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Photovoltaic Laboratory Instruments

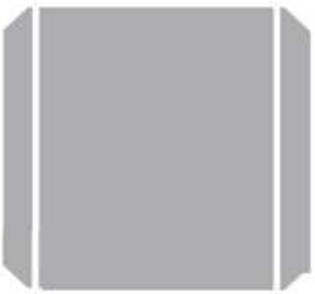
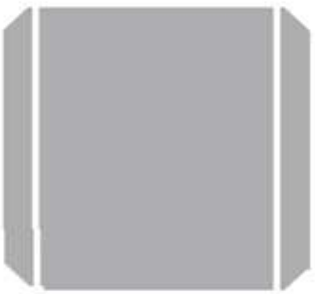
2015'










Module and Junction-box Testing Instruments Directory Index

BR-PV-VIT Visual inspection series instruments

Perform standards:
IEC 61215:2005 & Ed.3, IEC 61646:2008, IEC 61730-2:2004 & Ed.2, VDE 0126-5:2008

Visual inspection table:
Table Size: ≥2.2m×1.2m
Table material: Green mat
Frame material: Aluminum alloy profile
With drawers, for storing tools
Attachment:
①Illumination meter: Automatic range switching,
Measurement range: 0~20~200~2000~20000Lux
②Flashlight: illumination>2000Lux
③Magnifying glass

Purpose
To detect any visual defects in the module.

Procedure
Carefully inspect each module under an illumination of not less than 1000 lux for the following conditions:
– cracked, bent, misaligned or torn external surfaces;
– broken cells;
– cracked cells;
– faulty interconnections or joints;
– cells touching one another or the frame;
– failure of adhesive bonds;
– bubbles or delaminations forming a continuous path between a cell and the edge of the module;
– tacky surfaces of plastic materials;
– faulty terminations, exposed live electrical parts;
– any other conditions which may affect performance.
Make note of and/or photograph the nature and position of any cracks, bubbles or delaminations, etc. which may worsen and adversely affect the module performance in subsequent tests.

Requirements
Visual conditions other than the major visual defects listed in Clause 7 are acceptable for the purposes of type approval.

BR-PV-CS Programmable Control Voltage Insulation Meter

Perform standards:
IEC 61215:2005 & Ed.3, IEC 61646:2008, IEC 61730-2:2004 & Ed.2, UL 1703:2004 & Ed.2, VDE 0126-5:2008, VDE 0126-3:2009...

Voltage Insulation Meter

Insulation Test

Test Item: Insulation (leakage current) test, Wet leakage current test, r.m.s. withstand voltage test...

IEC 61215 IEC 61646	Insulation test	500V or 1000V plus twice the maxi. system voltage
	Wet leakage current test	500V or the maximum rated system voltage
IEC 61730	Insulation test	Class A: 2000V plus four times the maximum system voltage Class B: 1000V plus two times the maximum system voltage
UL 1703	Leakage Current Test	The rated maximum system voltage
	Dielectric Voltage-Withstand Test	Two times the system voltage plus 1000V
	Wet Insulation-Resistance Test	Voltage of DC 500V
VDE 0126	r.m.s. withstand voltage test	AC 2000V + 4 times rated voltage
	Wet leakage current test	DC voltage source, with current limitation, capable of applying 500V

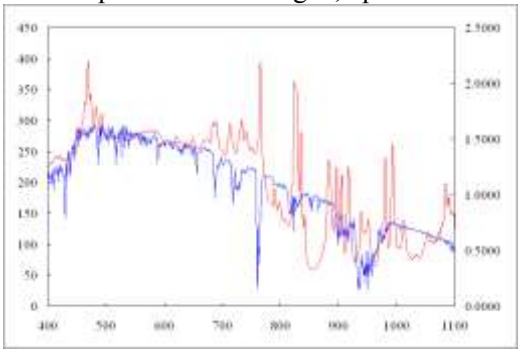
Voltage Test
AC: 0.00-6.000KV DC: 0.00-6.000KV
Stability: ±(1%+5V)
Resolution: 1 Volts/Step
Precision: ±(1%+5V)@voltage≥1.000KV, ±(2%+5V)@voltage<1.000KV
Leakage Current Test
AC: 0.000-12.00mA DC: 0.000-5.00mA
Set range: 0.01~12.00mA(AC) 0.001~5.000mA(DC)
Resolution: AC:0.01mA/Setp DC:0.001mA/step
Insulation Resistance Output Voltage
250V-1000V
Accuracy: ±(2%+5V)
Insulation Resistance Set
1MΩ-9999MΩ
Resolution: 1MΩ/Step
Insulation Resistance
Measure Range: 1MΩ~9999MΩ
Accuracy: ±5%@1MΩ~1000MΩ, ±10%@1000MΩ~9999MΩ
Other
Timer: 0.1~999.9s, 0=continuous
Resolution: 0.1s Precision: ±1%
Memory: 20 group
Test Step: 8 steps
Test failure mode: Buzzer (opening / closing can be set), indicating lamp, display
Input Characteristics: Single phase, 50Hz, 220V/AC±10%

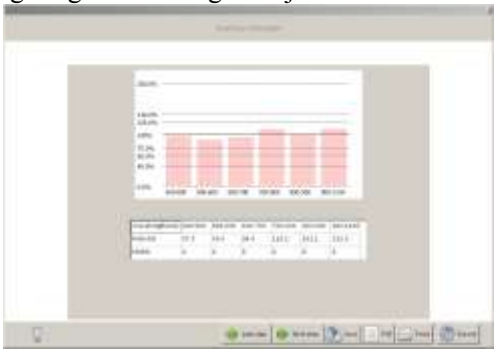
BR-PV-SSS Steady-State Solar Simulator & I-V Measure System

Perform standards:
IEC 61215:2005 & Ed.3, IEC 61646:2008, UL 1703-2012, IEC 60904.1~10, IEC 61853-1:2011...

Test Item	Classifications	Irr. W/m²	Temp. ℃	Time / Dose
Precondition	—	—	—	5~5.5KW·h/m²
Light soaking test	CCC	600~1000	50	43KW·h/m²
Hot-spot endurance test	CCB	700/800~1000	50	1 or 5h
Temperature test	—	1000	40	—
Measure of temperature coefficients	BBB	1000	20→55	Continuous
Performance at low irradiance	BBA	200	25	—
Performance at STC and NOCT	BBA	1000 / 800	25 / 20	—
Maximum power determination	BBA	1000	25	—
Arc test (for UL1703 method B)	—	800	20~30	15min
HTC power rating (IEC 61853-1)	BBB	1000	75	—

Main Technical Index:
Spectral Level: Class BBA or better
Effective Irradiation: 2000×1350mm (W×D) or more
Irradiance range: 600~1100W/m² (full lamps)
Irradiance resolution: 1W/m²
(200W/m2 at low irradiance performance test by using neutral filters or metallicscreen)
Spectral calibration range: 400~1100nm or 300~900nm
Testing temperature: 20~60 ℃±2 ℃
Irradiance and temperature control model: PLC Programmable Controller & PC control
Irradiance measure: by standard cell
I-V measuremen: Isc, Voc, Pm, Imp, Vmp, FF, η, Rs, Rp
Automatically generating and storing I-V-P curve
Xenon lamps matrix is arranged, optimization xenon lamps lighting fixtures angles adjustable.

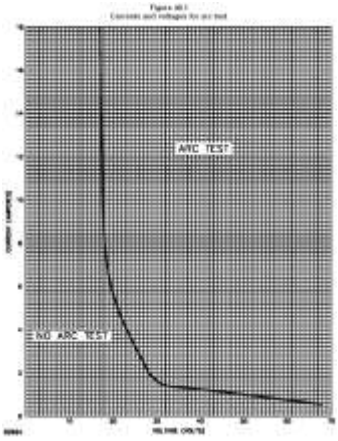




Automatic non-uniformity measurement system (see right):
mechanical transmission system program control,
along the X-Y axis horizontal - longitudinal reciprocating scanning,
data acquisition and processing.
Scanning time can be set.
Measurement point more than 64 (IEC 60904-10).
automatic alarm when more than 5%.

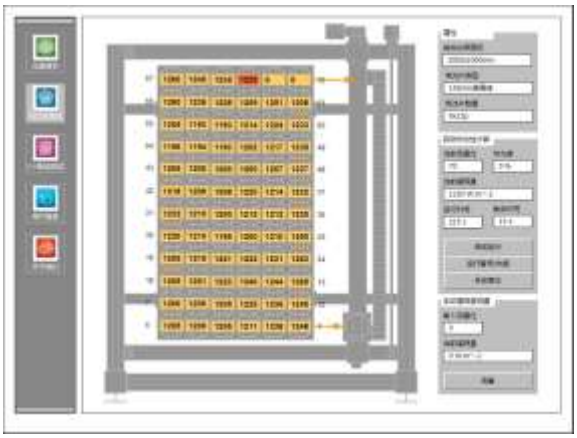
Shading plate for hot-spot endurance test:
□ Crystalline silicon module
Cells shaded plates: 50%,20%,20%,10%,5%
Can satisfy the 0 ~ 100% within 5% increasing or decreasing.
② Thin-film module
1~5 pieces cell shaded plates horizontal transmission (see right figure)
Ordinal sequence covering 1~5 pcs cells,
according to current find Imp×99%, determine shaded plates number.
Electric control displacement shaded plates to suitable current.
Adjust the shaded plates to suitable current.
Data processing system: current automatic collection & analysis

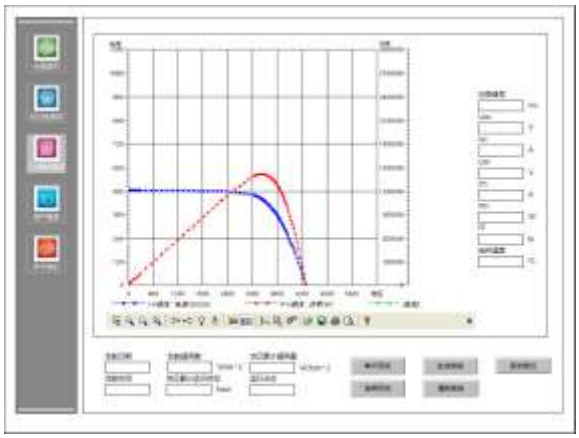
Arcing Test (method B):
Implementation of standards: UL 1703-2012
A single module or panel is to be used with a separate power supply as described in following:
The power supply is to be a constant voltage supply with a series connected current-limiting resistor. The parameters of the total system are to be as follows:
a) Open-Circuit Voltage – The voltage that is across the fracture during normal use of the modules or panels with the specified bypass diodes.
b) Short-Circuit Current – Not less than 80 percent nor more than the rated module or panel short-circuit current, when the current-limiting resistor is adjusted so that the voltage across the module or panel being tested is zero.connected in series to provide the remainder of the source. The module or panel under test is to be irradiated at 80mW/cm^2 or more at 20 ℃~30 ℃. The system load is to be a short circuit.



Electronic load:
Analog quantity collection frequency: 300points/30ms
Single module max. test power: 300W
(Max. 120V/30A)

Software Interface:





BR-PV-OMS Module Outdoor Measurement System

Perform standards:
IEC 61215:2005 & Ed.3, IEC 61646:2008, IEC 61730-2:2004 & Ed.2, UL 1703-2012, IEC 61853-2…
Precondition, Maximum power determination, Measurement of temperature coefficients, Measurement of temperature coefficients, Performance at low irradiance, Outdoor exposure test, Hot-spot endurance test, Light-soaking, Temperature test…

Modules mounting and test frame:
Modules Mounting and Testing Frame
Single axis solar tracker
Can fixed 8 pcs module of 2×1m (extensible)
According to the module size adjustment
Comparison double axis solar tracker,
mounting convenienter,
More suitable for testing.
Tracking principle: Based on GPS timing tracking
System life expectancy for more than 25 years
For light-soaking, outdoor exposure, hot-spot endurance test…

Double axis solar tracker
Mounting: 8 pcs modules of 2×1m (extensible)
Tracking accuracy:0.3°
Tracking angle range: The pitch direction -10°~75°and
the horizontal direction -120°~120°
System protection wind speed: 90kw/hr
System wind resistance limits: 170kw/hr
Tracking principle: automatic light control tracking or based on GPS timing tracking with automatic tracking and reset,
manual control, group control,
wind speed protection, night return...

NOCT and temperature test frame
NOCT test modules shall be positioned so that they are tilted at 45°±5°to the horizontal with the front side pointed toward the equator. The bottom edge of the test modules shall be 0.6 m or more above the local horizontal plane or ground level.
Wind speed and wind direction Instrument installed approximately 0.7 m above the top of the modules and 1.2 m to the east or west.
Temperature test for IEC 61730 & UL 1703 also in here carry out. We provide 19mm thick wood (current standard) or a thermal insulation with a k factor ≤0.24W/m^{2}K (IEC 61730 Ed.2) black painted wooden platform, The platform is to extend at least 0.6m beyond the module on all sides, can fast loading.

Electronic load and I-V measurement system

Analog quantity collection channel input signal: voltage 0~5V, 0~10V or current 4~20mA (with all the signal amplification A/D function)
Analog quantity collection frequency: 10ms
Analog quantity collection precision: 12bit
Temperature measurement precision: ±0.5 ℃
Irradiance measurement precision: ±2%@1000W/m^2
Wind speed measurement range: over 0.25m/s
Voltage measurement precision: 0.05%F.S.
Current measurement accuracy: 0.1%F.S.
Single module max. test power: 400W (Max. voltage 180V, max. current 30A) (can according to the demand for expansion system)
I-V measuremen: Isc, Voc, Pm, Imp, Vmp, FF, η, Rs, Rp
Automatically generating and storing I-V-P curve
Temperature and irradiance correction reference IEC 60904.1~10.

Temperature test

Wood 19mm±5% thick or
Automated calculation 40 ℃ and 1000W·m^{-2} normalised temperature.
Testing the temperature of different position in a module, and then judgeing the module Ok or False.
Voltage, current, power test: according to IEC 60904 calibrate test result to STC by standard module.
16-channel temperature sensor: Uncertainty ±1 ℃ or better, main test Point:
Front glass above center cell, Backsheet behind center cell, Ambient air within J-box, J-box inside surface, Back face sheet beneath J-box, Module output leads, Sealing compound around lamination (on the corner), Sealing compound inside junction box, Diode #1~6 case, Frame, Ambient (Absolute)

IEC 61730 Ed.2 (draft J)	UL 1703-2012
A black painted platform constructed of suitable wooden plate which has sufficient mechanical strength to avoid warping under temperature influence. Behind the board a thermal insulation with a k factor of max 0.24 W/m^{2}K shall be placed.	A module or panel intended for direct mounting on a roof or wall surface is to be mounted on a platform constructed of wood, pressed wood, or plywood, 19mm thick. The platform is to be painted flat black on the side facing the test sample. The platform is to extend at least 0.6m beyond the module or panel on all sides.
A resistive load sized to operate the module in maximum power point for STC or maximum power tracking. (We provide MPPT)	Modules Open Circuit, Modules Short Circuit, Center Cell Shaded 50% and Modules Short Circuit

Precondition

Irradiance cumulative dose: 5~5.5KWh·m^{-2}, Open circuit

NOCT Test

Mechanical Wind/ Direction Sensor: Alternate
Software features: automated data collection and storage, not counting the invalid data, automatic calculation of junction temperature.
Automatic fitting temperature (T_J–T_{amb}) - irradiance curve, based on standard deviation selected out of 10 effective data, and optimize the curve.
Irradiance, temperature, wind speed and direction automatic data collection, without invalid data, automatic calculation cell initial and final NOCT temperature.

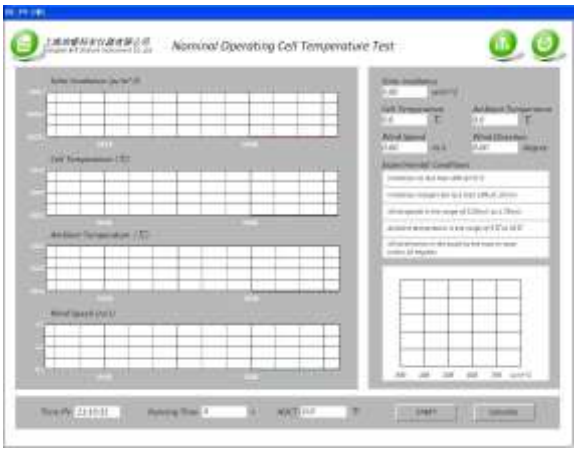
Measurement of temperature coefficients
Automatic calculation component 4 points average temperature (IEC 61215 Ed.3)
Temperature rising process, automatic fitting curve, automatic calculation of relative and absolute temperature coefficient.

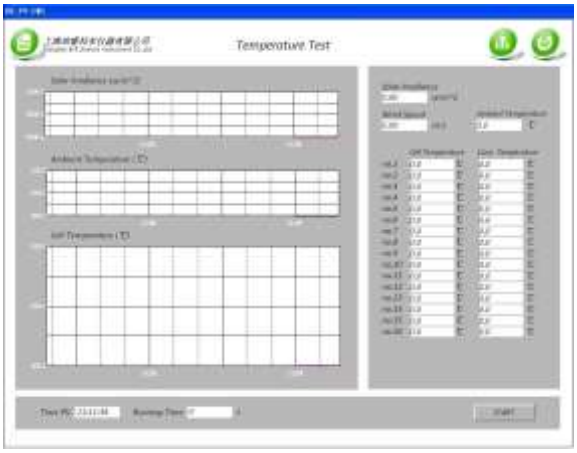
Performance at low irradiance
Irradiance, temperature according to the IEC 60904-10 measurement and amendment I-V measurement

Outdoor exposure test
Irradiance cumulative dose: 60KWh·m^{-2} with maximum power tracking (MPPT)

Light-Soaking
Valid data collection (1h): 600~1000W·m^{-2}@50±10 ℃ (module temperature)
Irradiance cumulative dose: 43KWh·m^{-2}
software just tells users if test is complete

Hot-spot endurance test
Valid data collection (1h): 900~1100W·m^{-2}@50±10 ℃ (module temperature)
Current measurement in different shadowing area.
Current measurement integrated in the system, automatic identification and screening effective Isc (Crystalline silicon cell for Imp and thin-film cell 99% Imp)
Cells shaded plates can satisfy the 0~100% within 5% increasing or decreasing.

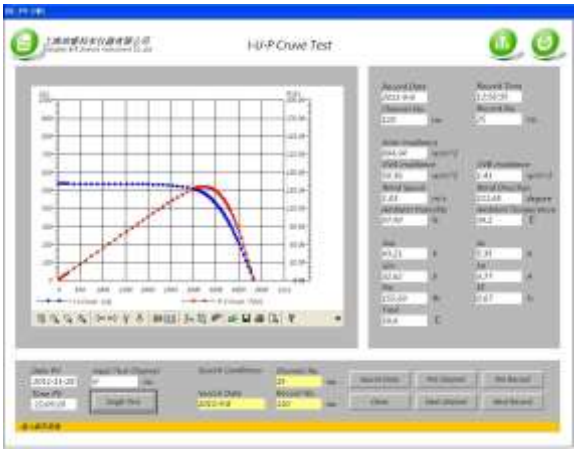




Expand the function is applied to IEC 61829:1995, IEC 62124:2004 etc.
Array I-V measurement: 16 modules or more I-V measurement
Grid-connected power measurement: automatic recording years power and meteorological data
Off-grid control system test: Reference IEC 62124:2004…

Multi-channel I-V curve measurement and remote monitoring
Through a channel exchange, can simultaneously test 16 modules (extensible).
I-V measurement replay each module I-V curve, P-V curve, include Isc, Voc, Pm, Im, Vm, FF, η, irradiance, temperature etc. Automatically save data, all-weather test.

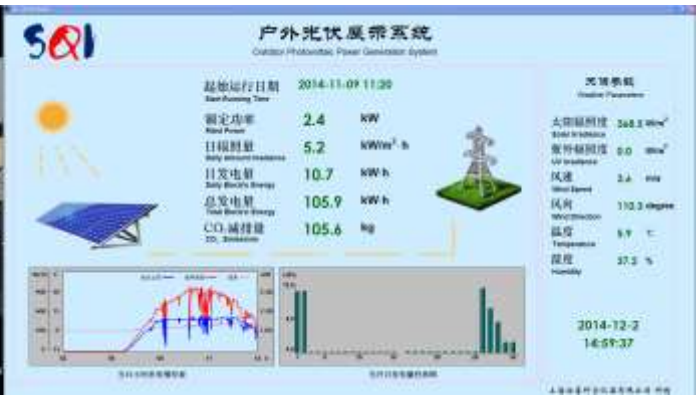
Incidence angle controller
For IEC 61853-2 energy rating -
Incidence angle and module operating temperature measurements.



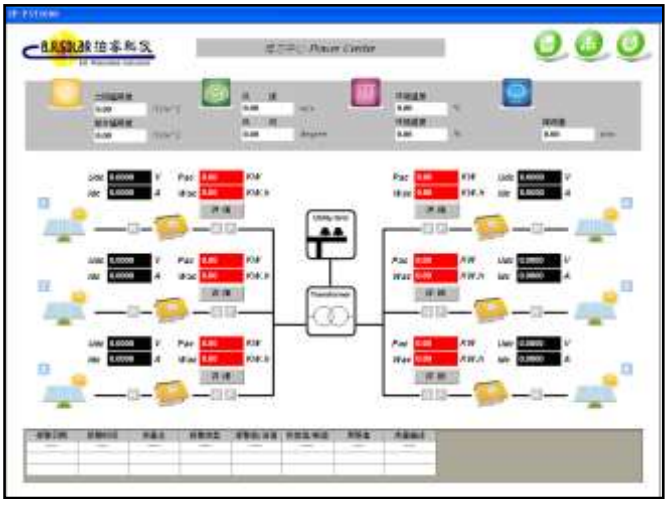
On-grid and Off-grid Photovoltaic Power System

Display system and monitoring room

Maximum Power Tracking System (MPPT Array)



Expand the function is applied to IEC 61829 Ed.2, IEC 62124:2004 etc.
Array I-V measurement: 16 modules or more I-V measurement
Grid-connected power measurement:
Automatic recording years power and meteorological data
Off-grid control system test: reference IEC 62124:2004…



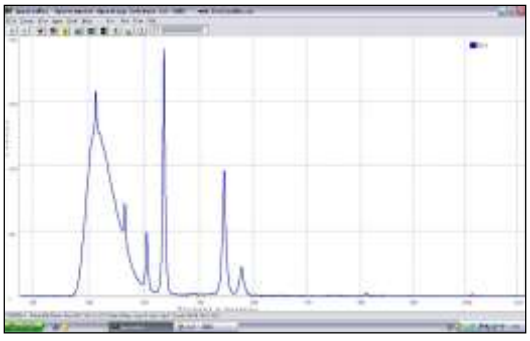
Power quality analysis system and inverter testing system…

BR-PV-UV UV Preconditioning Testing Chamber

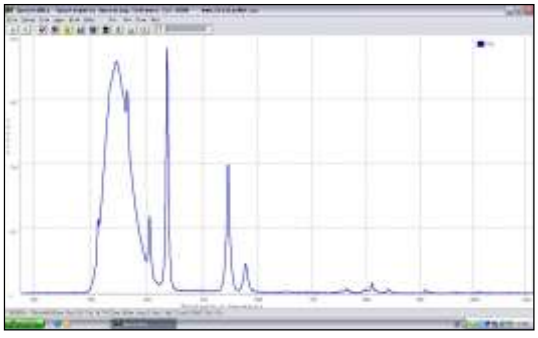
Perform standards: IEC 61215:2005 & Ed.3, IEC 61646:2008, IEC 61345:1998, IEC 62108:2007

Standard	UVB of UVA+B	UVB	UVA+B
IEC 61345:1998	1/2	7.5KW·h/m^2	15KW·h/m^2
IEC 61215:2005	≥1/3	≥5KW·h/m^2	15KW·h/m^2
IEC 62108:2007	3~10%	?	50KW·h/m^2
IEC 61646:2008	3~10%	0.45~1.5KW·h/m^2	15KW·h/m^2
IEC 61215 Ed.3	3~10%	0.45~1.5KW·h/m^2	15KW·h/m^2
Note: In IEC 61646:2008 for thin-film module, need “a load sized such that at STC the module will operate near the maximum power point”, but IEC 61215 Ed.3 without this requirement. This is because if use UV-high pressure metal halide lamps or filtered xenon lamps to carry out this experiment need a load, but ultraviolet fluorescent lamps donot need.			

System integration many technical highlights, such as centralized control, automatic dimming, servo drive, full panoramic scanning, automatic monitoring irradiation uniformity, database system etc.
With touch control screen, full automatic, high precision system loop (lateral and longitudinal drive), Any mechanical action, by PLC locking. Including radiation probe Automatic full panoramic scanning, irradiance automatic integration, data acquisition and storage, automatic storage scanning data etc.
Irradiation uniformity: better than ±15%
A calibrated UV irradiation sensor (NIST trace to the source), mounted on the transmission shaft, for IEC 61215:2005 and IEC 61646:2008 to 280~385nm and 280~400nm irradiation measurement.
280~320nm to total UV ratio measured by spectrometer.
A special guide rail, can easily push and pull module.
Uniform temperature distribution, maintaining the module temperature at 60 ℃±5 ℃.
Ultraviolet fluorescent lamps are cold light source without lower than 280nm UVC irradiation, to avoid the photochemical reaction of ozone synthesis, is important test conditions for IEC standard.
UVB and UVA ultraviolet fluorescent lamps, respectively for 280~385nm and 280~400nm test.
The lamps distance adjustable, asymmetric arrangement, easy to adjust the irradiation uniformity.



IEC 61215:2005 UV spectral distribution



IEC 61646:2008, 61215 Ed.3 UV spectral

BR-PV-THD Thermal Cycling, Humidity-Freeze, Damp-Heat Tester

Perform standards: IEC 61215:2005 & Ed.3, IEC 61646:2008, IEC 62108:2007, UL 1703-2012…

Thermal Cycling Test

Perform standards: IEC 61215:2005 & Ed.3, IEC 61646:2008 "TC200 thermal cycling test, TC50 thermal cycling test", and UL 1703-2012 "temperature cycling test".

1. IEC 61215 Ed.3, IEC 61646:2008 test condition:
The temperature of modules between -40°C±2°C and +**85**°C±2°C cycling, the rate of change of temperature between the low and high extremes shall not exceed **100** ℃/h and the module temperature shall remain stable at each extreme for a period of at least 10 min. The cycle time shall not exceed 6h.

2. UL 1703-2012 test condition:
The temperature of modules between -40°C±2°C and +**90**°C±2°C cycling, the instantaneous rate of temperature change of the test chamber with respect to time is not to be greater than **120**°C/h.

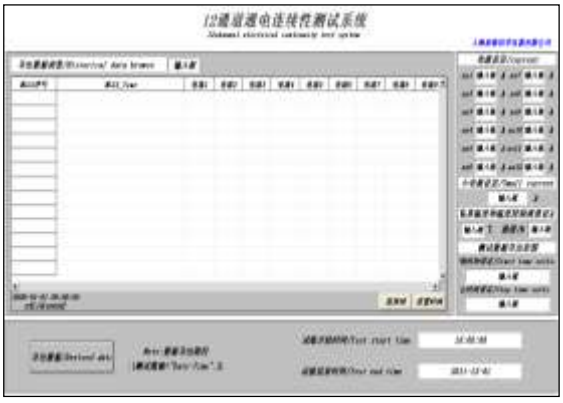
Humidity-Freeze Test

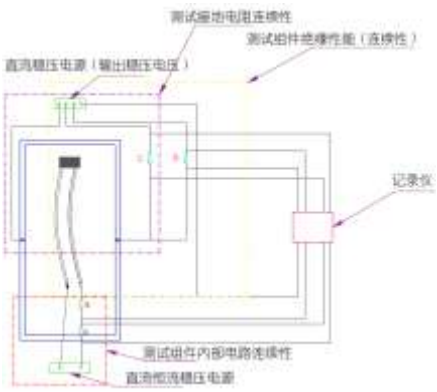
Perform standards:
IEC 61215 Ed.3, IEC 61646:2008 "humidity-freeze", UL 1703-2012 "humidity test"
The temperature of modules between -40°C±2°C and +85°C±2°C cycling.
Relative humidity 85%RH±**5**% at 85°C in IEC 61215 and 61646, but UL 1703 Control in 85%RH±**2.5**% at 85°C, allowable deviation range different.

Damp-Heat Test

Perform standards: IEC 61215:2005 & Ed.3, IEC 61646:2008 "damp-heat test"
Test temperature 85 ℃±2 ℃, Relative humidity 85%±5%, Test duration 1000h

Electrical continuity,
Insulation continuity,
Grounding continuity test system:
Perform standards: IEC 61215:2005 & Ed.3, IEC 61646:2008 "electrical continuity for TC200 thermal cycling test and humidity-freeze test" condition, and UL 1703-2012 "Insulation continuity and grounding continuity" condition.
DC power current / voltage output: 15A/80V or 10A/150V





IEC 61215:2005 & Ed.3:
During the 200 thermal cycle test set the current flow to the measured STC peak power current within ± 2%. Current flow shall only be maintained when the module temperature is above 25°C, below 25°C automatically switch to the small current, the small current should not change the temperature raising and lowering rate requirements, this is because the crystal silicon modules flow I_{mp}, below 25°C the heat generated will change temperature rate, even the modules cannot be reduced to -40°C.
IEC 61646:2008: Thin-film modules heat generated small, so flow I_{mp} during the whole test.
Note: During the 50 thermal cycle test no current flow is required.

Module type	Imp	TC 200 Thermal Cycling	Humidity-Freeze
1.58×0.808m monocrystalline	5.20A	Provide Im over 25 ℃ Provide 0.1~0.5A below 25 ℃	Provide current during the whole test
2×1m polycrystalline	7.66A	Provide Im over 25 ℃ Provide 0.1~0.5A below 25 ℃	Provide current during the whole test
1.4×1.1m Thin-film	1.66A	Provide current during the whole test	Provide current during the whole test
2.6×2.2m Thin-film	2.66A	Provide current during the whole test	Provide current during the whole test

UL 1703-2012:
Temperature Cycling Test and Humidity Test shall not result in:
1) Loss of circuit continuity;
2) Accessibility of parts that involves a risk of electric shock, such as by delamination or separation of materials;
3) A reduction in the resistance between parts involving a risk of electric shock and an accessible part such that the module or panel is not in compliance with leakage current test, Section 21;
Temperature Cycling Test shall not result in:
4) Reduction in the thickness of the wall of a nonmetallic wiring compartment below required values;
5) Reduction in the volume of a nonmetallic wiring compartment below required values; or
6) A gap greater than 1/16 in (1.6 mm) or an increase of 1/16 in or more in an existing opening between nonmetallic wiring compartment walls and the cover;
b) The module or panel shall comply with dielectric voltage-withstand test, section 26, at 50 ℃ or higher and also at room temperature;
c) Immediately following the dielectric voltage-withstand test, the module or panel shall comply with leakage current test, section 21;
d) Following the leakage current test, the module or panel shall comply with wet insulation-resistance test, section 27;
e) A module or panel with a wiring compartment as described in 13.1.6 shall comply with Wiring Compartment Securement Test, Section 42, following the wet insulation-resistance test; and
f) A module or panel with a wiring compartment as described in 13.1.6 shall comply with Wet Insulation-Resistance Test, Section 27, following the wiring compartment securement test.
Humidity Test shall not result in:
4) Corrosion of metal parts;
5) Reduction in the thickness of the wall of a nonmetallic wiring compartment below required values;
6) Reduction in volume of a nonmetallic wiring compartment below required values; or
7) A gap greater than 1.6mm or an increase of 1.6mm or more in an existing opening between nonmetallic wiring compartment walls and the cover.
b) Immediately following the test, the module or panel shall comply with dielectric voltage-withstand test, section 26.
c) The module or panel shall comply with Leakage Current Test, Section 21, immediately following the dielectric voltage-withstand test;
d) Following the leakage current test, the module or panel shall comply with wet insulation-resistance test, section 27;
e) A module or panel with a wiring compartment as described in 13.1.6 shall comply with Wiring Compartment Securement Test, Section 42, following the wet insulation-resistance test; and
f) A module or panel with a wiring compartment as described in 13.1.6 shall comply with wet insulation-resistance test, section 27, following the wiring compartment securement test.

BR-PV-RT Robustness of Terminations Tester

Perform standards:
IEC 60068-2-21:2006, IEC 61730-1:2004, IEC 61215:2005, IEC 61646:2008, UL 1703-2012, VDE 0126-5:2008…

Ua1 Tensile test: Poise weight or traction force with tolerance 40N±10%
Test subject: type A,B,C terminations.

Ub Bending test: 20N
The end of test sample hanging poise 20N±10%. Can be fixed module, vertical plane rotation.
The termination shall assume, during the course of the test, a displacement of at least 30° with respect to its initial position. over a period of 2~3s, through an angle of approximately 90° in the vertical plane and then returned to its original position over the same period of time; this operation constitutes one bend. this operation constitutes one bend. Automatic finish 10 cycles.
Two bends in the same direction without interruption, or a larger number of alternate bends where prescribed in the relevant specification. No device capable of imposing a radius of curvature shall be placed between the body of the component and the point of application of the force. Strip terminations shall be bent perpendicularly to the widest surface of the strip.



Ud Torque test: (IEC 61215:2005, IEC 61646:2008)
IEC 61215 & IEC 61646 as described in IEC 60068-2-21:2006 test Ud, with the following provisions:
All terminations shall be tested, severity 1
The nuts or screws should be capable of being loosened afterwards unless they are specifically designed for permanent attachment.

Nominal thread diameter(mm)	2.6	3.0	3.5	4.0	5.0	6.0	8.0
Torque (N·m) - Severity 1	0.4	0.5	0.8	1.2	2.0	2.5	5.0

Ud Torque test: (UL 1703-2012)

Screw size (Lbf-in)	12	16	20
Torque (N·m)	1.4	1.8	2.3

A wire-binding screw or nut on a wiring terminal shall be capable of withstanding 10 cycles of tightening to and releasing from the applicable value of torque specified in VDE 0126-5 Table 29.1 without:
1. Damage to the terminal supporting member
2. Loss of continuity
3. Short circuiting of the electrical circuit to accessible metal.

BR-PV-RT Robustness of Terminations Tester (IEC 61215 Ed.3 CD)

Perform standards:
IEC 61215 Ed.3 CD, VDE 0126-5:2008, VDE 0126-3:2009



BR-JB-CAP Cable Anchorage Tester
Test subjects: cable anchorage
Motor control off-centre pulley rotation
Pivot point: Height adjustable
Fulcrum point: adjustable
The cable is pulled for duration of 1s, 50 times without jerks in the direction of the axis.
Pull forces for cord anchorage test: 30N

BR-JB-CTT Cable Torsion Tester
Values for torsion test: 0.1N·m
The rotating pointer: torque value of direct reading test mandrels shall consist of a metallic rod with an elastomeric sheath having a hardness of 70 Shore D ± 10 points in accordance with ISO 868.
A tolerance of ± 0.2 mm for mandrels up to and including 16 mm diameter.

Retention of Junction Box on Mounting Surface Tester
The tests described below shall be performed on specimen that have successfully passed the previous stress tests as shown in Figure 1 and Table 1. During test, there shall be no displacement of the junction box at the mounting surface impairing isolating characteristics.
A force of 40 N shall be gradually increased and applied for 30 min in each direction parallel to the mounting surface.
A force of 40 N shall be gradually increased and applied for 30 min without jerks, in a direction perpendicular to the mounting surface.
The pull force should be applied at the centre point of the box.

Requirements
a) No evidence of major visual defects.
b) The degradation of maximum output power shall not exceed 5 % of the value measured before the test.
c) Insulation test and the wet leakage current test shall meet the same requirements as for the initial measurements.

BR-PV-RT Strain Relief Test, Wiring Compartment Securement Test

Strain Relief Test
Perform standards: UL 1703-2012, IEC 61730-1:2004

UL 1703-2012:
89N force

IEC 61730-1 10.6:
Strain relief shall be provided so that stress on a lead intended for field connection, or otherwise likely to be handled in the field, including a flexible cord, is not transmitted to the electrical connection inside the module. Mechanical securement means which comply with **10.14 of IEC 61215** meet this requirement.

Wiring Compartment Securement Test
Perform standards: UL 1703-2012, IEC 61730-1:2004

Fellowing for UL 1703:
Wiring Compartment Securement Test
The tensile force required to separate a wiring compartment or box from a module shall not be less than 155.7N or 4 times the wiring compartment or box weight, whichever is greater, when tested as specified in following. For a test in which the superstrate or substrate fails prior to the adhesive, the force required to cause the superstrate or substrate to fail shall be used to determine compliance, and shall not be less than the specified minimum separation force.

Seven assemblies consisting of a wiring compartment or box secured to a module with adhesive as intended are to be tested. One assembly is to be tested in the as-received condition, three after being conditioned in accordance with temperature cycling test, section 35, and three after conditioning in accordance with humidity test, section 36.

The force is to be applied to each assembly so as to separate the wiring compartment or box from the module. The force is to be applied until the wiring compartment or box and the module separates; or the superstrate or substrate fails.

Fellowing for IEC 61730-1:
Field wiring compartments with covers
Modules designed for the application of a permanently attached wiring system by an installer in the field shall be provided with an enclosed wiring compartment, which provides protection of the conductors and connections from environmental stress, protection from accessibility to live uninsulated parts and strain relief for the attached wiring system.

BR-PV-WLC Wet Leakage Current Tester with Spray System

Perform standards:
IEC 61215:2005 & Ed.3, IEC 61646:2008, IEC 61730-2:2004, UL 1703-2012, VDE 0126-5:2008, VDE 0126-3:2009...

With heating system ↑
With spray and light-Screen safety protection system →

Insulation voltage test explains:
IEC 61215/61646/61730, were not given insulation voltage test pass/fail discriminant basis, we quoted UL 1703 "Dielectric Withstand Test" by - as Test discriminant basis, namely: Compression test stage no more than 0.05 mA leakage current. In addition, the program, should not be greater than pressor 500V/s, module belong to capacitive load, we find that moment caused by leakage current charging electric current exceeds. The insulation and spacings between live parts and accessible conductive parts and between live parts and exposed nonconductivesur faces shall withstand the application of a DC test voltage equal to two times the system voltage plus 1000V without the leakage current between these two points exceeding 50μA DC. The voltage is to be applied in both polarities.

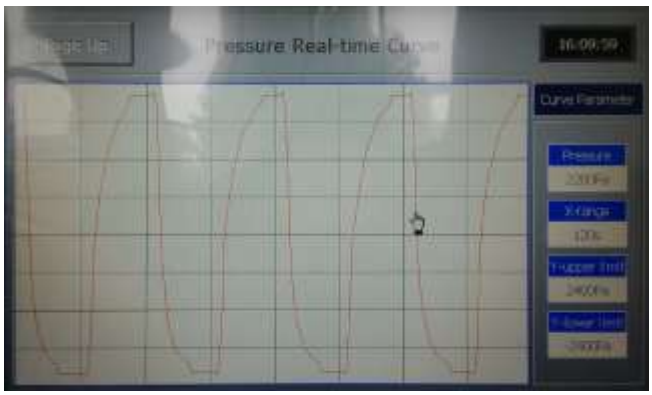
Conductivity meter
Range: 0~200μs/cm~20ms/cm (automatic range switching)
Resolution: 1μs/cm and 0.1 ℃
With temperature compensation and temperature measurement
With conductivity correction
Automatic temperature compensation when conductivity measure
Simultaneous measurement of conductivity and temperature

Surface tension determine instrument (PC control)
Testing method: Pt-board method
Operating mode: automatic operation
Range: 0~199m·N/m
Measurement accuracy: 0.2m·N/m
Resolution: 0.1m·N/m
Software: automatic measurement equilibrium surface tension
Note: Not recommend use, because IEC 61646:2008 and IEC 61215 Ed.3 has delete the measurement, Instead of module will be immersed in the solution to eliminate the surface tension.

Programmable Control Voltage Insulation Meter
Voltage lifting: Programmable Control
Voltage test: output 1KV (DC) or above
Leakage current measurement range: 0.001~5.000mA(DC)
Insulation resistance measurement range:1MΩ~9999MΩ

BR-PV-ML Dynamic & Static Mechanical Load Tester

Dynamic + static load



Pressure real-time curve

Dynamic load mode: Cylinder + vacuum suction cup pressure

Perform standards: IEC 61215:2005 & Ed.3, IEC 61646:2008, UL 1703-2012, IEC 62782 draft, IEEE 1262-1998; VDE-QT-PV-001…
Effective test area: > 2000×1350mm (L×W)
Deflect measurement mode: ultrasonic wave feedback
Control type: PLC and industrial control computer

Standard	Load mode	Test method	Pass criteria
IEC 62782	dynamic	±1,000Pa; 1,000cycle; 2~3cycle/min	Continuity of module internal circuit monitoring.
IEEE 1262	static	2400Pa, 30min	
	dynamic	±1,440Pa; 10,000cycle; ≤20cycle/min	
VDE-QT-PV-001	static	Down-push: 2400Pa·1h×2+5400Pa×1 Up-pull: 2400Pa·1h×3	
	dynamic	±1,000Pa; 1,000cycle; 0.1~1Hz	
IEC 61215 IEC 61646	static	Down-push: 2400Pa·1h×2+5400Pa×1 Up-pull: 2400Pa·1h×3	
UL 1703	static	2200Pa; 30min	Module deflection monitoring.

Air cylinder, cupule, pressure sensor: 32 set (Each cupule controled by a cylinder and a pressure sensor)
Vacuum cupules: 32 pcs, between cupules is adjustable, all universal frame, assure uniformity on the surface of module after deflect. ensure 32 pressure points uniformly.

High precision load detection system: Nonlinear degrees is no more than 0.5%FS
Loading tracking system: According to the test process, certain slope, platform, system can preprogram on the need for the pressure, and drive system can load to module.

High precision loading drive system: With main components of load actuators, precision is not more than 0.2% F.S. Automatic adjustment fast loading system: In the long time testing process, many factor lead to changes in load of the module, and the system can be applied to repair pressure tend to constant load.

Loading pressure curve record: Because of the loading process over a long period of time, the operator is difficult to monitor the whole process of loading. The system can record all loading pressure curve, and it can help operators know the result of the test load process, assistant analysis.

Loading pressure curve formula function: The system can store a number of group of prefabricated load curve, convenient operator calls or storage common load curve, decrease working intensity and error probability. Loading orientation: Positive and negative direction.

Loading control and continuity test are integration in software.
Load monitoring: Real-time display the general pressure of cylinders, Input the size of module, automatically compute the surface pressure of module.

Extremely cold environment dynamic and static load test

Static load mode: Gasbag pressure

Perform standards: IEC 61215:2005 & Ed.3, IEC 61646:2008, UL 1703-2012…

Static load (front-push)

Static load (back-push)

The new design, convenient operation, Pressure more evenly, 0~+100Pa @ 2400Pa
Load mode: unidirectional or bidirectional
Pressure regulation: an external air compressor is connected with a pressure regulating valve
Electrical continuity measurement system: contain PC, DC 80V/5A power, PLC, Software.

BR-PV-HT Hail Tester

Perform standards: IEC 61215:2005 & Ed.3, IEC 61646:2008

Diameter mm	Mass g	Test velocity m.s-1	Diameter mm	Mass g	Test velocity m.s-1
12.5	0.94	16.0	45.0	43.9	30.7
15.0	1.63	17.8	55.0	80.2	33.9
25.0	7.53	23.0	65.0	132.0	36.7
35.0	20.7	27.2	75.0	203.0	39.5
From the table, we calculated the square of hail speed by 0.047~0.049 equals hail diameter. Thus we calculate the hail air resistance coefficient. When the hail free fallers accelerated to a certain stag, hail gravity and hail resistance balance final constant speed landing. Based on the above principles, our hail tester is for hail and shells by the pneumatic acceleration. When cartridge from gun, hail with constant speed bumps after components.					

Vertical firing mode, solved technical problems of the acceleration of gravity of hail and speed deviation. In order to avoid the hail breached, we give the hail added a protective device hail shell, or cartridge. The diameter of hail shell and the gun shell is very consistent. The diameter of it and the shell, very consistent gun size. High-pressure gases in this state promote cartridge directly, so speed control and speed repeatability is better.
Module mounting: > 2.2m×1.35m (compatible with larger and smaller modules)
Speed repeatability (firing success rate): > 90%
Gun positioning: laser sighting, electric control displacement
Ultra high speed optical fiber measurement system: speed reading
Low temperature test chamber temperature and deviation range: -10 ℃±2 ℃
Electronic balance: maximum weighing range 100g, accuracy 0.1mg
Gas source or silent air compressor: > 0.3MPa

Standard model

Fully automatic model

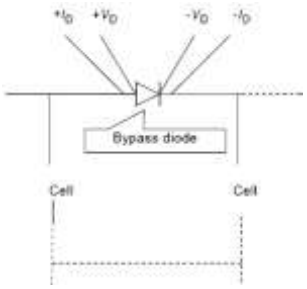
Gun compatible
25/35/40/45mm hails

Standard hail diameter: 25mm±2%
Standard hail mass: 7.53g±2%
Send speed setting: 23.0m/s (Continuously adjustable)
Speed measure accurately: ±2%
Speed windage range: ±5%
NOTE: Hail manufacturing temperature -10 ℃, storage temperature -4 ℃, This to for hail more easily out from mould.

Pass criteria:
The 11 points before and after ice impact, through EL equipment inspection crack, because cannot pass through visual inspection method.

BR-PV-BDT Bypass Diode Thermal Test System

Perform standards:
IEC 61215:2005 & Ed.3, IEC 61646:2008, UL 1703-2012, VDE 0126-5:2008



System include:
DC power supply: Voltage 0~50V, current 0~15A, can Provide 1.25 times Isc.
High temperature test chamber: RT~100°C, can into module
Data collector: Connecting to PC computer, automatic temperature and voltage data acquisition
Temperature rise glue: for adhesive thermocouple
A hand-held electric drill: for junction box borehole and export cable and thermocouple
Silica sealant and silica sealant gun: for Sealing
Ohm meter: for verify that the diode is still operational after 1.25 times Isc.
Computer: data analysis and processing
English operating software: automatic voltage and temperature data acquisition, then calculate diode junction temperature

New additional procedure from IEC 61215 Ed.3 and IEC 61646:2008:
a) Electrically short any blocking diodes incorporated in the module.
b) Determine the rated STC short circuit current of the module from its label or instruction sheet.
c) Connect the lead wire for V_D and I_D on both diode terminals as shown in above figure.
d) It is recommended that the connections be made by the module manufacturer
e) Put the module into the chamber set up to 30 ℃ ±2 ℃ until the module temperature reaches the saturation.
f) Apply the pulsed current (pulse width 1ms) equal to the STC short circuit current of the module, measure the forward voltage V_{D1} of diode.
g) Using the same procedure, measure V_{D2} at 50 ℃ ±2 ℃.
h) Using the same procedure, measure V_{D3} at 70 ℃ ±2 ℃.
i) Using the same procedure, measure V_{D4} at 90 ℃ ±2 ℃.
j) Then, obtain the V_D vs. Tj characteristic by a least-squares-fit curve from V_{D1}, V_{D2}, V_{D3} and V_{D4}.
NOTE: This V_D vs Tj characteristic may be provided by the diode manufacturer with a manufacturer's certification.
k) Heat the module to 75 ℃ ±5 ℃. Apply a current to the module equal to the short circuit current of the module as measured at STC ±2 %. After one hour measure the forward voltage of the each diodes.
l) Using the V_D vs. Tj characteristic obtained in item j), obtain Tj of the diode during the test in l).
m) Increase the applied current to 1,25 times the short-circuit current of the module as measured at STC while maintaining the module temperature at 75 ℃ ±5 ℃.
n) Maintain the current flow for one hour.
o) Verify that the diode is still operational after completing this test.

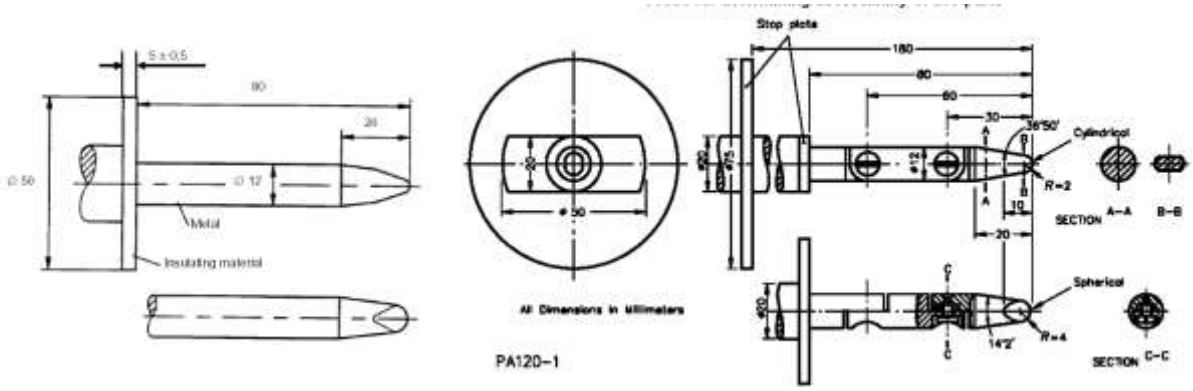
BR-PV-AF Accessibility Test Finger

Perform standards: IEC 61032-1997, IEC 61730:2-2004 & Ed.2, UL 1703-2012, VDE 0126-5:2008, VDE 0126-3:2009, IEC 60529:2001...

This probe may be used to verify the protection of persons against access to hazardous parts, and to verify the mechanical strength of openings in the enclosure or internal barriers.

Fibger Technical index:
Tolerance on dimensions when no specific tolerance is given: on angles 0~ -10°
On linear dimensions:
up to 25 mm: 0~ -0.05mm
over 25 mm: ± 0.2mm
Test probe B: Both joints shall permit movement in the same plane and the same direction through an angle of 90° with a 0° to +10° Tolerance.
Test probe 11: Different force requirement, 50N for IEC 61730 Ed.1 (quote IEC 61032:1997), 10N±10% for IEC 61730 Ed.2.
Attachment: Ohm meter for IEC 61730

Standard	Test force	Test subject	Finger type
IEC 61032:1997	50N	Module	Test probe 11
IEC 61730 Ed.2	10N±10%	Module	Test probe 11
UL 1703-2012	The minimum force necessary toaccurately determine accessibility	Module	Test probe B
VDE 0126-5:2008	75N / 20N	Junction box	Test probe 11 + probe B
VDE 0126-3:2009	20N / 10N	Connector	Test probe 11 + probe B



Application in VDE 0126-5 and VDE 0126-3, junction box and connector test conditions are as follows:
1. Fixing of lid at rewireable junction box - Screwless fixing of lid: Enclosures shall be tested with the test probe 11 according to IEC 61032 applied with a force of 75N for one minute to all points where this could cause a loosening of the lid. During test the lid shall not come off.
2. Protection against electric shock: Connectors shall be tested by t he IEC test finger in accordance to IEC 60529 using a test force of 20N.

BR-PV-CS Cut Susceptibility Tester

Perform standards: IEC 61730-2:2004 & Ed.2, UL 1703-2012, ASTM E2685-2009

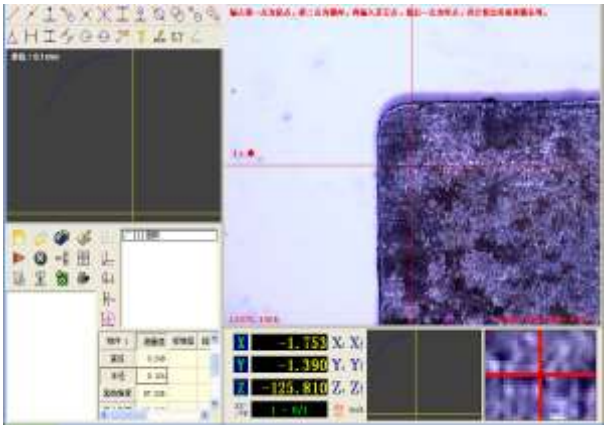
Purpose:
To determine whether any front and rear surfaces of the module made of polymeric materials are capable of withstanding routine handling during installation and maintenance without exposing personnel to the danger of electric shock. This test is derived from ANSI/UL 1703.
Note: does not apply to the glass surface.

Cutter:
A 0.64±0.05mm thick hardened steel blade over the surface of the module with an applied force of 8.9 N±0.5N.
Distance and angle can be adjusted, the factory indicators according to the standard requirement to adjust.

Adjustable speed motor:
At the same time to meet 150±30mm/s (IEC 61730) and 152.4±30.5mm/s (UL 1703) displacement speed pull-off module backplane surface.

The pass criteria are as follows:
1. No visual evidence that the superstrate or substrate surfaces have been cut, exposing the active circuitry of the module.
2. Dielectric Withstand test (MST 16) and Wet Leakage Current test (MST 17) shall meet the same requirements as for the initial measurements.

Blade basic requirements:
A test fixture as shown in Figure, designed to draw a defined shaped object, a 0.64±0.05mm thick hardened steel blade over the surface of the module with an applied force of 8.9 N±0.5N. The tip shall have a top angle of 90°±2°, being rounded with a radius of 0.115±0.025 mm.

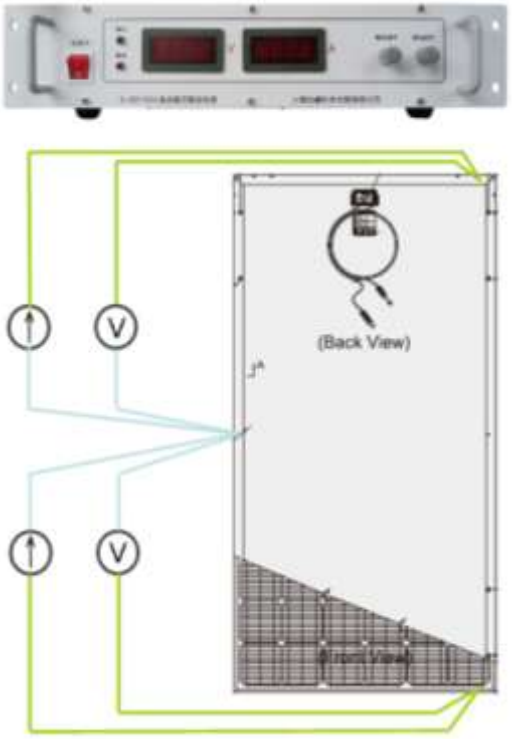


Blade processing and radius measuring:
Blade material: hardened steel
Blade mounting angle: horizontal 40°
Radiu measurement using image instrument

BR-PV-GCT Ground Continuity Test System

Perform standards: IEC 61730-2:2004 & Ed.2, UL 1703-2012

Test Purpose:
To demonstrate that there is a conductive path between all exposed conductive surfaces of the module, so that the exposed conductive surfaces can be adequately grounded in a PV system. This test is required only if the module has exposed conductive parts such as a metal frame or a metallic junction box.



Procedure:
1. Select the manufacturer's designated grounding point and recommended grounding connection. Attach to one terminal of the constant current supply.
2. Select an adjacent (connected) exposed conductive component with the greatest physical displacement from the grounding point, and attach to the other terminal of the current supply.
3. Attach the voltmeter to the two conductive components attached to the current supply in proximity to the current leads.
4. Apply a current 2.5 times ± 10% of the maximum over-current protection rating of the module for a minimum of 2 min.
5. Measure the applied current and the resultant voltage drop.
6. Reduce the current to zero.
Five times test in different connection position.

Pass criteria:
The resistance between the selected exposed conductive component and each other conductive component of the module shall be less than 0.1Ω .

Module type	Maximum over-current	DC power supply
Module of 6" cells (156×156)	15A	37.5A
Module of 5" cells (125×125)	10A	25.0A
Thin-film module	5A	12.5A

Apparatus
The apparatus is as follows:
a) A constant current supply capable of producing a current that is 2.5 times the maximum overcurrent protection rating of the module under test.
b) A suitable voltmeter.
NOTE 1: According to. IEC 61730-1 the maximum overcurrent protection rating has to be provided by the manufacturer. The maximum overcurrent protection rating is verified in MST 26 (Reverse current overload Test).
NOTE 2: Common types of overcurrent protection are fuses or circuit breakers.

Pass criteria:
The resistance between the selected exposed conductive component and each other conductive component of the module shall be less than 0.1 Ω.

Note: Cannot use AC grounding resistance tester, must DC.

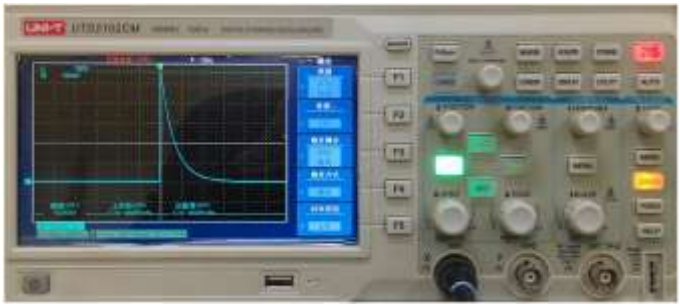
BR-PV-IVT Impulse Voltage Test System

Perform standards: IEC 61730-2:2004 & Ed.2, VDE 0126-5:2008

The test equipment and procedure shall comply with IEC 60060-1. The values for T1 and T2 have been adjusted due to the variable and comparably high capacity of the many different samples a laboratory will perform the test on.

Maximum System Voltage	Impulse Voltage	
	Application class A	Application class B
1000	8000	6000
1500	10000	8000

Pulse voltage: 0.01~10KV (Max.12KV)
Loading waveform can be adjusted separately, Voltage comprehensive wave:
Front time T1: 1.2μs±30%
Pulse width T2: 50μs±20%
Capacitance range of module: 6pF~250μF
(Crystalline silicon module about 300pF, thin-film module about 100μF)
Oscilloscope: including shielded boxes



T = Time width of rated voltage from 30% to 90%
Front time T1 = 1.67 × T = 1.2μs
Pulse width T2 = 50μs (time to half rated voltage value)

Pass criteria:
a) No evidence of dielectric breakdown or surface tracking of the module is observed during the test.
b) No evidence of major visual defects as defined in 10.1.
c) MST 16 shall meet the same requirements as for the initial measurements.

Copper and conducting glue:

Copper thickness:
we provide 0.04mm
(IEC require 0.03~0.05mm)

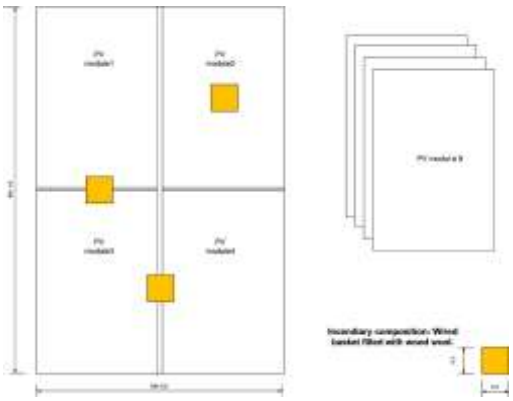
Total thickness:
we provide 0.065mm
(IEC require 0.05mm~0.07mm)

Conducting glue:
conductivity <1Ω
measuring area: 625mm^2

BR-PV-FR Fire Resistance Test Room

Perform standards:
IEC 61730-2:2004 & Ed.2, UL 1703-2012, UL 790-2004, ENV 1187:2006, EN 13501-5:2006, ISO 9705-1993, ISO 834-1:1999, ISO 834-3:1994, ISO 5657:1997...

Fire test:
The ENV 1187 fire test methods, parts 1 to 4, differ in terms of radiant heat, the used brands, additional air flow (wind simulation), tilt angels, amount and size of the demanded test specimen. The pass criteria for each test method are described in EN 13501-5.
In general building integrated PV systems shall be tested in conjunction with a defined mounting system following the installation instruction of the module manufacturer. When testing PV modules, the mounting material and the joints between modules as well as sealing materials have to be considered and included in the test set-up.



Spread-of-flame test:
The test is to be performed twice in two set-ups:
a) one sample centred to the flame (unless the sample has smaller dimensions than described in section 3.2.2; in this case the set-up under b) shall be used twice)
b) two samples mounted next to each other according to the manufacturers mounting instruction with the suggested mounting materials. The test sample shall be installed in such a way, that the gap between them is centred to the flame.
The luminous gas flame applied shall be applied as described in 6.1 of ANSI/UL 790. The test is to be conducted with the module or panel oriented with respect to the test flame, such that the flame impinges only on the top surface of the module or panel.

Burning-brand test:
A test sample is to be mounted as described in 6.1 of ANSI/UL 790, except that the framework is to be 1.5 m from the air duct outlet (see Figure A.1), and the gas piping and burner are to be removed so as not to obstruct the air flow.
Before application to the test sample, the brands are to be ignited so as to burn freely in still air, as described in A.4.3.2, A.4.3.3 or A.4.3.4, as applicable. The flame of the gas burner used to ignite the brands is to essentially envelop the brands during the process of ignition.
The temperature of the igniting flame is to be (888 ℃ above the top of the burner. The burner is to be shielded from drafts.
Fire safety class A brands are to be exposed to the flame for 5min, during which time they are to be rotated to present each surface to the flame as follows:
a) each (300 by 300) mm face for 30s,
b) each (57 by 300) mm face for 45s,
c) each (300 by 300) mm face again for 30s.

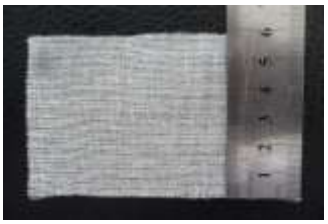
BR-PV-RCO Reverse Current Overload Test System

Perform standards: IEC 61730-2:2004 & Ed.2, UL 1703-2012

DC power supply:
DC 30.00A (stability during test better than ±2%)
Pine board:
19.1mm thick (NOTE: IEC 61730-2:2004 provisions 9mm thick soft pine boardis wrong, but IEC 61730-2 Ed.2 have corrected error. UL 1703-2012 description a 19.1mm thick pine board)
Single layer of white tissue paper:
12~30g/m^2 (Reference IEC 60695-2-10 and ISO 4046 6.86)
Cheesecloth:
(26,28)m^2/kg, 32in×28in

Module of 5" cells (125×125)
Maximum protection current: 10A
Test current: 13.50A
Module of 6" cells (156×156)
Maximum protection current: 15A
Test current: 20.25A
Thin-film module
Maximum protection current: 5A
Test current: 6.75A

IEC 61730-2 Ed.2 tissue paper requirement
Specific gravity: 12~30g/m^2
Width:255mm Length:360mm
Weight:2.5935g Specific gravity:28.25g/m^2
We provide tissue paper about 28.25 or 17g/m^2



UL 1703-2012 cheesecloth requirement
Specific gravity: 26~28m^2/kg
Length:100mm width:60mm
Weight:0.228g Specific gravity:26.32m^2/kg
We provide cheesecloth about 26.32m^2/kg

BR-PV-MBT Module Breakage Tester

Perform standards:
IEC 61730-2:2004 & Ed.2, AS/NZS 2208:1996, ISO 12543-2:2006, ISO 12543-3:1998...

45.5Kg (IEC 61730:2-2004 & Ed.2)
46.0Kg (AS/NZS 2208:1996)
45.0Kg (ISO 12543-2, ISO 12543-3)

Module fixture: can installat 2×1.35m, 2×1m, 1.58×0.808m, 1.4×1.1m, 1.3×1.1m etc.

The apparatus is as follows:
a) The impactor shall be a bag made of a suitable material and capable to be filled to the required weight using a suitable filling material (e.g. steel balls or pellets). The exterior of the bag shall be wrapped with tape as shown in the figure 4 in order to avoid uneven surfaces like stitching.When filled the length of the impactor shall lie within 300mm to 400mm. The ratio of widest diameter to height shall lie within 1:1.5 to 1:1.4)
b) When filled, the impactor bag shall have dimensions as described in figure 4 and a weight of 45.5kg ±0.5kg. Adhesive tape bag used in diagonal, overlapping manner shall cover the entire surface of bag. Tape neck shall be processed separately.
c) A test frame similar to that shown in Figures 5 and 6 shall be provided to minimize movement and deflection during testing. The structure framing and bracing shall be steel channel (approximately C 100mm, 200mm or larger) and shall have a minimum moment of inertia of approximately 187cm^4. The frame shall be welded or securely bolted at the corners to minimize twisting during impact. It shall also be bolted to the floor to prevent movement during impact testing.

The procedure is as follows:
a) At rest the impactor bag shall hang no more than 13mm from the surface of the module sample and no more than 50 mm from the centre of the module sample.
b) Lift the impactor to a drop height of 450mm from the surface of the module sample, allow the impactor to stabilize, and then release it to strike the module sample.

BR-PV-PDT Partial Discharge Test System

Perform standards: IEC 61730-2:2004 & Ed.2, IEC 60664-1:2007, IEC 60243-1:1998

Capable of testing capacitance range: 6pF~250μF
Electric charge measurement range: 0.1~1000pC
Electric charge measurement precision: 0.1pC
Application AC voltage: AC0.01kV~5kVrms
(Voltage change: automatic / manual)
Automatic voltage change model: 3 basic models
Voltage measurement accuracy: better than 5%

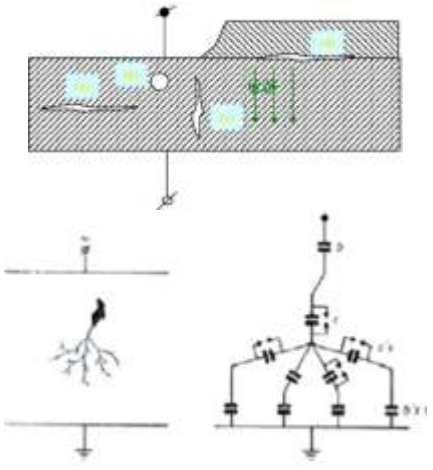
Test object:
TPT (IEC 61730:2004)
TPT into silicone oil during test
IEC 60664-1:2007

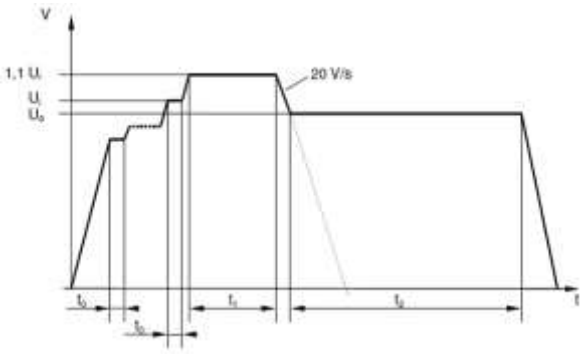
Module (IEC 61730 Ed.2)
IEC 60243-1 figure 1a (see right)

Electrode diameter: 25cm
Chassis diameter: 75cm

Apparatus
Calibrated charge measuring device or radio interference meter according to IEC 60664-1. If testing foils, the geometry of the electrodes shall be in conformance with IEC 60243-1 figure 1a. If testing a complete module, one electrode shall be connected to the short circuited module terminals, the earth electrode acc. to IEC 60243-1 figure 1a (bottom electrode) shall be connected to the frame and placed on the surface of the module (front or back sheet). The position of the electrode shall be chosen to represent critical points; a total number of 10 points shall be chosen.

Pass criteria
The solid insulation / module has passed the test if the mean value minus the standard deviation of the partial discharge extinction voltage is greater than 1,5 times the given maximum system voltage. When calculating the standard deviation the voltage step distance of the apparatus used shall be taken into account.





↑ Test voltage process
← Partial discharge test principle

Note: Care should be taken to prevent undesired noises to occur during the test according to IEC 60664-1 annex D.3.

BR-PV-CBT Conduit Bending Tester

Perform standards: IEC 61730-1:2004, IEC 61730-2:2004 & Ed.2, UL 514C-2007

Note: The test for nonmetallic outlet boxes or Flush-Device boxes, not for junction boxes.

Conduit applications – Non-metallic
The sides, end walls, and bottom of a non-metallic wiring enclosure specified for conduit applications shall not have a thickness less than the values specified in Table.

Wall thickness and test force of polymeric boxes intended for conduit

Trade size of conduit (mm)	Minimum wall thickness (mm)	Force load (N)
13 to 25	3	220
26 to 50	4	330
51 to 100	5	490

Conduit applications – Metallic
A threaded hole in a metal wiring compartment intended for the connection of rigid metal conduit shall be reinforced to provide metal not less than 6,4 mm (1/4 in.) thick, and shall be tapered unless a conduit end stop is provided.
If threads for the connection of conduit are tapped all the way through a hole in a compartment wall, or if an equivalent construction is employed, there shall not be less than 3,5 nor more than 5 threads in the metal and the construction shall be such that a conduit bushing can be attached as intended.
If threads for the connection of conduit are not tapped all the way through a hole in a compartment wall, there shall not be less than 5 full threads in the metal and there shall be a smooth, rounded inlet hole for the conductors which shall afford protection to the conductors equivalent to that provided by a standard conduit bushing.
For a non-threaded opening in a metal wiring compartment intended to accommodate rigid metallic conduit, a flat surface of sufficient area shall be provided around the opening to accept the bearing surfaces of the bushing and lock washer.
Conduit shall comply with the Conduit bending test described in Clause 11 of IEC 61730-2, MST 33.

Modules provided with junction boxes intended for attachment of a permanent wiring system using conduitmust provide assurance of the ability of the box construction to withstand load forces which may be applied to the conduit during and after installation.
One end of the conduits connected to electric knob, so it can according to the standard requirements, in a minute junction box and conduits rotate around the central axis of tester 360°, then automatically stop.

Two shafts distance: > 920mm (adjustable)
Rotating speed: 360° / min
Test program set: after 1min automatically stop rotating
Poise weight: 220N, 330N, 490N

BR-JB-TBK Terminal Box Knockout Tester

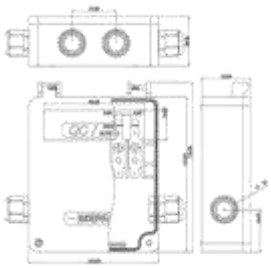
Perform standards: IEC 61730-1:2004, IEC 61730-2:2004 & Ed.2, VDE 0126-5:2008, EN 168

Mandrel: minimum 38mm long by 6.4 mm diameter
Junction box fixture: adjustable
Load force: 44.5N
Mandrel and poise lifting: pneumatic control
The test for hydrostatic test, must reduce or eliminate the drop impact force influenceing test results.
Gas pressure method, adjustable speed, avoid the impact caused by direct terminal box knockout.
Mandrel and pressure bar is separate, when mandrel pressure to junction box, mandrel and pressure bar separate, At this time knockouts force only mandrel add poise, have nothing to do with gas pressure.

Attachment:

① Timer or mobile phone time
□ Low temperature test chamber
③ Gap measurement and sharpness of edge determination

Terminal unction box Real figure:



Purpose:

Removable hole covers in the walls of module terminal enclosures (knockouts) shall remain in place under nominal force application and also be easily removed for the field application of permanent wiring system components.

Condition:

A sample of the polymeric terminal box with knockouts will be tested in an “as-received” condition at a 25℃ ambient temperature. Another sample of the polymeric box is to be conditioned for 5h in air maintained at -20℃±1℃. The test shall be repeated on the box immediately following this conditioning.

Procedure:

The knockout shall be easily removed without leaving any sharp edges or causing any damage to the box. The procedure is as follows:

Step 1 – A force of 44.5N shall be applied to a knockout for 1min by means of a mandrel, minimum 38mm long by 6.4 mm diameter, with a flat end. The force is to be applied in a direction perpendicular to the plane of the knockout and at the point most likely to cause movement. Wait 1 h and measure the displacement between the knockouts and the box.

Step 2 – The knockout shall then be removed by means of a screwdriver, used as a chisel. The edge of a screwdriver blade may be run along the inside edge of the resulting opening once only, to remove any fragile tabs remaining along the edge.

Step 3 – Repeat steps 1 and 2 on two additional knockouts. For a box employing multi-stage knockouts, there shall be no displacement of a larger stage when a smaller stage is removed.

Pass criteria:

The knockout shall remain in place after the application of the steady force and the clearance between the knockout and the opening shall not be more than 0.75 mm when measured. The knockout shall be easily removed without leaving any sharp edges or causing any damage to the box.

BR-PV-SST Salt Mist Corrosion Testing Room

Perform standards: UL 1703-2012, IEC 61701 Ed.2 (Refer IEC 60068-2-52)

Size and design:
Internal size (W×D×H)(mm):2550×1530×1560
External size (W×D×H)(mm): 2700×1700×2200
Test chamber Volume: 6m^3 without top of tower

Note: UL 1703-2012 regulate the chamber minimum size is (L×W×H) 1.22m×0.76m×0.91m.
Need at the same time at least begin 2 pcs 2m×1.35m Crystalline silicon module (96 pcs 156×156 cells) test, or begin 4 pcs 2m×1m modules.
External higt 2200mm just is P.P. maximum length.

Test temperature and Relative humidity:
35±2 ℃, 40±2 ℃ and 93%$^{+2}_{-3}$%R.H.

Spray mode:
For UL 1703-2012: Continuous spray mode
For IEC 61701 Ed.2: Alternating spray mode

Attachment:
Acidity meter: precision 0.1pH
Coating on zinc-coated (galvanized) iron or steel:
G90 or G60 coating designation
Reference ASTM A90(A)-1991
Size: 102mm×305mm
single groove approximately: 152mm

The main performance of equipment:
Water jacket (UL 1703 test condition, option)
Double-deck Layer P.P., Good performance of insulation
Automatic water supply, water shortage can automatically supplement.
Double door, ensure the water and gas no leakage.
Precision glass nozzle, mist diffusion uniform.
Double over-temperature protection, water level warning, ensure safe use.
Temperature control precision: 0.5°C (resolution 0.1°C)
Heating, humidification, gas delivery system, from the outside to the inside.
Compressed air fast exclusion of mist after test.
The PLC programmable control, English operation interface.

Test subject and pass criteria:
① UL 1703-2012:
After the test, the corrosion products formed on the test sample shall not be more than that formed on the reference sample as determined by visual observation. Corrosion in the scribed line area is judged by the spread of corrosion from the scribed line.
② IEC 61701 Ed.2:
Visual inspection, Maximum power determination, Insulation test, Bypass diode thermal test, Wet leakage current test, Ground continuity test.

BR-PV-FMC NH_3 / Moist Carbon Dioxide / Sulphur Dioxide Flowing Mixed Gas Corrosion Test Chamber

Perform standards: UL 1703-2012, IEC 60068-2-60:1995
IEC 62716 "Ammonia corrosion testing of photovoltaic (PV) modules":2010 (draft-B/C)

Photovoltaic modules commonly used aluminum alloy frame, UL 1703 test subject is galvanized material (a module constructed of materials such as plastic, stainless steel, or aluminum that are inherently resistant to atmospheric corrosion need not be tested), corrosive atmosphere test already can not adapt to the need of photovoltaic industry. The following key Introduction Ammonia corrosion testing.

Ammonia corrosion test conditions:

Cycles	1 test section	Hours	8 including heating up
		NH_3 - Concentration	6,667 ppm
		Temperature	40 ±3℃ (maybe draft-C require 60℃)
		rel. Humidity	Saturation at about 100% (dewing of the samples)
	2 test section	Hours	16 including cooling (Test chamber opened and/or ventilates)
		NH_3 - Concentration	0 ppm
		Temperature	18 to 28℃
		rel. Humidity	Maximum 75% (maybe draft-C require 100%)
The concentration is related to the volume of the test chamber and corresponds to a ground quantity of water of 2 litres with a chamber volume of 300 litres. During testing the inclination to the vertical of the face of the PV module normally exposed to solar irradiance shall be 15 °to 30 °inside the climatic chambers.			

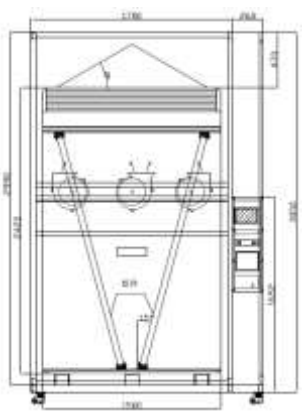
Test reference ISO 12944, ISO 3231, ISO 6988 and DIN 50018 relevant provisions.

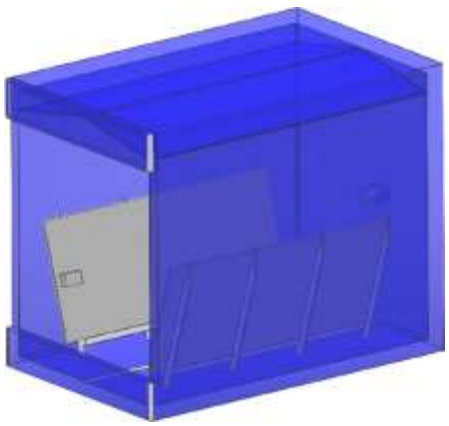
Molecular filter: Ammonia external emissions should not exceed 5% of the total test Concentration, we must purify exhaust emissions.
Ammonia measurement: PID for high concentration measurement, range 0~10,000ppm
Safety detector: LEL sensor, range 0~100% LEL (The lower explosive limit of Ammonia: 15%)

Mothed: Dominant potential failure mechanisms in the reaction of ammonia with PV modules are identified by applying different ammonia concentrations to PV modules and its components (encapsulation materials, front glass...) and evaluating the damage mechanisms by various analytical methods. The permeation of ammonia through encapsulant and back skin materials (EVA and Tedlar/ PET/ Tedlar) are evaluated quantitatively.

Crystalline silicon final measurements:
Maximum power determination
Wet leakage current test
Visual inspection
Ground continuity test
Dielectric withstand test
Bypass diode functionality test

Thin-film final measurements:
Performance at STC (not NOCT)
Wet leakage current test
Light soaking
Visual inspection
Ground continuity test
Dielectric withstand test
Bypass diode functionality test





BR-PV-SED Sharpness of Edge Determination Equipment

Perform standards: IEC 61730-1:2004, UL 1703-2012, UL 1439-2004

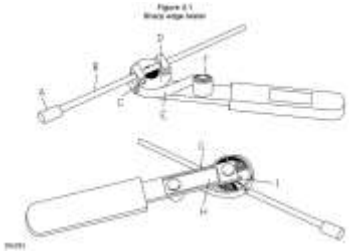
Edges, projections, and corners of photovoltaic modules and panels shall be such as to reduce the risk of injury to persons.
Whenever a referee measurement is necessary to determine that a part as mentioned in 6.9 is not sufficiently sharp to constitute a risk of injury to persons, the method described in the requirements in the standard for Determination of Sharpness of Edges on Equipment, UL 1439, is to be employed.

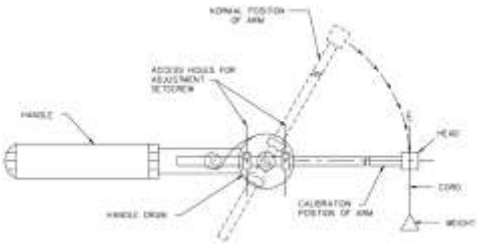
The test apparatus is to consist of the following:

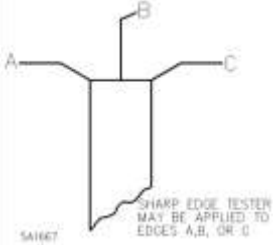
a) Sharp-Edge Tester – The instrument consists essentially of a handle with a pivoted arm attached. A constant-tension spring secured to the handle is used to apply a steady force to the arm. The arm head is a piece of round steel, with an outside diameter of 12.7mm located at the end of the adjustable arm. The arm head is to be wrapped with three layers of tape, the two outer layers act as sensing tapes; the inner layer acts as an indicating tape, or the tapes are to be applied to a 15.9mm removable sleeve that is placed onto the 12.7mm steel head.

b) Indicating Tape (Inner Layer) – 19.1mm wide, adhesive backed, single-adhesive coated, vinyl foam tape, black in color, having the tape properties given in Table 5.1.
c) Sensing Tape No. 2 (Middle Layer) – 19.1mm wide, double-adhesive coated, vinyl foam tape, white in color, having the tape properties given in Table 5.1.
d) Sensing Tape No. 1 (Outer Layer) – 19.1mm wide, single-adhesive coated skived tetrafluorethylene tape – natural color, having the tape properties given in Table 5.1. The skived tetrafluorethylene backing (film) is shaved in a thin layer from a cylindrical block of material.
e) Calibration Equipment – A weight that can exert 6.7N and a length of string.

Test Procedure:
The curved face of the tester head shall be covered with three layers of tape in the order indicated below:
a) First Layer (Inner Layer) – Indicating type, black vinyl foam tape as described in 5.1(b).
b) Second Layer (Middle Layer) – Sensing Tape No.2, white vinyl foam tape as described in 5.1(c).
c) Third Layer (Outer Layer) – Sensing Tape No.1, tetrafluorethylene tape as described in 5.1(d). Each tape is to be applied over approximately 180 degrees of the circumference of the test head to prevent stretching of the tape.
The tapes are not to be stretched when positioned on the head.
The center of the tape-covered head of the sharp-edge tester shall be positioned on the edge to be tested in the manner illustrated in Figure 7.2. The arm of the tester shall be between stops so that the tape-covered head exerts a 6.7N on the edge. The tester shall be immediately moved along the edge a distance of 50.8mm and then back to its starting position without removal of the tester from the edge. It shall then be withdrawn from the edge. The total distance of engagement between the edge and the tape-covered head is not to exceed 101mm. The time of travel is not to take longer than 5 seconds nor less than 2 seconds.
Exception: An edge less than 50.8mm long shall be tested for a distance of twice its length.
(Example: For an edge 41.2mm long, the tester is to be moved along its length and back to the starting position so that the total distance of engagement between the edge and tester is 76.2 mm.







BR-UL-PMS Polymeric Materials Testing Instrument Series

Perform standards: IEC 61730-1:2004, UL 1703-2012, ASTM D3638-1993, ASTM D2303-1997…

Test Item.	IEC 61730-1	UL 1703
5-V flammability rating	5.2 Polymers serving as an enclosure for live parts (such as a junction box)	7.1 Polymeric material system serving as the enclosure of a part involving a risk of fire or electric shock
Water immersion and exposure		
UL 746C Ultraviolet light exposure		
Hot wire ignition rating of 30		
High arc ignition test	5.3 Polymers serving to support live parts (such as integrated terminals)	7.2 Polymeric material system serving as the support or insulation of a part involving a risk of fire or electric shock
Comparative Tracking Index test		
Inclined plane time-tracking test		
UL 746C Ultraviolet light exposure		
Temperature test	5.4 Polymers serving as an outer surface	7.3 Polymeric substrate or superstrate
Flame spread index of 100 test		
UL 746C Ultraviolet light exposure		7.4 Polymeric material that serves as the outer enclosure
Partial discharge test		
Refer IEC 61140, Thickness measurement	5.5 Barriers	7.5 Barrier
MST32 Module breakage test (IEC61730)	5.6 Structural glazing materials	17. Superstrate
Impact test (UL1703)		

A polymeric material system serving as the support or insulation of a part involving a risk of fire or electric shock shall:

Flammability tester

Hot-wire ignition tester

Arc generator

a) Have a flammability classification of HB, V-2, V-1, or V-0 determined in accordance with the Standard for Tests for Flammability of Plastic Materials for Parts in Devices and Appliances, UL 94;

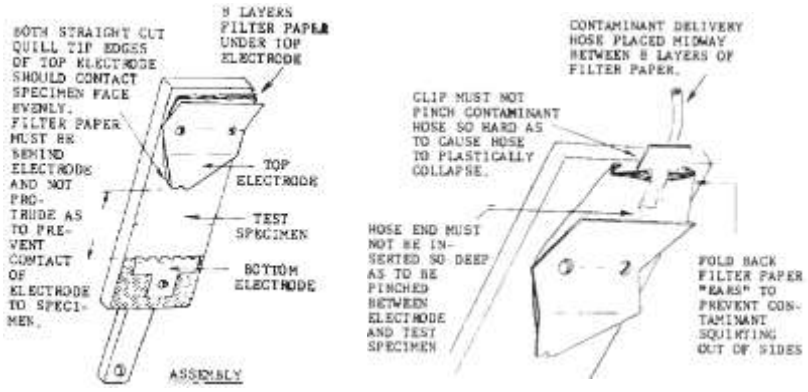
b) Have a minimum high-current arc ignition performance level category (PLC) in accordance with the following:

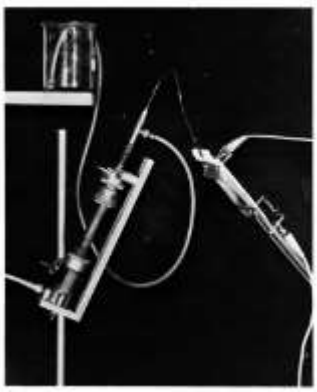
Flammability classification	High-current arc ignition (PLC)
HB	1
V-2	2
V-1	2
V-2	3

c) Have a Comparative Tracking Index performance level category (PLC) of 2 or better, when the system voltage rating is 600V or less, as determined in accordance with the Standard for Polymeric Materials – Short Term Property Evaluations, UL 746A;

Platinum Electrodes, having a rectangular cross section measuring 5×2mm, extending 20mm minimum from suitable mounting shanks. The end of each electrode is machined to form a 30 °chisel-point edge, having a radius from 0.05 to 0.10 mm, extending along the 5 mm side of the electrode. This is the radius that generally results from polishing a "Omm" radius electrode. Since the direction of polish may influence the results, all electrodes should be polished in a direction perpendicular to the long dimension of the electrode face.
Two electrodes distance: 4.0mm
Electrodes to sample surface force: 1.0±0.05N
Power supply with an output voltage from 100V to 600V
Maximum test current: 3A
Electrolyte dropping apparatus: dropping time interval can be set arbitrarily.
Drop height for the electrolyte should not be more than 40 mm above the electrode gap.
The holding device is designed to store an aqueous solution and deliver periodically a measured drop to the specimen. The drop size is to be 20(+5~0)mm^3 and the drop rate is to be 1 drop / 30±5s.

d) Have an Inclined Plane Tracking (ASTM D2303) rating of 1h using the time to track method at 2.5 kilovolts when the system voltage rating is in the range 601~1000V.



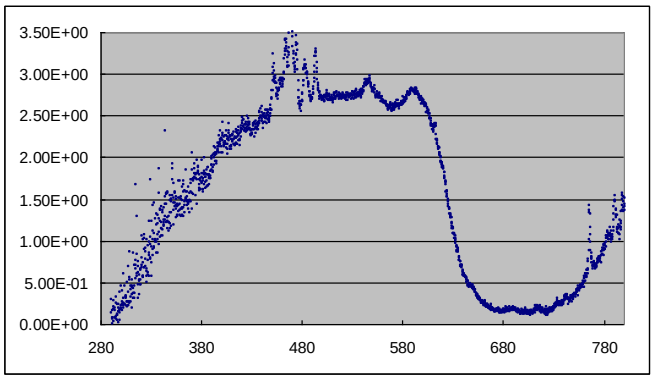


Top and bottom electrodes material: Stainless steel
Electrodes thickness: 0.5mm
Top and bottom electrodes distance: 50.0mm±0.1mm
A pad of filter paper cut to fit under the top electrode and used to smooth out the flow of the contaminant solution.
Power supply with an output voltage from 100V to 6000V with a rated current of no less than 0.1 A for every test station to be used. (that is, 0.5 A for five stations)
Aset of ballast resistors (50, 10, and 1kV rated at 200W each) to be connected as specified in series with each test specimen on the high-voltage side of the power supply.
A 330-V, 1⁄2-W, carbon resistor5 mounted with a simple tension spring and connected in series with the specimen and ground to act as an overload, high-voltage fuse.
Structural parts and a grounded safety enclosure.
A means for applying a specified contaminant solution at a controlled rate to the specimen surface, liquid automatic dropping device.

e) Comply with the requirements for exposure to ultraviolet light as determined in accordance with the standard for polymeric materials – use in electrical equipment evaluations, UL 746C, when exposed to light during normal operation of the product. Polymeric materials that are exposed to sunlight and are protected by glass, or other transparent medium, shall be tested with an equivalent layer of that medium attenuating the ultraviolet light exposure during the test. (see next page - Ultraviolet light exposure)

BR-UL-UVE Ultraviolet Light Exposure Chamber

Perform standards:
 IEC 61730-1:2004, UL 1703-2012 Polymeric materials (quote UL 746C-2006"Ultraviolet Light Exposure", spectral distribution conform to ASTM G155-2005)
 VDE 0126-5:2008 Junction box "Weather resistance test", VDE 0126-3:2009 Connector "Weather resistance", spectral distribution conform to ISO 4892-2-2006
 ETAG 002-2000, ASTM C1184-2000 Silicone sealant UV age test, spectral distribution conform to ASTM G155-2005
 General specification of crystalline silicon solar cell for terrestrial application: Cell maximum power in early light attenuation ratio test



Effective area of irradiation: 500×400mm
Measurement point or range:
300~400nm, 290~800nm, 340nm/nm, 420nm/nm
Irradiation uniformity: better than ±10% at 312×312mm
Irradiation deviation: ±2W/m^2@300~400nm
Temperature control range: RT~90 ℃±2.5 ℃
Air temperature control range: 20~80 ℃
With refrigeration compressor, spray system
Irradiation, temperature and spray: Program control
Irradiation and temperature closed loop control…

① DayLight filter: for junction box and connector test, spectral distribution conform to ASTM G155 and ISO 4892-2 requirements.
② AM1.5 filter (option): for cell maximum power in early light attenuation ratio test, spectral distribution conform to IEC 60904.9 Class C requirements.

Spectral after filter comparison ASTM G155:

Wavelengh range	Transmission after filter	Benchmark solar	ASTM G155	Radiation precent after filter
(<290nm)	0.01%	0~0.15%	0~0.15%	0.02%
(290~320nm)	2.85%	5.80%	2.6~7.9%	4.34%
(320~360nm)	23.90%	40.00%	28.3~40.0%	36.46%
(360~400nm)	38.79%	54.20%	54.2~67.5%	59.18%
Total UV	65.54%	100.00%	100.00%	100.00%

UL 1703 (UL 746C) test results discriminant:

Physical-property consideration	Material test method
Functional support	Tensile strength or Flexural strength (The ultraviolet-exposed side is to be in contact with the two loading points when using the three-point loading method.)
Impact resistance	Tensile impact, Izod impact, or Charpy impact

BR-UL-Push Push Tester

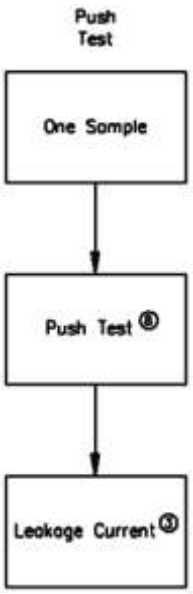
Perform standards: UL 1703-2012, UL 746C-2004

A 89N force applied by a 12.7mm diameter steel rod, the end of which is rounded to a 12.7mm diameter hemisphere, 89N force applied;
A 17.8N force applied by a 1.6mm diameter steel rod, the end of which is rounded to a 1.6mm diameter hemisphere, 17.8N force applied.

Probe of lifting: pneumatic
Poise box transmission: X-Y axis of electric

Keys in the panel, control rod:
up and down, leftward, rightward, forward, backward
Module pressed position see the left figure:
1. The center of the long side
2. The center of the short side
3. The center of module
Or application to any point (UL 1703 original).

Test procedure and pass criteria:
A module back and front shall be capable of withstanding for 1 min. without creating a risk of fire, electric shock, or injury to persons.



A risk of fire is considered to exist, if, as a result of the application of either probe, parts of the module are displaced to the extent that arcing between parts of available current and voltage in the “Arc test” zone, Figure 40.1, is likely.

A risk of electric shock is considered to exist if:
a) A part involving a risk of electric shock is contacted by the applied probe;
b) A part involving a risk of electric shock is rendered accessible (transitory or permanent) as a result of the application of either probe; or
c) There is a reduction in resistance between a part involving a risk of electric shock and an accessible part such that the module or panel would not comply with the leakage current test, section 21.

A risk of injury to persons is considered to exist, if, as a result of the application of either probe, parts are displaced or broken so as to expose edges which would not comply with the requirements for sharp edges in 6.9.

BR-UL-Impact Drop-Ball Impact Tester

Perform standards:
UL 1703-2012 for module and junction box
ISO 12543-2:2006 for toughened glass (option, not suitable for suede glass)
ISO 12543-3:1998 for laminated glass
VDE 0126-5:2008 for junction box mechanical strength at low temperatures test (option, standard test method usd impact hammer)

Theory: the ball is specified in a certain height adjustment, free fall, blow and observe the damaged extent specimens to determine module, glass and junction box of quality.

Balls quality:
535g (UL 1703-2012): for module and junction box
1040/2260g (ISO 12543) (option): for toughened glass / laminated glass
Drop high: 200~1295~2000mm (0.2~2.0m range, adjustable)
Note: 1295mm for UL1703, 1200 → 4800mm for thin-film module

Standard ball quality: 535g
Standard ball diameter: 51mm
Sucker of dropping ball: adjustable along the guide rail
Dropping ball position to cover the total module
Dropping point control: laser positioning
Ball drop control method:
DC electromagnetic control
Module fixture: adjustable
Junction box fixture: adjustable
Shield: prevent drop-ball rebound
Volume (W×D×H): about 50×50×210cm
Weight: about 63Kg
Power: 1□, 220V, 0.5A

Test purpose:
A polymeric material serving as the enclosure of a part involving a risk of fire or electric shock and a superstrate material evaluated in accordance with 17.1(c) are to be subjected to the tests described in 30.2 and 30.3.

Test for module:
A module or panel is to be mounted in a manner representative of its intended use, and is to be subjected to a 6.78J impact normal to the surface resulting from a 51mm diameter smooth steel sphere weighing 535g falling through a distance of 1.295m. The module or panel is to be struck at any point considered most vulnerable. If the construction of a module or panel does not permit it to be struck free from above by the free falling sphere, the sphere is to be suspended by a cord and allowed to fall as a pendulum through the vertical distance of 1.295m with the direction of impact normal to the surface.
Pass criteria: When a module is impacted as described in 30.3, there shall be no accessible live parts as defined in Accessibility of Uninsulated Live Parts, Section 15. Breakage of the superstrate material is acceptable provided there are no particles larger than 6.5cm^2 released from their normal mounting position.

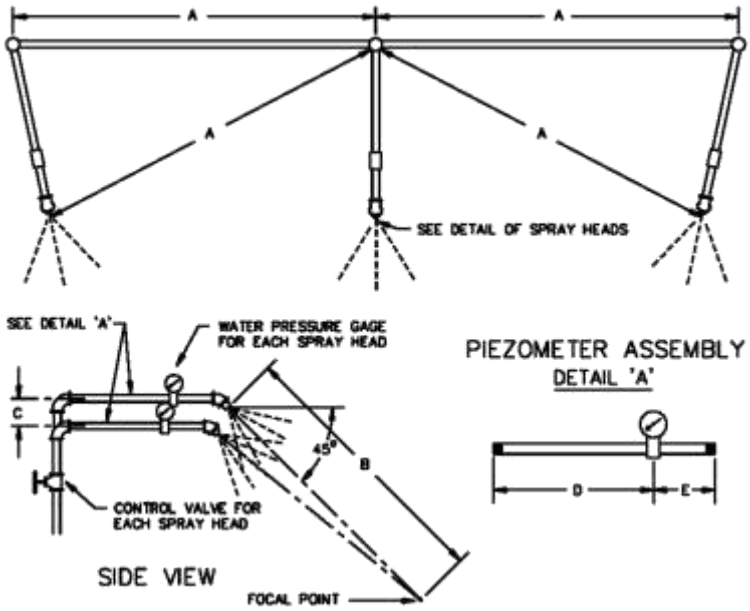
Test for polymeric wiring enclosure:
The test is to be performed on the enclosure at 25 ℃ and also after being cooled and maintained for 3h at a temperature of minus 35 ℃.
+25 ℃ pass criteria: The junction box no broken
-35 ℃ pass criteria： After the junction box be broken, unable to contact to the conductive parts (usd a test finger conduct accessibility test)

BR-UL-Spray Water Spray Test System

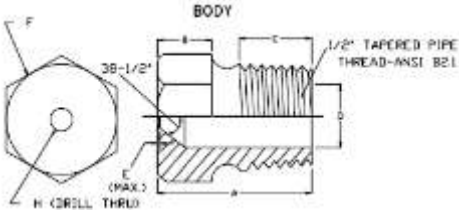
Perform standards: UL 1703-2012

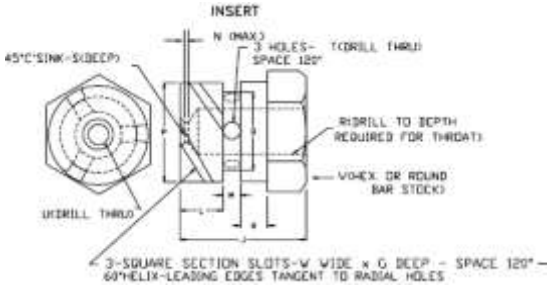
Module mounting angle 35 °with the horizontal plane.
The exposure time is to be 1h to the back and front of module.
Test pass criterion: wet leakage current test

Rain-test spray-head piping:



Water pressure: 34.5kPa
Spray water resistivity: 3500Ω·cm±5%@25 ℃
Note: Temperature of spray water no requirement





Test spray heads material: Molded nylon rain (see UL 1703)

BR-PV-UMT Universal Material Tester

Perform standards:
UL 1703-2012 "Accelerated Aging Test"
GB/T 2790 and GB/T 2791: EVA "Peel strength test"
GB 18173 and GB 12952: Backsheet "Stretching and tear test"
GB/T 2059: Solder Strip "Tensile strength and elongation epigastric test"
ETAG 002-2000: Silicone Sealant "bonding test"

Max. test force range: 500N (Provide a 200N sensor backup)
The biggest test force value: 1%~100%F.S.
Test accuracy: better than the indication force 1%
Beam displacement measurement resolution: 0.01mm
Deformation measurement accuracy: ±1% or better
Deformation measurement resolution: 0.01mm
Adjustable speed range: 1~500mm/min
Effective tensile space: ≥600mm
Tester dimension: 600mm×400mm×1650mm
Microcomputer control: with computer and software
Software functions: data storage function, automatically generate statements format…
Note: for EVA test, automatic calculation after the average 100mm to peel strength within.

The application in UL 1703 Accelerated Aging Test:

Minimum tensile strength	Minimum ultimate elongation	Compressive set, maximum set
Silicone rubber – 500 psi (3.45 MPa)	100%	15%
Flexible cellular materials (that is such as foam rubber) – 65 psi (0.448 MPa)	100%	Compressive set is not applicable to flexible cellular materials.
Other Elastomers – 1500 psi (10.3 MPa)	300%	15%
Nonelastomers (excluding cork, fiber and similar materials) – 1500 psi (10.3 MPa)	200%	15%

Temperature on material in temperature test	Conditioning Procedure	Minimum percent of the result with unaged specimens		Maximum change (Duro) from unconditioned value
		Tensile strength	Ultimate elongation	
60 ℃ or less	Air oven aging for 70h at 100 ±2 ℃	60	60	5
61~75 ℃	Air oven aging for 168h at 100 ±2 ℃	50	50	5
76~90 ℃	Aged in full-draft, air-circulating oven for 168h at 121 ±2 ℃	50	50	10
91~105 ℃	Aged in full-draft, air-circulating oven for 168h at 136 ±2 ℃	50	50	10
Above 105 ℃	20 ±1 ℃ (36 ±2 ℉) greater than use temperature in circulating convection oven, 168 h exposure	50	50	10

Other tests:
CQC 3307-2013 EVA and glass and backsheet peel test
CQC 3308-2013 Backsheet interlamination and sealant peel test
GB/T 2790-1995 180° horizontal peel test…
IEC draft "Edge protecting materials for laminated solar glass modules"
GB/T 2059-2008 Welding strip tensile strength and elongation test
GB/T draft" Backsheet tensile strength, elongation test…

BR-UL-MCT Metallic Coating Thickness Test System

Perform standards: UL 1703-2012, ASTM B499-2009, ISO 2178-1995

The test for corrosive atmosphere Test, include salt spray test and moist carbon dioxide / sulphur dioxide, measure the thicknees of coating on Zinc-coated (galvanized) Iron or steel articles. Recommend ASTM B499 and ISO 2178 Nonmagnetic coatings on magnetic basis metals measurement of coating method. UL 1703-2012 use mass loss method (chemical method), Maneuverability is not strong, and chemical reagent may pollute the environment.

The method for determining the thickness of a zinc or cadmium coating mentioned in 14.1 and 14.2 is described in following.

The solution to be used for the metallic coating thickness test is to be made from distilled water and is to contain 200g/L of reagent (or better) grade chromium trioxide (CrO_3) and 50g/l of reagent (or better) grade concentrated sulfuric acid ($H2_SO_4$). The latter is equivalent to 27ml/l of reagent grade concentrated sulphuric acid, specific gravity 1.84, containing 96 percent of H_2SO_4.

The test solution is to be contained in a glass vessel such as a separatory funnel with the outlet equipped with a stopcock and a capillary tube of approximately 0.64 mm inside bore and 150mm long. The lower end of the capillary tube is to be tapered to form a tip, the drops from which are about 0.05 milliliter each. To preserve an effectively constant level, a small glass tube is to be inserted in the top of the funnel through a rubber stopper and its position is to be adjusted so that when the stopcock is open, the rate of dropping is 100±5 drops/min. If desired, an additional stopcock may be used in place of the glass tube to control the rate of dropping.

The sample and the test solution are to be kept in the test room long enough to acquire the temperature of the room, which should be noted and recorded. The test is to be conducted at a room temperature of 21.2 ℃~32.0 ℃.

The sample is to be thoroughly cleaned before testing. All grease, lacquer, paint, or other nonmetallic coatings, including skin oils, are to be removed completely by means of solvents. The sample is then to be thoroughly rinsed in water and dried with clean cheesecloth.

The sample to be tested is to be supported from 17mm to 25mm below the orifice. The surface to be tested shall be inclined at approximately 45 degrees from the horizontal so that the drops of solution strike the point to be tested and run off quickly.

The stopcock is to be opened and the time in seconds is to be measured until the dropping solution dissolves the protective metal coating, exposing the base metal. The end point is the first appearance of the base metal recognizable by the change in color at that point.

The sample of a test lot is to be subjected to the test at three or more points, excluding cut, stenciled, and threaded surfaces, on the inside surface and at an equal number of points on the outside surface, at places where the metal coating may be expected to be the thinnest. (On enclosures made from precoated sheets, the external corners that are subjected to the greatest deformation are likely to have thin coatings.)

To calculate the thickness of the coating being tested, select from following the thickness factor appropriate for the temperature at which the test was conducted and multiply by the time in seconds required to expose base metal as noted in 38.7.

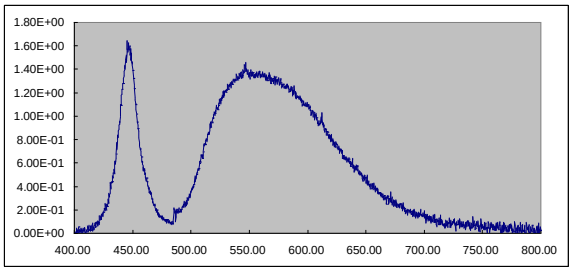
Temp.	Thickness factors		Temp.	Thickness factors		Temp.	Thickness factors	
	Cadmium platings	Zinc platings		Cadmium platings	Zinc platings		Cadmium platings	Zinc platings
21.1	1.331	0.980	25.0	1.405	1.042	28.9	1.480	1.100
21.7	1.340	0.990	25.6	1.416	1.050	29.4	1.490	1.110
22.2	1.352	1.000	26.1	1.427	1.060	30.0	1.501	1.120
22.8	1.362	1.010	26.7	1.438	1.070	30.6	1.513	1.130
23.3	1.372	1.015	27.2	1.450	1.080	31.1	1.524	1.141
23.9	1.383	1.025	27.8	1.460	1.085	31.7	1.534	1.150
24.4	1.395	1.033	28.3	1.470	1.095	32.2	1.546	1.160

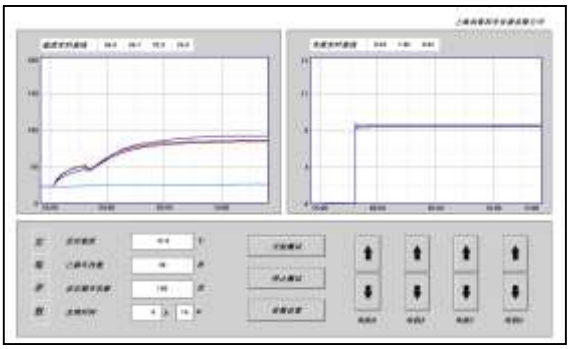
BR-UL-HSE Hot-Spot Endurance Tester

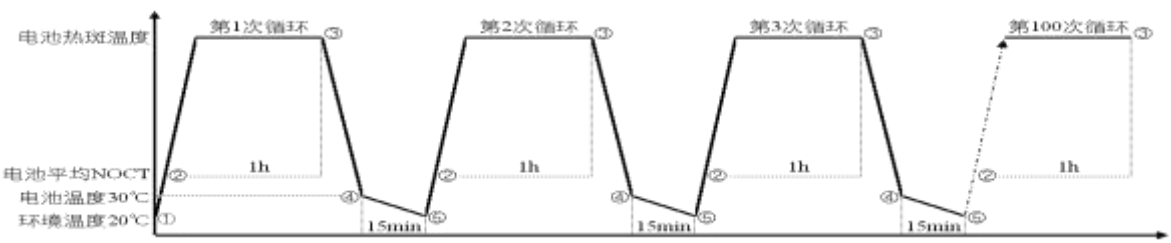
Perform standards: UL 1703-2012

Light: LED lamps, small Calorific value, to avoid the battery temperature exceeds NOCT
Center shaft two sets LED lamps, solved a technical problems of measuring cells in the same column.
Light source horizontal and vertical displacement: transmission system
Radiation intensity: Electric lifting LED lamps, let I_{test} is the short-circuit current of an average cell at 100mW/cm^2 and NOCT.
Infrared heating source: transmission system orient, with a visible light contribution below 50W/m^2
Program control: automatic completion 100 cycles
English operation software and interface…

Control system:







BR-PV-PID PID Resistance (System Voltage Durability Test) Test System

Perform standards: IEC 62804 (Draft) “System voltage durability test for crystalline silicon modules – design qualification and type approval”

Leakage current monitoring system

Connection mode: Module frames all along connect ground, the connector connect high voltage. -1500V and +1500V tests just switch to switch, do not need to change the connection mode…

Power supply: DC ±1600V

Leakage current detection can accurately to 0.1μA and above

Leakage current measurement range: 0~100 μA

Measuring channels: 8 channels, each channel current display

Constant voltage source device with supporting data transmission interface

Automatic data acquisition, computer monitoring

Constant voltage source is at least 1000h long-term continuous working ability

Automatic safety protection

If leakage current more than 50mA, automatically cut off the constant voltage power supply

Software: real-time acquisition leakage current of module

Automatic data storage, analysis, EXCEL output

Standard configuration: industrial control computer, power supply, electrical control cabinet