Photovoltaic Modules: ESPEC Solutions for the Solar Market
The solar energy market, and specifically the solar modules sector, needs ESPEC solutions. To conduct your quality tests with high accuracy and performance, you need the best, you need ESPEC. Because environment is your business, and our concern.

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   2-4. Ultra View Temperature (& Humidity) Chamber - Platinous Series
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Why work with us?

✓ We can meet all testing for solar modules (wide product line)

✓ Our keywords are: Reliability and Top Quality

✓ We have a global service network

✓ We are ISO certified (9001-14001)

✓ We are an eco-conscious company

1. Overview of the required test standards

1-1 Humidity Freeze Test

To determine the ability of the module to withstand the effects of high Temperature and Humidity followed by sub-zero temperatures.

IEC61215, 10.12 (JIS C-8990)
Silicon terrestrial PV modules
-Design qualification and type approval

Tested item: Silicon terrestrial PV module

Room temp. 85%±5%rh 100ºC/h max.
Start of cycle 20ºC/h max.
No RH control
Continue for total of 10 cycles
Module temperature (ºC) Time (h)
-40 +85

IEC61646, 10.12 (JIS C-8991)
Thin-film terrestrial PV modules
-Design qualification and type approval

Tested item: Thin-film terrestrial PV module

✓ +65ºC±2ºC, 85%±5%rh, <20 h, >-40ºC, >0.5 h max. 4h incl.
  Temperature heat-up & pull-down
  Temperature change rate in the temperature range of 0ºC or more :
  <1.67ºC/min.
  Temperature change rate in minus temperature range : <3.3ºC/min.
  No. of cycles : 10 cycles
1. Overview of the required test standards

1-2 Thermal Cycling Test

To make an assessment of the module’s ability to withstand exposure to several environmental conditions during transportation/storage.

**JIS C-8917**
Environmental and endurance test methods for crystalline solar PV modules
Tested item: Non-light gathering type crystalline terrestrial solar PV module

**JIS C-8938**
Environmental and endurance test methods for amorphous solar cell modules
Tested item: Non-light gathering type amorphous terrestrial solar cell module

To determine the ability of the module to withstand thermal mismatch, fatigue and other stress caused by repeated changes of Temperature.

**IEC61215, 10.11 (JIS C-8990)**
Silicon terrestrial PV modules
- Design qualification and type approval
Tested item: Silicon terrestrial PV module

**IEC61646, 10.11 (JIS C-8991)**
Thin-film terrestrial PV modules
- Design qualification and type approval
Tested item: Thin-film terrestrial PV module

1-3 Temperature and Humidity Cyclic Test

To determine the deterioration level for use/storage in short time under condition of temperature change in high relative Humidity

**JIS C-8917**
Environmental and endurance test methods for crystalline solar PV modules
Tested item: Non-light gathering type crystalline terrestrial solar PV module

**JIS C-8938**
Environmental and endurance test methods for amorphous solar cell modules
Tested item: Non-light gathering type amorphous terrestrial solar cell module

- +85°C±2°C, 85%±5%rh ≥ -20°C±3°C or -40°C±3°C
- Dwell time : high>2.5 h (-20°C) or >10 min. (-40°C) ≥ low>1 h
- T. change time : <90 min.
- Cycle time : ≥6 h
- No. of cycles : 10 cycles

**IEC60068-2-38 6.3.1 (JIS C-8962)**
Testing procedure of power conditioner for small PV power generating systems

- No. of cycles : 5 cycles including low Temperature sub-cycle
- Test Humidity : 93%±3%rh at +65°C±2°C, 80% to 96%rh at +25°C±2°C
- Temperature change time : 1.5 to 2.5h
- Dwell time : 5.5 h (high) → 8 h (room temp.) → Start to 13.5 h (high) → 1 to 2 h (room temp.) → 3 h (low) → Start to 24 h (high)
1. Overview of the required test standards

1-4 Damp Heat Test (Temperature and Humidity Test)

To evaluate the ability of the module for use/storage under high Temperature and Humidity

- IEC60068-2-78: Environmental testing - Part 2-78: Tests - Test Cab: Damp heat, steady state
- JIS C-8917: Environmental and endurance test methods for crystalline solar PV modules

To evaluate the ability of the module for use under high Temperature

- IEC60068-2-78: Environmental testing - Part 2-78: Tests - Test B: Dry heat
- JIS C-8938: Environmental and endurance test methods for amorphous solar cell modules

To determine the ability of the module to withstand the effects of long-term penetration of humidity

- IEC61215, 10.13 (JIS C-8990): Silicon terrestrial PV modules - Design qualification and type approval
- IEC61646, 10.13 (JIS C-8991): Thin-film terrestrial PV modules - Design qualification and type approval

1-5 Temperature Test

To evaluate the ability of the module for use/storage under high Temperature

- IEC60068-2-2: Environmental testing - Part 2-2: Tests - Test B: Dry heat
- JIS C-8938: Environmental and endurance test methods for amorphous solar cell modules

- JIS C-8917: Environmental and endurance test methods for crystalline solar PV modules

Tested item: Non-light gathering type crystalline terrestrial solar PV module

Tested item: Non-light gathering type amorphous terrestrial solar cell module

Tested item: Thin-film terrestrial PV module

Tested item: Non-light gathering type amorphous terrestrial solar cell module

+85°C ± 2°C / 85% ± 5%rh

1000 ± 12 Hours
2-1. Solid Walk-in Chamber

Solid walk-in chambers with higher temperature range

Most walk-in chambers are limited to 85°C or less, but EWS models can go to 150°C to accommodate extreme simulations for solar panel equipment. EWS chambers are solid, one-piece construction, using high-temperature fiberglass. Conventional chambers are built using panels with foam insulation that cannot withstand higher temperatures and may cause leaks where the panels attach, especially under extreme conditions. The strength of a solid chamber allows a full-opening door for easy loading of large arrays without restriction. Temperature and humidity performance can be configured for your test application.

Features
- High temperature to +150°C
- Low temperature to -35°C or -65°C
- Optional humidity control with extended range over conventional chambers
- Fast temperature cycling, up to 15°C/min.
- High volume airflow of 110 m$^3$/minute
- Size can be built to your needs

Humidity Comparison

Temperature Comparison

Change Rate Comparison

Standards

Humidity Freeze Test
- IEC61215, 10.12 (JIS C-8990)
- IEC61646, 10.12 (JIS C-8991)

Thermal Cycling Test
- IEC61215, 10.11 (JIS C-8990)
- IEC61646, 10.11 (JIS C-8991)
- JIS C-8917
- JIS C-8938

Damp Heat Test
- IEC60068-2-78 (JIS C-8917, C-8938, C-60068-2-3)
- IEC61215, 10.13 (JIS C-8990)
- IEC61646, 10.13 (JIS C-8991)

Specifications

<table>
<thead>
<tr>
<th>Standard Size Examples</th>
<th>EWS183</th>
<th>EWS364</th>
<th>EWS499</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interior volume</td>
<td>5000 L</td>
<td>10000 L</td>
<td>14000 L</td>
</tr>
<tr>
<td>Inside dimensions</td>
<td>1210 x 2380 x 1770</td>
<td>1570 x 2380 x 2740</td>
<td>2150 x 2380 x 2740</td>
</tr>
</tbody>
</table>

Capabilities

| Temperature range      | -35°C or -65°C to +150°C |
| Humidity range        | Optional |
| Change rate           | 1°C to 15°C/min. (Per your requirement) |

System Options

Low humidity control
Distributed airflow
Rain/mist simulation
Heavy-duty floor
Separate personnel door
2-2. Large Capacity Temperature & Humidity Chamber - SM series

**Features**
- Large size interior
  3570 L, W1200 x H1750 x D1700mm
- Maximum 3°C/min. temperature pull-down rate with load (225kg, Only for SMS model)
- Optional fixture for easy handling and uniformed stress
- Highly accurate temperature and humidity control

**Standards**

**Humidity Freeze Test**
- IEC61215, 10.12 (JIS C-8990)
- IEC61646, 10.12 (JIS C-8991)

**Thermal Cycling Test**
- IEC61215, 10.11 (JIS C-8990)
- IEC61646, 10.11 (JIS C-8991)
- JIS C-8917
- JIS C-8938

**Damp Heat Test**
- IEC60068-2-78 (JIS C-8917, C-8938, C-60068-2-3)
- IEC61215, 10.13 (JIS C-8990)
- IEC61646, 10.13 (JIS C-8991)

**Specifications**

<table>
<thead>
<tr>
<th>Model</th>
<th>Large capacity temperature &amp; humidity chamber</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>SML-2</td>
</tr>
<tr>
<td></td>
<td>SMS-2</td>
</tr>
</tbody>
</table>

**Performance**

<table>
<thead>
<tr>
<th></th>
<th>SML-2</th>
<th>SMS-2</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Temperature range</strong></td>
<td>-40°C to +90°C</td>
<td>-60°C to +180°C</td>
</tr>
<tr>
<td><strong>Humidity range</strong></td>
<td>40% to 95%rh</td>
<td>20% to 98%rh</td>
</tr>
<tr>
<td><strong>Temperature &amp; Humidity fluctuation</strong></td>
<td>±0.5°C / ±3%rh</td>
<td>±1.5°C / ±5%rh</td>
</tr>
<tr>
<td><strong>Temperature &amp; Humidity uniformity</strong></td>
<td>±5°C / ±1%</td>
<td>±5°C / ±1%</td>
</tr>
<tr>
<td><strong>Temperature heat-up time</strong></td>
<td>-40°C to +90°C within 40 min.</td>
<td>-60°C to +180°C within 80 min.</td>
</tr>
<tr>
<td><strong>Temperature pull-down time</strong></td>
<td>+90°C to -40°C within 90 min.</td>
<td>+180°C to -60°C within 80 min.</td>
</tr>
</tbody>
</table>

**Dimensions**

<table>
<thead>
<tr>
<th>Inside dimensions (W x H x Dmm)</th>
<th>1200 x 1750 x 1700</th>
</tr>
</thead>
<tbody>
<tr>
<td>Outside dimensions (W x H x Dmm)</td>
<td>1810 x 2700 x 2926</td>
</tr>
<tr>
<td>Interior volume</td>
<td>3570 L</td>
</tr>
</tbody>
</table>
ESPEC Platinous models are a great choice for basic temperature or Temperature & humidity testing, either steady-state or cycling conditions.

Top Quality and Reliability
- Environmentally friendly design
- Stainless steel exterior construction for long life
- Extremely accurate and very reliable
- Standard features: clear view window, cable port, adjustable shelves and casters
- From 120 L to 800 L

Specifications

Temperature & Humidity Chamber

<table>
<thead>
<tr>
<th>Model</th>
<th>Temperature</th>
<th>Humidity</th>
<th>Interior volume</th>
<th>Cleanliness</th>
</tr>
</thead>
<tbody>
<tr>
<td>PH</td>
<td>+10°C to +100°C</td>
<td>60% to 98%rh</td>
<td>120 L, 225 L, 408 L, 800 L</td>
<td>none</td>
</tr>
<tr>
<td>PR</td>
<td>-20°C to +100°C</td>
<td>20% to 98%rh</td>
<td>225 L, 408 L, 800 L</td>
<td>none</td>
</tr>
<tr>
<td>PL</td>
<td>-40°C to +100°C</td>
<td>20% to 98%rh</td>
<td>225 L, 408 L, 800 L</td>
<td>none</td>
</tr>
<tr>
<td>PWL</td>
<td>-40°C to +120°C</td>
<td>none</td>
<td>none</td>
<td>none</td>
</tr>
<tr>
<td>PSL</td>
<td>-70°C to +100°C</td>
<td>30% to 90%rh</td>
<td>312 L</td>
<td>Class 100</td>
</tr>
</tbody>
</table>

Temperature Chamber

<table>
<thead>
<tr>
<th>Model</th>
<th>Temperature</th>
<th>Humidity</th>
<th>Interior volume</th>
</tr>
</thead>
<tbody>
<tr>
<td>PU</td>
<td>-40°C to +100°C</td>
<td>5% to 98%rh</td>
<td>408 L, 800 L</td>
</tr>
<tr>
<td>PWU</td>
<td>-40°C to +120°C</td>
<td>none</td>
<td>none</td>
</tr>
<tr>
<td>PG</td>
<td>-70°C to +100°C</td>
<td>225 L, 408 L, 800 L</td>
<td>none</td>
</tr>
</tbody>
</table>

Standards

Temperature Cycling Test
- IEC61215, 10.11 (JIS C-8990)
- IEC61646, 10.11 (JIS C-8991)
- JIS C-8917
- JIS C-8938

Temperature/Humidity Cyclic Test
- JIS C-8917
- JIS C-8938

Damp Heat Test
- IEC60068-2-78 (JIS C-8917, C-8938, C-60068-2-3)
- IEC61215, 10.13 (JIS C-8990)
- IEC61646, 10.13 (JIS C-8991)

Temperature Test
- IEC60068-2-2 (JIS C-8917, C 60068-2-2)
- IEC60068-2-2 (JIS C-8938, C 60068-2-2)

Low Temperature Sub-Cycle Test
- IEC60068-2-38, 6.3.1 (JIS C-8962)
Ultra View Temperature (& Humidity) Chamber is equipped with a large observation window that has been developed to satisfy our customers’ wish “to see” “to touch” “to operate” and “to measure”, which are fundamentals of environmental test and evaluation test.

**Features**
- High performance with a large viewing window
- Highly accurate temperature and humidity control by a unique electronic auto-expansion valve
- Large window & fluorescent lights for optimum visibility
- Clear view without dew condensation
- Optional reach-in ports on the door, clear from dew condensation

**Temperature**

- **Damp Heat**
  - IEC60068-2-78 (JIS C-8917, C-8938, C-60068-2-3)
- **Thermal Cycling**
  - IEC61215, 10.11 (JIS C-8990)
  - IEC61646, 10.11 (JIS C-8991)
  - JIS C-8917
  - JIS C-8938

**Specifications**

**Model**
- PWL-2KP
- PWL-3KP
- PWL-4KP

<table>
<thead>
<tr>
<th>Utility requirements</th>
<th>PWL-2KP</th>
<th>PWL-3KP</th>
<th>PWL-4KP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum current</td>
<td>220V</td>
<td>22.5A</td>
<td>23.0A</td>
</tr>
<tr>
<td></td>
<td>220V</td>
<td>22.0A</td>
<td>22.0A</td>
</tr>
<tr>
<td></td>
<td>380V</td>
<td>11.0A</td>
<td>11.0A</td>
</tr>
<tr>
<td></td>
<td>400V</td>
<td>10.4A</td>
<td>10.4A</td>
</tr>
</tbody>
</table>

**Performance**

<table>
<thead>
<tr>
<th>Temperature range</th>
<th>without reach-in ports: -40°C to +120°C / with reach-in ports: -40°C to +100°C</th>
</tr>
</thead>
<tbody>
<tr>
<td>Humidity range</td>
<td>20% to 98%rh</td>
</tr>
<tr>
<td>Temperature fluctuation</td>
<td>+100.1°C to +120°C / ±0.5°C</td>
</tr>
<tr>
<td>Humidity fluctuation</td>
<td>+100.1°C to +120°C / ±2.5%rh</td>
</tr>
<tr>
<td>Temperature uniformity</td>
<td>-40°C to +100°C / ±0.5°C</td>
</tr>
<tr>
<td></td>
<td>+100.1°C to +120°C / ±1.0°C</td>
</tr>
</tbody>
</table>

**Equipment**

- **Viewing window effective size (W×H:mm)**
  - PWL-2KP: 470×720
  - PWL-3KP: 570×820
  - PWL-4KP: 970×970
- **Reach-in ports (Optional)**
  - PWL-2KP: none
  - PWL-3KP: Inside diameter Ø130mm (2 ports or 4 ports can be chosen)
  - PWL-4KP: Door hinges for opening and closing (The covers can be detached)
- **Inside dimensions (W×H×D:mm)**
  - PWL-2KP: 500×750×600
  - PWL-3KP: 800×850×800
  - PWL-4KP: 1000×1000×800
- **Outside dimensions (W×H×D:mm)**
  - PWL-2KP: 910×1590×1039
  - PWL-3KP: 1010×1690×1239
  - PWL-4KP: 1410×1970×1239
- **Interior volume**
  - PWL-2KP: 225 L
  - PWL-3KP: 408 L
  - PWL-4KP: 800 L

Temperature only models are also available.
Thermal Cycling

2-5. Ultra Low Temperature Chamber - Mini Subzero

Capable of ultra low temperature as low as -85°C with ESPEC unique controller

This chamber embodies the high performance, reliability, and durability of a full-size chamber. Select either the P-Instrumentation for programming temperature cycling or the T-Instrumentation for constant operation. Also choose from two very wide temperature ranges that use environmentally-friendly HFC refrigerants.

Features
- Compact type high-performance chamber with reliability and durability
- Select either controller for programming temperature cycling (P-instrumentation) or constant operation (T-instrumentation)
- Wide temperature range
- Accurate temperature control

Instrumentation panel (Programmable type)

Specifications

<table>
<thead>
<tr>
<th>Model</th>
<th>MC-711</th>
<th>MC-811</th>
</tr>
</thead>
<tbody>
<tr>
<td>Temperature range</td>
<td>-75°C to +100°C</td>
<td>-85°C to +180°C</td>
</tr>
<tr>
<td>Inside dimensions (W x H x D mm)</td>
<td>400 x 400 x 400</td>
<td>940 x 1200 x 610</td>
</tr>
<tr>
<td>Outside dimensions (W x H x D mm)</td>
<td>64 L</td>
<td>155 kg</td>
</tr>
</tbody>
</table>

Standards
Thermal Cycling Test
- IEC61646, 10.11 (JIS C-8991)
- JIS C-8917
- JIS C-8938

IEC61215 / IEC61646, 10.11

<table>
<thead>
<tr>
<th>Module temperature (°C)</th>
<th>Maximum cycle time</th>
<th>Minimum dwell time 10 min.</th>
<th>Continue for specified number of cycles</th>
</tr>
</thead>
<tbody>
<tr>
<td>-85° to +100°C</td>
<td>100°C/h max.</td>
<td>10 min.</td>
<td></td>
</tr>
<tr>
<td>-85° to +180°C</td>
<td>100°C/h max.</td>
<td>10 min.</td>
<td></td>
</tr>
<tr>
<td>+25° to +90°</td>
<td>87°C/h max.</td>
<td>10 min.</td>
<td></td>
</tr>
<tr>
<td>-40° ±3°C</td>
<td></td>
<td>10 min.</td>
<td></td>
</tr>
<tr>
<td>+90°C ±2°C</td>
<td></td>
<td>10 min.</td>
<td></td>
</tr>
<tr>
<td>-40°C ±3°C</td>
<td></td>
<td>10 min.</td>
<td></td>
</tr>
</tbody>
</table>

JIS C-8917 / JIS C-8938

<table>
<thead>
<tr>
<th>Room temp.</th>
<th>Module temperature (°C)</th>
<th>1 cycle (6 h max.) x 200 cycles</th>
</tr>
</thead>
<tbody>
<tr>
<td>-40°C ±3°C</td>
<td>+90°C ±2°C</td>
<td></td>
</tr>
<tr>
<td>-85°C ±2°C</td>
<td>-40°C ±3°C</td>
<td></td>
</tr>
</tbody>
</table>
ESPEC’s precision industrial ovens are used for temperature testing, as well as heat treatment and drying during manufacturing. For solar energy market applications, ESPEC ovens provide the suitable evaluation for modules’ use/storage under high temperature conditions. Selection among a variety of sizes and ranges.

Features
- Horizontal and vertical configurations
- From 91 L to 4050 L
- Temperature ranges to 200, 300, 500 or 700°C
- Very tight temperature control

Standards
Temperature Test
- IEC60068-2-2 (JIS C-8917, C 60068-2-2)
- IEC60068-2-2 (JIS C-8938, C 60068-2-2)

JIS C-8917 / C-8938 B-1
Evaluation of the ability of the module for use/storage under high temperature
+85±2°C 1000 ± 12 Hours