' N
Longitude [°] 经度	120°61' E
Collector tilt [° from horizontal] 集热器倾角 (从水平面)	60
Collector azimuth [° from south] 集热器方位 (从正南)	0
Orientation of absorber or pipes 吸热体/管道方位	Horizontal
Heat transfer fluid 传热流体	Air
Gross area A_G [m ²] 总面积	0.72



7.2.2 Calculation method 计算方法

The instantaneous efficiency of a solar air heating collector, operating under steady-state conditions, is defined as the ratio of the extracted power to the solar energy intercept by the collector. The useful power output for an open to ambient collector can be described by:

稳态状态下的运行的太阳能空气集热器的瞬时效率被定义为集热器提取到的功率与吸收太阳能量的比例。一个开式集热器的有效输出功率可表示为:

$$\dot{Q} = \dot{m}_{pe} * (c_{f, e} * t_e - c_{f, amb} * t_i)$$

The solar energy intercept is $A * G$, where the area is A_A when referred to the absorber area, A_a when referred to the aperture area and A_G when referred to the gross area of the collector.

吸收到的太阳能量为 $A * G$, 当参照吸热体体积时面积为 A_A ; 当参照采光面积时为 A_a ; 当参照总面积时为 A_G .

$$\eta = \dot{Q} / A_G = [\dot{m}_{pe} * (c_{f, e} * t_e - c_{f, amb} * t_i)] / A_G$$

η : Efficiency

\dot{Q} : Power output (W)

A: Reference area (m²)

G: Global irradiation (W/m²)

\dot{m}_{pe} : Mass flow, collector outlet (kg/s)

$c_{f, e}$: Specific heat capacity of the heat transfer medium, collector outlet (KJ/kg·K)

$c_{f, amb}$: Specific heat capacity of the surrounding air (KJ/kg·K)

t_e : Temperature of the heat transfer medium, collector outlet (K)

t_i : Temperature of the heat transfer medium, collector inlet (K)

7.2.3 Schematic of the testing loop 测试回路图解

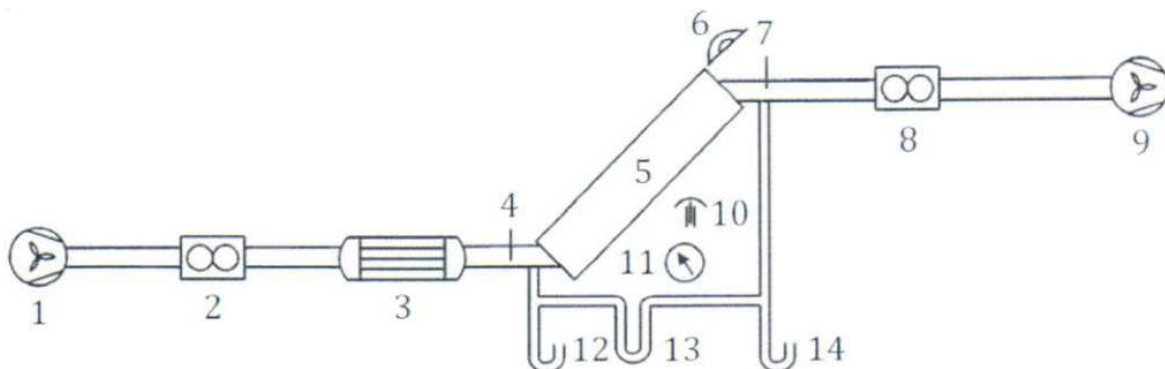


Fig. 3: Schematic of the testing loop

测试回路图解



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Key

- | | |
|--|---|
| 1 Fan | 9 Fan |
| 2 Flow meter ($\dot{m}_i = f(\dot{V}_i, \vartheta_{mp,i}, rH_i, P_i)$) | 10 Ambient temperature sensor (ϑ_a) |
| 3 Electric air heater | 11 Pressure gauge for surrounding air (P_{abs}) |
| 4 Temperature Sensor (ϑ_{in}) | 12 Pressure gauge ($P_{f,i}$) |
| 5 Solar air heater | 13 Differential pressure ($\Delta P = P_{f,i} - P_{f,e}$) |
| 6 Pyranometer (G) | 14 Pressure gauge ($P_{f,e}$) |
| 7 Temperature Sensor (ϑ_e) | |
| 8 Flow meter ($\dot{m}_e = f(\dot{V}_e, \vartheta_{mp,e}, rH_e, P_e)$) | |

7.2.4 Performance measurement result

7.2.4.1 efficiency

Power output measurement data

\dot{m}_{pe} (kg/h)	t_i (°C)	t_e (°C)	dT/G (Km ² /W)	G (W/m ²)	η_a -
97.2	21.1	35.7	0.002	994.6	58.1%
126.0	31.7	43.8	0.006	985.4	63.0%
158.4	32.0	42.3	0.008	998.0	66.6%

The above values given are valid for radiation of normal incidence and gross area as reference.

7.2.4.2 Power output per collector as function of irradiation

\dot{m} (kg/h)	$\vartheta_m - \vartheta_a$ (K)	400 (W/m ²)	700 (W/m ²)	1000 (W/m ²)
97.2	13.1	167 W	292 W	418 W
126.0	11.8	181 W	317 W	453 W
158.4	9.0	191 W	335 W	479 W



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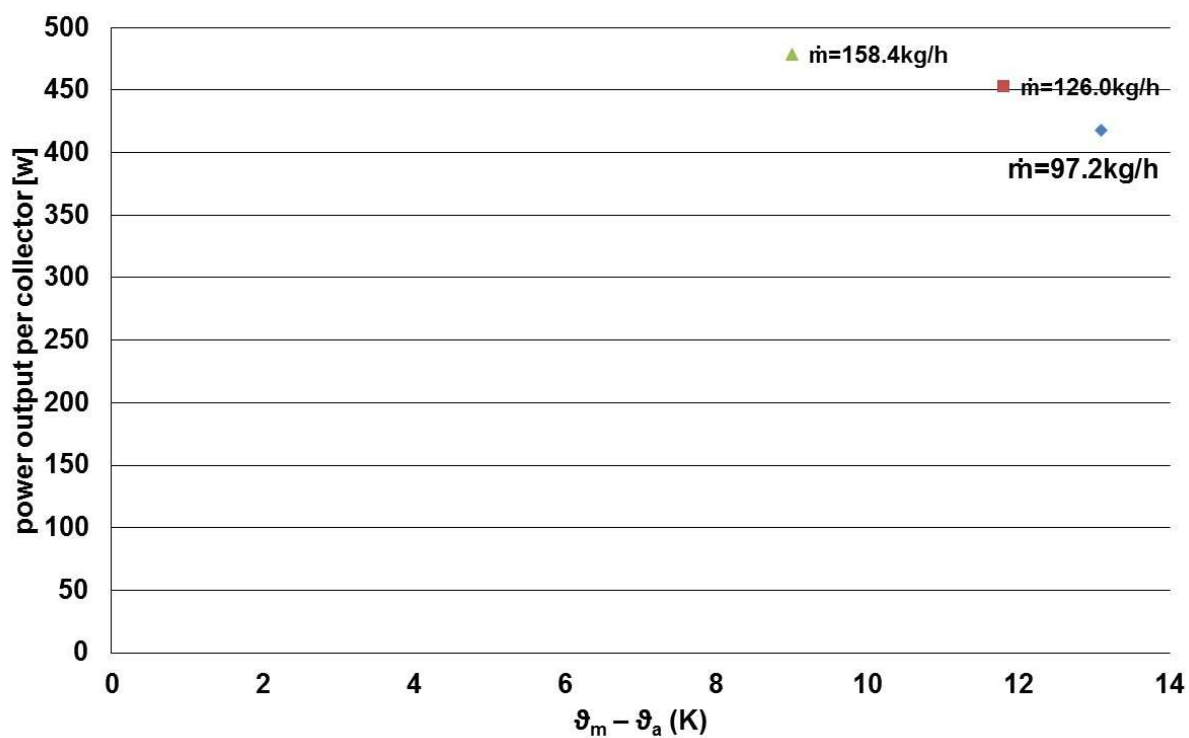


Fig. 4: Power output per collector unit over the temperature difference between the mean collector temperature t_m and the ambient temperature t_a , represented for 1000 W/m^2

辐射为 1000 W/m^2 时单一集热器平均温度与环境温度差值对应的输出功率



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7.3 Measuring results of time constant testing 时间常数测试结果

Serial no. 序列号	OS22-20180109-005
Date 日期	2018-04-18
Tester 测试员	Yi Zhang

7.3.1 Test conditions 测试条件

Collector tilt [° from horizontal] 集热器倾角 (从水平面)	tracked
Orientation of absorber or pipes 吸热体/管道方位	Horizontal
Mass flow (A_G) [kg/(m ² s)] 质量流量	0.049
Gross area A_G [m ²] 总面积	0.72

7.3.2 Test results 测试结果

Collector Time constant τ_c [s] 时间常数	150s
---	------



7.4 Collector incident angle modifier 集热器入射角修正

7.4.1 Test method according to ISO 9806:2017 Chapter 26 根据 ISO 9806:2017 第 26 章的测试方法

Serial no. 序列号	OS22-20180109-005	
Date (Start/ End) 开始/结束日期	2018-04-11	2018-05-04
Tester 测试员	Yi Zhang	

7.4.2 Test conditions 测试条件

Latitude [°] 纬度	30°50' N
Longitude [°] 经度	120°61' E
Collector tilt [° from horizontal] 集热器倾角 (从水平面)	60°
Collector azimuth [° from south] 集热器方位 (从正南)	0
Orientation of absorber or pipes 吸热体或管道方位	Horizontal
Heat transfer fluid 传热流体	Air
Gross area A_G [m ²] 总面积	0.72

7.4.3 Quasi-dynamic test results 准动态测试结果

Angle [°]	0	30	40	50
$K_{\theta b IAM}()$ []	1.00	0.97	0.94	0.87
$K_{\theta b IAM}()$ []				
Incidence angle modifier $K_{\theta}(50)$ [] 入射角修正系数	0.87			

Requisite additional information for incident angle modifier:

入射角修正必须的附加信息:

The evaluation in Chapter 7.4 was detected according to ISO 9806:2017 Chapter 26.4
 第 7.9.4 章的分析根据 ISO 9806:2017 的第 26.4 章进行。

For more details about incident angle modifier see Appendix 1: Thermal performance test results
 入射角修正的更多细节请参照附录 1: 热性能测试结果



8 General remarks 总论

All results only refer to the test samples that were subjected to testing. Symbols are in accordance with ISO 9488 and ISO 9806:2017 chapter 4. Solar Keymark – Specific Scheme Rules v30.00 April 2017 is not part of D-PL-11097-02-01 scope.

所有结果仅针对于经受过测试的样品.符号依据于ISO 9488 和 ISO 9806:2017 第4章. Solar keymark 特殊要求2017年4月版本v30.00不在D-PL-11097-02-01范围内。

Comment:

The following test item was performed by **Zhejiang Provincial Solar Energy Products Quality Inspection & Testing Center** (CNAS register number: CNAS L6894, address: No.208 Lianhong Road, Yuanhua town, Haining city 314412, Zhejiang province, China):

Pressure drop test; Time constant test and Thermal performance test.



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Appendix 1: Thermal performance test results 热性能测试结果

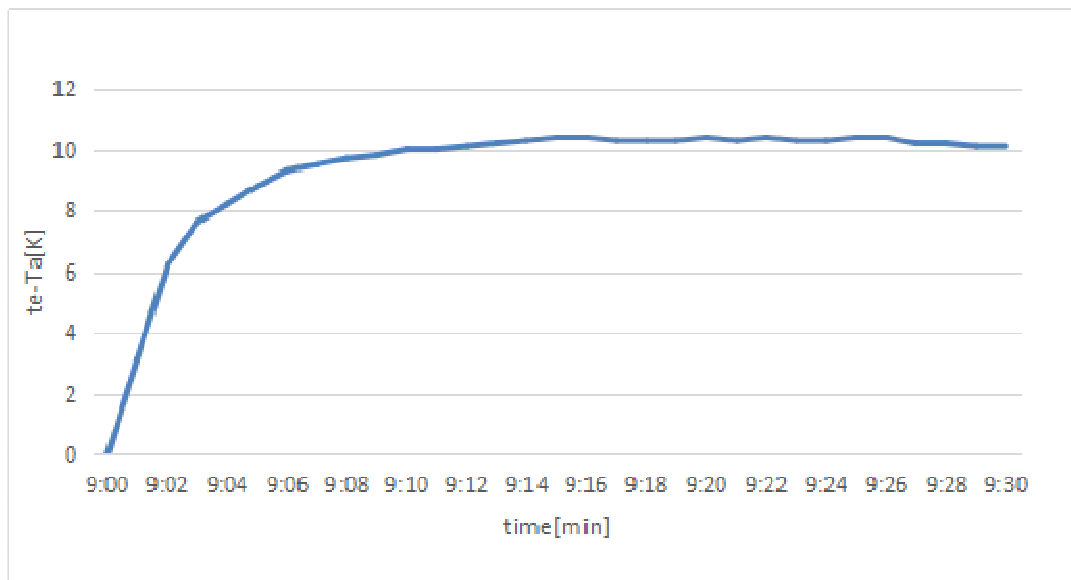


Figure A1.1: Time Constant 时间常数



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Appendix 2: Photo documentation 照片文件



Fig. 5: incoming inspection
图 5: 初检