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: **50152941-001**

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Report-No.: 50152941-001

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：	33
Appendix:附件：	30 to 33

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	OS42		
Year of manufacture 生产年份	2018		
Length 长	1970 mm	Absorber area 吸收面积	1.872 m²
Width 宽	1000 mm	Aperture area 采光面积	1.850 m²
Height 高	60 mm	Gross area 总面积	1.970 m²
Weight (empty) 空重	33 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	0.669	0.712	0.704
Heat transfer coefficient a_1	14.829 W/(m²K)	15.791 W/(m²K)	15.605 W/(m²K)
Temperature dependent heat transfer coefficient a_2	0.028 W/(m²K²)	0.030 W/(m²K²)	0.029 W/(m²K²)

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/m²	700 W/m²	1000 W/m²
111.6	14.3	355 W	621 W	887 W
165.6	13.3	420 W	735 W	1050 W
255.6	8.9	508 W	888 W	1269 W

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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 : OS42

Test 测试项目		Date 日期 Start 开始	Date 日期 End 结束	Summary of main test results 主要测试结果信息
Internal pressure test 内压测试		2018-03-23		No visual damages
Rupture or collapse test 破裂测试		2018-03-27		No visual damages
Stagnation temperature 停滞温度		2018-04-10		No visual damages
Exposure test 空晒测试		2018-01-26	2018-02-25	No visual damages
External thermal shock 外部热冲击测试	1st	2018-01-30		*1008 W/m² No visual damages
	2nd	2018-02-28		*1028 W/m² No visual damages
Internal thermal shock 内部热冲击测试	1st	2018-04-07		*950 W/m² No visual damages
	2nd	2018-05-08		*911 W/m² No visual damages
Rain penetration 喷淋测试		2018-03-02		No visual damages
Freeze resistance 抗冻测试		NA		Air as freeze resistance fluid
Mechanical load 机械载荷测试		2018-03-19 2018-03-20		Negative 1936Pa: the glass cover broken
Thermal performance 热效率测试		2018-05-14	2018-05-16	No visual damages
Impact resistance 耐撞击测试		2018-04-02		Height 1.4m: glass cover broken
Final inspection 终检		2018-05-30		Height 1.4m of the 150g steel ball impact cause glass cover broken. Negative 1936Pa cause the glass cover broken.

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

Lily Chen

Assistant Project Manager
项目副经理

Cai Zhao

2 Setting of tasks 任务

A complete collector test in accordance with EN12975-1:2006+A1:2010 and ISO 9806:2017 of the Oscar Science & Technology Co., Ltd. collector OS42 should be performed with the aim of Solar Keymark certification.

Oscar集热器OS42为申请Solar Keymark证书而根据EN12975-1:2006+A1:2010和ISO 9806:2017标准进行的完整测试.

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	○
Samples from pilot production 实验性产品中抽样	○
Samples from serial production 生产线抽样	◙
Selection of test samples acc. To Solar Keymark scheme rules 根据 SK 相关规定进行抽样	◙

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	OS42
Category 类型	Flat plate collector
Date of manufacture 生产日期	2018
Serial number 序列号	OS42-20180109-009 OS42-20180109-003 OS22-20180109-007
Drawing numbers 图纸编号	KJ-4-OS22-00 KJ-4-OS42-00

Collector & construction:

Gross dimensions l x w x t [mm] 总面积尺寸	1970 x 1000 x 60 ①
Aperture dimensions l x w [mm] x no. glazes 采光面积尺寸	1932 x 958 x 1 ①
Physical Absorber dimensions l x w [mm] x no. of fins 额定吸热体尺寸	1912 x 985 x 1 ①
Deducting absorber area [m²] 扣除吸热体面积	0.011 ①
Gross/ Aperture/ Absorber area [m²] 总面积/采光面积/吸热体面积	1.970 / 1.850 / 1.872 ①
Weight empty [kg]空重	33 ①
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

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

Absorber thickness [mm] 吸热体厚度	0.70 ①
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 / $Ø_{outer}$ / 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 $Ø_{outer}$ / thickness [mm] 长度/宽度（或者直径）/厚度	1950 / 985 / 3.14 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）	1970 x 1000 x 60 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

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

Insulation 保温	Primary Material 第一层
Material 材质	Not part of construction
Thickness [mm]厚度	NA
Material thermal conductivity [W/Km²] 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/(m²h)] 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 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

Instruction/installation manual: 操作/安装手册
Installation manual is reviewed to the requirements of EN12975-1:2006+A1:2010
安装手册根据 EN12975-1:2006+A1:2010 的要求进行审核

	Comments 备注	Fulfilled 满足
Dimensions and weight of the collector, nstructtions for transport and handling thereof 集热器尺寸和重量及运输、操作说明		Yes
Description of the assembly procedure 组装流程说明		Yes
Recommendations regarding lightning protection 关于防雷击的建议		Yes
Instructions for connecting collectors to each oth-er and for connection of the collector field to the heat transfer circuit as well as dimensions of tube connections in collector groups up to 20 m² 多个集热器单元组合到一起直到 20 ㎡的连接方式		Yes
Recommendations regarding the usable heat transfer media (also with regard to corrosion) as well as precautionary measures which are to be taken for filling, operation, servicing and mainte-nance 可用传热介质的相关建议（包括腐蚀）和充水、操作、服务及维修时的防护措施		Yes
Maximum operating pressure, pressure loss as well as largest and smallest tilt angles 最大操作压力、最大和最小倾角时的压力降		Yes
Permissible wind and snow load 允许的风或雪负荷		Yes
Maintenance requirements 维修要求		Yes

Collector type plate: 集热器标签
Collector marking is reviewed to requirements of EN12975-1:2006+A1:2010
集热器标签根据 EN12975-1:2006+A1:2010 的要求进行审核

	Comments 备注	Fulfilled 满足
Name of the manufacturer 厂家名称		Yes
Type of collector 集热器型号		Yes
Serial number 序列号		Yes
Year of manufacture 生产年份		Yes
Gross collector area 总面积		Yes
Dimensions of the collector 集热器尺寸		Yes
Maximum operating pressure 最大操作压力		Yes
Stagnation temperature, at 1000 W/m² and 30 °C 1000 W/m² 和 30 °C 时的停滞温度		Yes
Volume of the heat transfer fluid 传热流体体积		Yes
Empty weight of the collector 空重		Yes
Manufactured in: …生产地		Yes
Durability: 耐久性		Yes

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	
A000689745-001	OS42-20180109-009	No visual damages	
A000689744-001	OS22-20180109-007	No visual damages	
A000689744-002	OS42-20180109-003	No visual damages	

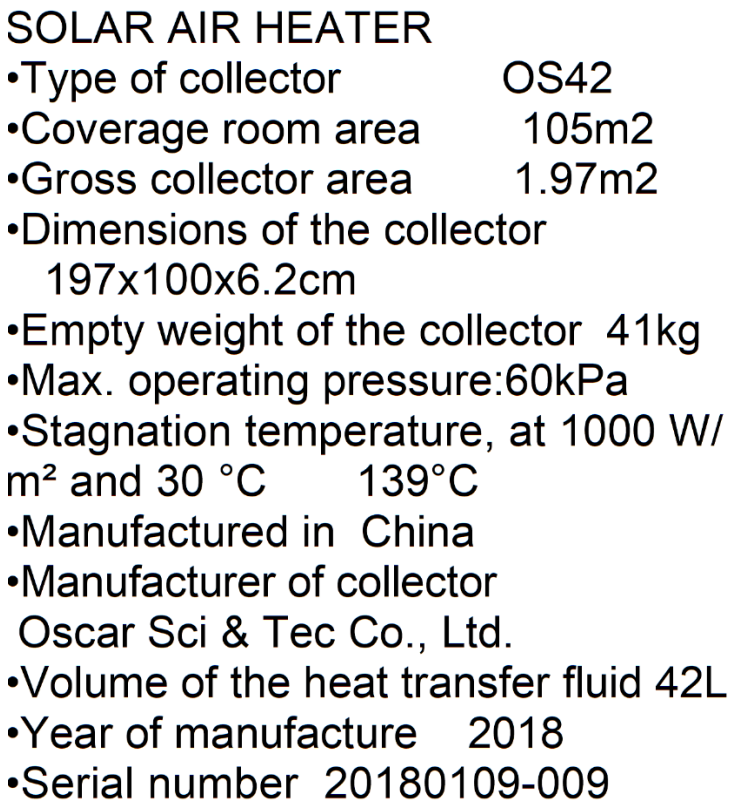

Fig. 1: test sample label
测试样品标签

6.2 Internal pressure test 内压测试

6.2.1 *Collector type 集热器类型*

Absorber material 吸热体材质	◙ Inorganic 无机	○ Organic 有机
Maximum collector operating pressure specified by manufacturer [kPa] 生产商指定最大集热器操作压力	60	
Serial no. 序列号	OS42-20180109-003	

6.2.2 *Test conditions 测试条件*

Date 日期	2018-03-23	Tester 测试员	Yi Zhang
Test temperature [°C] 测试温度	18.4		
Test irradiance (W/m2)测试辐射度	934		
Max. positive test pressure [KPa]测试最大正压	90		
Max. negative test pressure [KPa] 测试最大负压	Not performed		
Test duration [min] 测试时间	15		
Pressure difference [kPa] 压力差	-		

6.2.3 *Test results 测试结果*

Details of any observed or measured leakage, swelling or distortion and problems which according to 7.4 of ISO 9806:2017 are to be classified as “severe”. 根据 ISO 9806:2017 第 7.4 部分所观察或测量到的任何泄露、膨胀、变形等问题细节要归为“严重”.
No visual damages

6.3 Rupture or collapse test 破裂测试

6.3.1 *Collector type 集热器类型*

Serial no.序列号	OS42-20180109-003	
Date (Start/End)开始/结束日期	2018-03-23	2018-05-16
Tester 测试员	Yi Zhang	

6.3.2 *Test conditions 测试条件*

Test duration [min] 测试时间	10
Test absorber temperature [°C] 吸热体温度	102.2
Test irradiance [W/m²] 测试辐照度	956
Ambient temperature [°C] 环境温度	20.8
Inlet fluid temperature [°C] 进口空气温度	21.3
Ambient air absolute pressure [Pa] 大气压力	101300
Max. positive test pressure [Pa]测试最大正压	90000
Max. negative test pressure [Pa] 测试最大负压	Not performed

6.3.3 *Test results 测试结果*

Details of any observed or measured leakage, swelling or distortion and problems which according to 8.3 of ISO 9806:2017 are to be classified as “severe”. 根据 ISO 9806:2017 第 8.3 部分所观察或测量到的任何泄露、膨胀、变形等问题细节要归为“严重”.
No visual damages

6.4 Stagnation temperature 停滞温度

Serial no.序列号		OS22-20180109-007	
Date 日期	2018-02-25	Tester 测试员	Jinping Yang

6.4.1 Method used to heat collector 测试方法

Test performed with outdoor exposure / solar simulator 在户外暴晒/太阳模拟器进行测试	outdoor

6.4.2 Conditions for testing stagnation temperature 停滞温度测试条件

Collector tilt angle [° from horizontal] ◦ 集热器倾角（从水平面）	30
Average irradiation during test [W/m²] 测试期间平均太阳辐射	1007
Average ambient air temperature [°C] 平均环境温度	26.0
Average ambient air speed [m/s] 平均环境风速	0.8
Absorber temperature [°C] 吸热体温度	145.0

6.4.3 Determination of stagnation temperature 停滞温度的确定

Stagnation temperature [°C] for ambient conditions of 1000W/m² and 30°C 停滞温度 在辐射为 1000W/m² 且环境温度为 30°C 时	148.2

6.4.4 Test remarks 备注

Requisite additional information for stagnation temperature: 停滞温度必须的附加信息：
NA

6.5 Exposure test 暴晒测试

Serial no.序列号	OS42-20180109-009	
Date begin/ end 开始/截止日期	2018-01-26	2018-02-25
Tester 测试员	Jinping Yang	

6.5.1 Test conditions 测试条件

Collector tilt angle [° from horizontal] 集热器倾角（从水平面）	30	
Total no. of test days and radiation energy [MJ/m²]总测试天数和总辐射	30	581.4
No. of days with more than 14 MJ/m² 超过 14MJ 的天数	21	
No of rain days and total rainfall [mm] 下雨天数及总降雨量	2	3.2
Time period with G>900 W/m² & ta>15°C [h] 辐射大于 900 W/m² 且环境温度大于 15°C 的时间	64.5	
	minimum value 最小值	maximum value 最大值
Ambient temperature of test days [°C] 测试日内环境温度	0.3	30.7
Ambient temperature during high irradiation > 900 W/m² [°C] 辐射大于 900 W/m²的环境温度	21.0	27.6
Total daily rainfall [mm] 总日降雨量	0.0	3.1

6.5.2 Test results 测试结果

Details of any observed or measured problems or failures which according to A.8 of ISO 9806:2017 are to be classified as “severe”. 根据 ISO 9806:2017 A.8 章所观察或测量到的任何问题或失效细节归为“严重”.
No visual damages

For more details about exposition test see Appendix 2: Climate data.

对于暴晒测试的更多详细信息请参照附录 2：天气数据

6.6 External thermal shock test 外部热冲击

6.6.1 Test conditions 测试条件

	1st shock 第一次冲击		2nd shock 第二次冲击	
Test performed with outdoor exposure / solar simulator 在室外暴晒时/太阳模拟器进行测试	outdoor		outdoor	
Serial no.序列号	OS42-20180109-009			
Date 日期	2018-01-30		2018-02-28	
Tester 测试员	Jinping Yang		Jinping Yang	
Collector tilt angle [° from horizontal] 集热器倾角（从水平面）	30		30	
Irradiation G^*_{min} & G^*_{mean} [W/m²] 最小和平均太阳辐射	1008	1026	1028	1063
Ambient air temperature $t_{a\ min.}$ & $t_{a\ mean}$ [°C] 最小和平均环境温度	20.81	21.19	26.82	27.42
Period during which steady state conditions were maintained prior to shock [min] 在冲击之前的温度状态维持时间	60		60	
Water spray mass flow rate [kg/(sm²)] 测试流体质量流量	0.041		0.050	
Water spray temperature [°C] 水温	15.4		22.3	
Spraying duration [min] 测试持续时间	15		15	
Absorber temperature immediately prior to spraying water [°C]: 测试前吸热体温度	-		-	

6.6.2 Test results 测试结果

Details of any observed or measured cracking, distortion, condensation, water penetration or loss of vacuum found and problems which according to 11 of ISO 9806:2017 are to be classified as “severe”. 根据 ISO 9806:2017 第 11 章所观察或测量到的任何破裂、变形、凝结、渗水、失去真空等问题细节要归为“严重”.
No visual damages

6.7 Internal thermal shock test 内部热冲击

6.7.1 Test conditions 测试条件

	1st shock 第一次冲击		2nd shock 第二次冲击	
Test performed with outdoor exposure / solar simulator 在室外暴晒时/太阳模拟器进行	outdoor		outdoor	
Serial no.序列号	OS42-20180109-003			
Date 日期	2018-04-07		2018-05-08	
Tester 测试员	Yi Zhang		Yi Zhang	
Collector tilt angle [° from horizontal] 集热器倾角（从水平面）	60		60	
Irradiation G^*_{min} & G^*_{mean} [W/m²] 最小和平均太阳辐射	950	971	911	921
Ambient air temperature $t_{a\,min.}$ & $t_{a\,mean}$ [°C] 最小和平均环境温度	12.7	13.5	20.8	21.9
Period during which steady state conditions were maintained prior to shock [min] 冲击前稳态维持的时间	60		60	
Mass flow rate [kg/(sm²)] 测试流体质量流量	0.0236		0.0236	
Fluid temperature [°C] 流体温度	14.2		22.2	
Test duration [min] 测试持续时间	5		5	
Absorber temperature prior to test [°C] 测试后吸热体温度	99.5		97.1	

6.7.2 Test results 测试结果

Details of any observed or measured cracking, distortion, condensation, water penetration or loss of vacuum found and problems which according to 12 of ISO 9806:2017 are to be classified as “severe”. 根据 ISO 9806:2017 第 12 章所观察或测量到的任何破裂、变形、凝结、渗水、失去真空等问题细节要归为“严重”.
No visual damages

6.8 Rain penetration test 淋雨测试

Serial no.序列号	OS42-20180109-009
Date 日期	2018-03-02
Tester 测试员	Jinping Yang

6.8.1 Test conditions 测试条件

Collector mounted on:集热器安装在	Open frame
Collector tilt angle [° from horizontal] 集热器倾角（从水平面）	60
Detection of ingress of water:检查是否进水	By weighing collector
Water spray flow rate [kg/(s*m²)]流量	0.039
Spraying duration [h]持续时间	4
Weight difference before and after testing[kg]	0.0476

6.8.2 Test results 测试结果

Details of any problems which according to 13 of ISO 9806:2017 are to be classified as “severe”.: 根据 ISO 9806:2017 第 13 章的相关问题细节归为“严重”.
No visual damages

6.9 Mechanical load test 机械载荷测试

Serial no.序列号	OS42-20180109-009
Date 日期	2018-03-19 (positive) 2018-03-20 (negative)
Tester 测试员	Jinping Yang

6.9.1 Positive pressure test of the collector cover 集热器盖板正压测试

Method used to apply pressure 适用的方法

○ Suction cups 吸盘 ◙ Loading with water 用水压

Maximum pressure load [Pa]最大压力	2400
Remaining deflection [mm]形变量	-

6.9.2 Negative pressure test of collector 集热器负压测试

Method used to apply pressure 适用的方法

◙ Suction cups 吸盘 ○ Loading with water 用水压

Maximum pressure load [Pa]最大压力	1936
Remaining deflection [mm]形变量	-

6.9.3 Test results 测试结果

Details of any damage to the collector cover, cover fixings or mounting fixings and problems which according to 15 of ISO 9806:2017 are to be classified as “severe”: 根据 ISO 9806:2017 第 15 章的任何集热器盖板、盖板配件或紧固配件损坏或问题细节归为“严重”.
During the negative pressure test, the glass cover broken detected when the pressure increased to 1936Pa.

6.10 Impact resistance test using steel ball 用钢球做抗撞击测试

Serial no.序列号	OS22-20180109-007
Date 日期	2018-04-02
Tester 测试员	Jinping Yang

6.10.1 Test conditions 测试条件

Diameter of ball: 33.3 mm 钢球直径　　Mass of ball: 150g 钢球质量

◙ vertical impact 垂直撞击　　○ horizontal impact 水平撞击

Maximum height of drops [m] 最大下降高度	No. of drop tests 下降次数
0.4	4
0.6	4
0.8	4
1.0	4
1.2	4
1.4	2
1.6	
1.8	
2.0	

6.10.2 Test results 测试结果

Details of any damage to the collector and problems which according to 16 of ISO 9806:2017 are to be classified as “severe”. 根据 ISO 9806:2017 第 16 章的任何集热器损坏或问题要归为“严重”.
During the steel ball impact test, the glass cover broken detected when the vertical height increased to 1.4m.

6.11 Final Inspection 终检

Serial no.序列号	OS42-20180109-009
Date 日期	2018-05-30
Tester 测试员	Jinping Yang

6.11.1 Test results 测试结果

	Collector component 集热器部件	Potential problem 潜在问题	Evaluation 评价
a)	Collector box, fasteners 集热器联箱、紧固件	Cracking, warping, corrosion, rain penetration 破裂、弯曲、腐蚀、渗水	0
b)	Mountings, structure 支架、结构	Strength, safety 强度、安全性	0
c)	Seals, gaskets 密封、垫圈	Cracking, adhesion, elasticity 破裂、粘附、弹性	0
d)	Cover, reflector 盖板、反光板	Cracking, crazing, buckling, delamination, warping, out gassing 破裂、碎裂、屈曲、分层、扭曲、漏气	1
e)	Absorber coating 吸热体涂层	Cracking, crazing, blistering 破裂、碎裂、起泡	0
	Absorber tubes and headers 吸热管和管头	Deformation, corrosion, leakage, loss of bonding 变形、腐蚀、泄露、失去粘合	0
	Absorber mounting 吸热体安装	Deformation, corrosion 变形、腐蚀	0
f)	Insulation 保温材料	Water retention, out gassing, degradation 渗水、外漏、退化	0

Evaluate each potential problem according to the following scale:
根据下列形式评价每一个潜在问题

0 No problem没有问题
1 Minor problem较小问题
2 Severe problem严重问题

- Inspection to establish the condition was not possible.
  检验建立的条件是不可能的.

Requisite additional information for final inspection:
终检必须的附加信息：

Height 1.4m of the 150g steel ball impact cause glass cover broken.

Negative 1936Pa cause the glass cover broken.

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	OS42-20180109-003
Date 日期	2018-05-12
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	21.5

7.1.2 Test results 测试结果

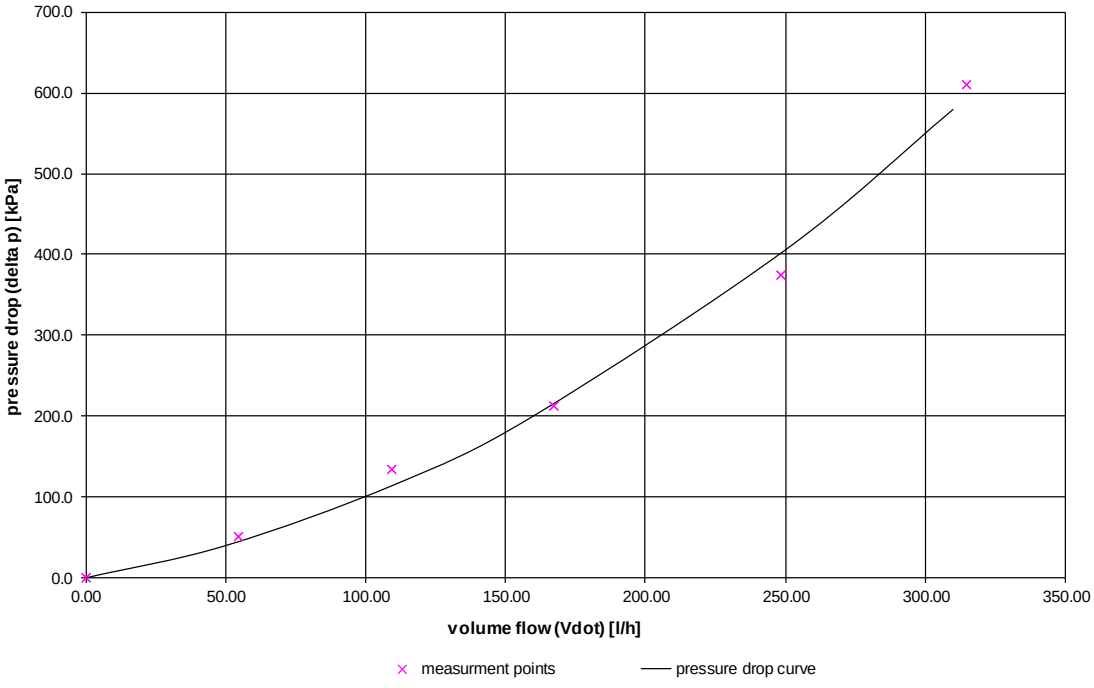

Fig. 2: pressure drop curve 压力降曲线

Function of pressure drop curve 压力降曲线函数	$\Delta p(\dot{V}) = 4.119E\text{-}03 * \dot{V}^2 + 5.937E\text{-}01 * \dot{V}$

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) ○ indoor steady state (6.1.5)
室外稳态法 室内稳态法

Serial no.序列号	OS42-20180109-003	
Date (Start/End)开始/结束日期	2018-05-14	2018-05-16
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 [m²]总面积	1.970

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 AA;当参照采光面积时为 Aa;当参照总面积时为 AG.

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

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

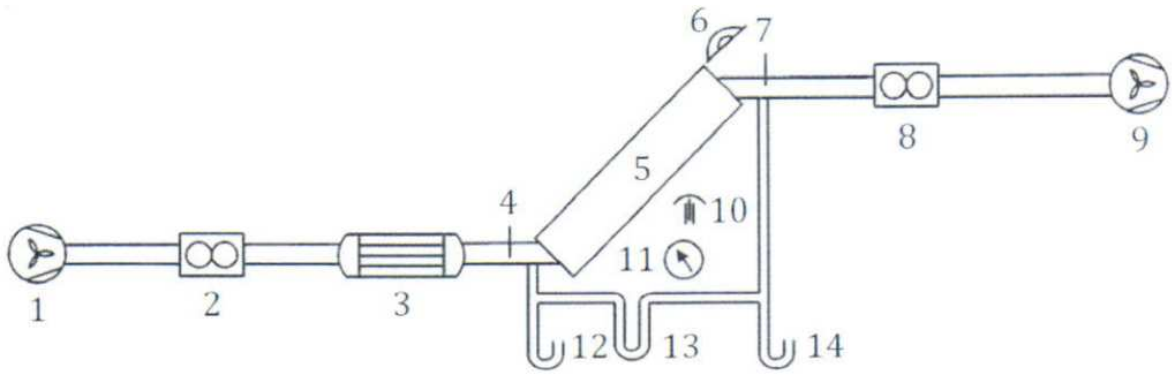

Fig. 3: Schematic of the testing loop

测试回路图解

Key

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

7.2.4 Performance measurment result

7.2.4.1 efficiency

Power output measurement data

m_{pe} (kg/h)	t_i (°C)	t_e (°C)	dT/G (Km²/W)	G (W/m²)	η_a -
111.6	35.1	61.8	0.001	951.7	45.0%
165.6	33.4	54.7	0.003	971.8	53.3%
255.6	34.0	50.5	0.001	942.5	64.4%

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

ṁ (kg/h)	$\vartheta_m - \vartheta_a$ (K)	400 (W/m²)	700 (W/m²)	1000 (W/m²)
111.6	14.3	355	621	887
165.6	13.3	420	735	1050
255.6	8.9	508	888	1269

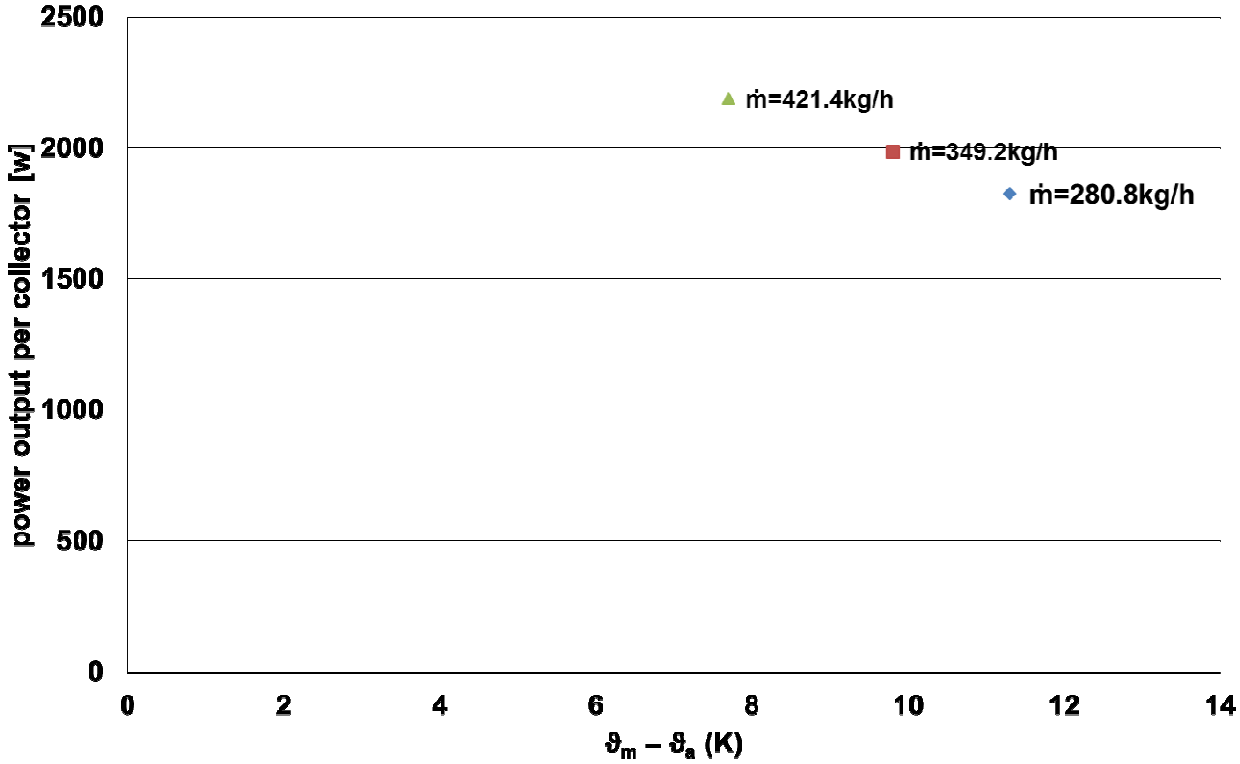

Fig. 4: Power output per collector unit over the temperature difference between the mean collector temperature t_m and the ambient temperature t_a, represented for 1000 W/m²

辐射为1000 W/m² 时单一集热器平均温度与环境温度差值对应的输出功率

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

Serial no.序列号	OS42-20180109-003
Date 日期	2018-05-14
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/(m²s)]质量流量	0.0236
Gross area A_G [m²]总面积	1.970

7.3.2 Test results 测试结果

Collector Time constant τ_c [s]时间常数	140s

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	OS42-20180109-003	
Date (Start/ End)开始/结束日期	2018-05-14	2018-05-16
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 [m²]总面积	1.970

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

Angle [°]	0	30	40	50
$K_{\theta b\ longi}$ () [ ]	1.00	0.97	0.93	0.85
$K_{\theta b\ trans}$ () [ ]				

Incidence angle modifier K_θ(50) [ ] **入射角修正系数**	**0.85**

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。

During outdoor tests irradiation class C “Temperate” according to ISO 9806:2017 was covered.
户外暴晒测试根据ISO 9806:2017中B级进行。

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):

Internal pressure test; Rupture or collapse test; 1th and 2nd internal thermal shock test; pressure drop test; IAM; time constant and performance test.

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

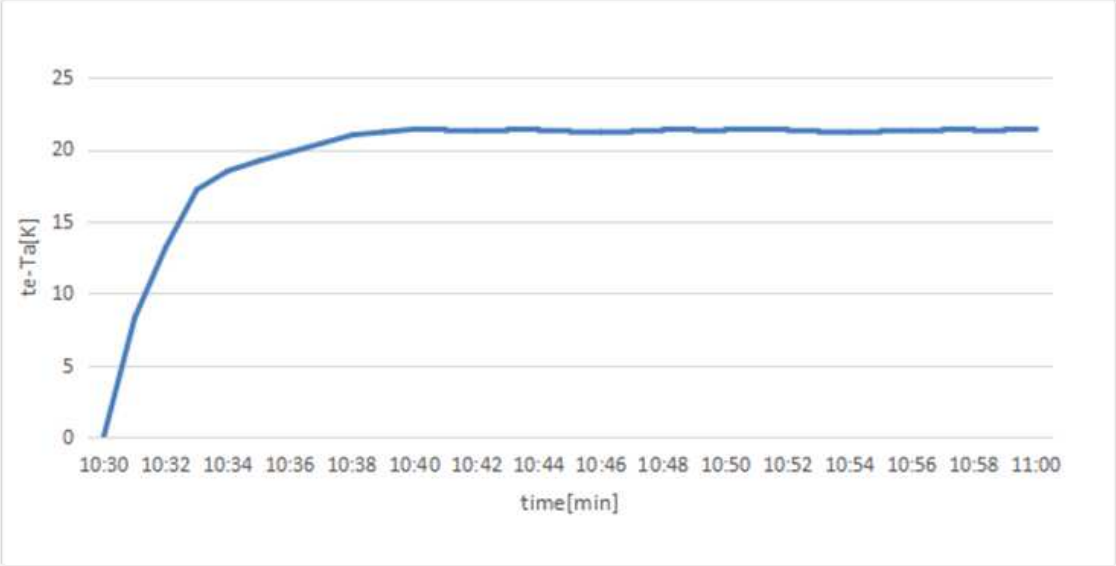

Figure A1.1: Time Constant 时间常数

Appendix 2: Climate data 天气数据

January 18								
Date	time (G*>850W/m²)	ta (G*>850W/m²)	H	min ta	max. ta	mean ta	Rain	Comments
	min	°C	MJ	°C	°C	°C	l/m²	
2018-01-01			12.5	8.5	23.9	18.3		
2018-01-02			4.7	10.8	19.6	17.6		
2018-01-03			2.6	10.9	13.0	11.6	3.0	
2018-01-04	235	20.0	24.2	6.1	23.4	18.2		
2018-01-05	235	20.2	24.5	3.9	23.5	18.1		
2018-01-06	235	20.8	24.8	7.4	24.3	19.2		
2018-01-07	255	20.6	25.3	8.8	23.9	19.2		
2018-01-08	255	20.2	25.5	2.5	24.5	18.1		
2018-01-09	240	20.4	24.8	2.9	24.5	18.4		
2018-01-10			3.8	7.3	12.7	9.9		
2018-01-11			10.9	7.3	15.0	11.3		
2018-01-12			1.6	8.1	9.0	8.5		
2018-01-13			3.4	7.8	13.4	10.4		
2018-01-14	75	19.7	18.2	8.6	21.4	16.6		
2018-01-15	170	20.5	23.6	3.1	24.2	18.0		intermittent failure
2018-01-16	200	20.5	23.2	5.6	22.7	18.2		
2018-01-17	225	20.5	23.8	3.5	24.2	18.4		
2018-01-18	150	20.4	22.5	4.0	23.4	18.1		
2018-01-19	160	20.9	23.5	4.5	24.6	18.8		
2018-01-20	235	21.9	24.6	4.4	25.3	19.7		
2018-01-21	225	21.8	24.1	4.6	25.0	19.4		
2018-01-22	230	21.8	24.4	1.5	31.7	19.6		
2018-01-23	240	21.1	24.9	4.1	31.3	19.0		
2018-01-24	250	22.8	25.3	5.8	26.9	21.1		
2018-01-25	265	23.4	25.9	8.1	25.6	21.3		
2018-01-26	235	22.4	24.8	6.3	25.8	20.2		
2018-01-27	255	21.7	25.2	9.6	23.3	19.8		
2018-01-28	270	21.0	26.1	3.5	24.3	18.6		
2018-01-29	225	21.7	24.7	0.3	27.0	19.1		
2018-01-30	250	21.4	25.1	5.8	24.3	19.5		
2018-01-31			4.0	8.4	11.9	10.1		

February 18								
Date	time (G*>850W/m²)	ta (G*>850W/m²)	H	min ta	max. ta	mean ta	Rain	Comments
	min	°C	MJ	°C	°C	°C	l/m²	
2018-02-01			7.0	7.6	17.3	11.5		
2018-02-02			0.6	1.9	8.3	4.1	3.1	
2018-02-03			1.9	1.9	5.0	3.8	0.1	
2018-02-04			9.1	5.2	14.4	10.2		
2018-02-05			2.2	3.7	5.3	4.6		
2018-02-06			5.6	4.6	11.8	8.1		
2018-02-07			12.6	7.8	19.8	14.2		
2018-02-08	145	21.2	22.7	8.7	25.9	19.4		
2018-02-09	260	23.9	25.9	6.3	25.5	20.8		
2018-02-10	130	22.7	21.4	11.4	24.3	19.9		
2018-02-11	180	22.8	23.9	5.1	24.9	20.0		
2018-02-12	245	23.7	26.0	5.3	27.2	21.2		
2018-02-13	165	25.1	24.8	6.1	30.7	22.8		intermittent failure
2018-02-14	165	27.6	23.5	9.4	30.3	23.7		
2018-02-15	160	24.7	23.5	14.4	26.4	23.0		
2018-02-16	290	24.7	27.7	4.5	28.3	22.1		
2018-02-17	300	26.6	28.2	5.7	29.7	23.7		
2018-02-18	235	25.5	26.0	11.3	27.5	23.4		
2018-02-19	260	25.4	25.8	8.4	27.9	22.9		
2018-02-20	235	26.4	25.3	9.3	29.2	23.9		
2018-02-21	135	26.0	22.2	10.3	27.5	22.5		
2018-02-22	270	25.9	26.6	8.9	29.0	23.6		
2018-02-23	210	25.8	25.2	9.5	27.8	23.2		
2018-02-24	45	24.6	12.6	15.8	26.4	22.7		intermittent failure
2018-02-25	260	25.2	26.0	6.7	28.9	22.5		
2018-02-26	145	25.2	23.0	8.7	29.1	23.0		
2018-02-27	110	25.2	19.4	14.3	29.3	23.1		
2018-02-28	290	26.6	27.7	8.4	31.3	24.6		

Appendix 3: Photo documentation 照片文件

Fig. 5: incoming inspection
图5：初检

Fig. 6: incoming inspection
图6：初检

Fig. 7: impact testing
图7：撞击测试

Fig. 8: final inspection
图8：终检