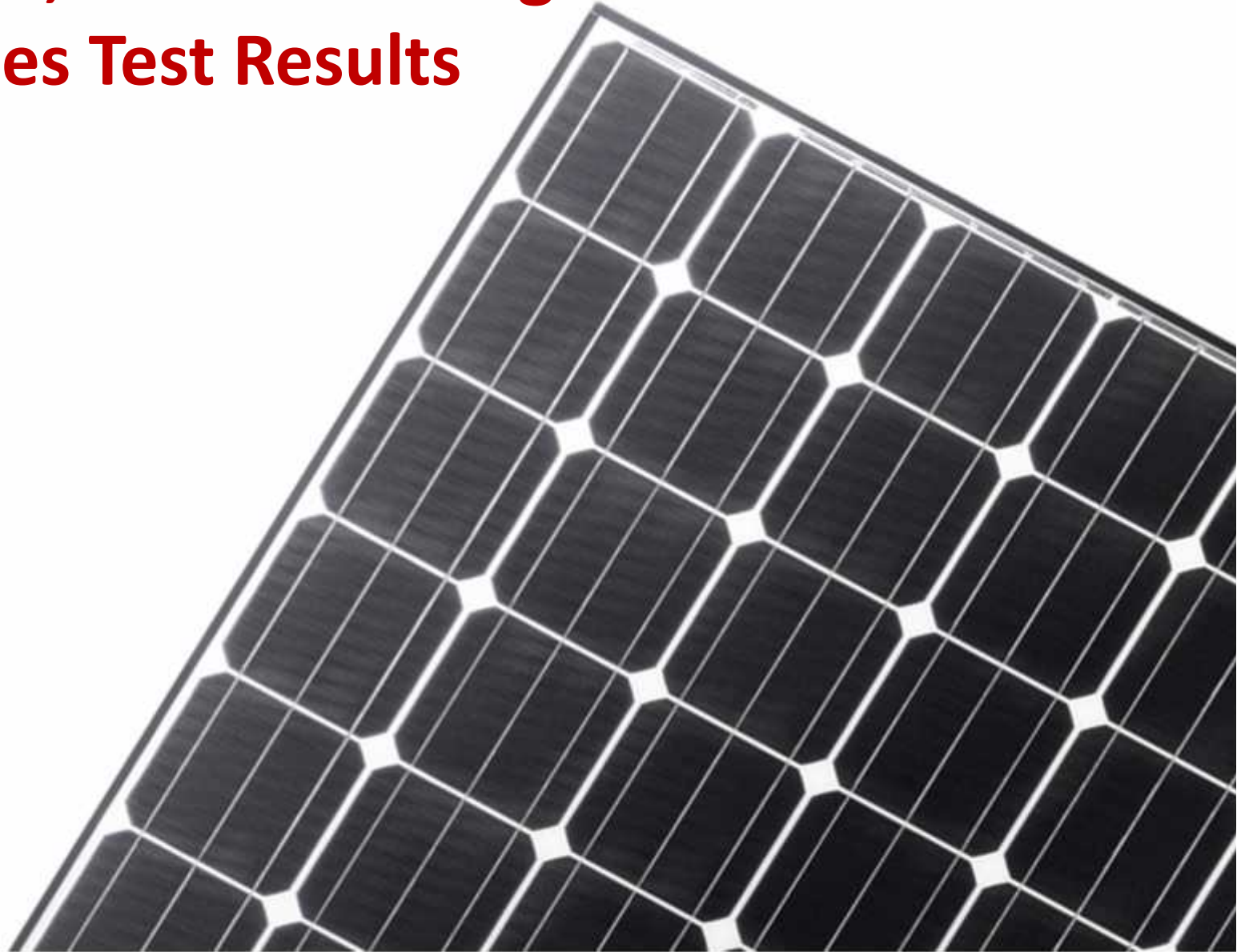




LG Solar, Manufacturing Process & Modules Test Results



We create an aesthetic built module



MonoX™ & NeON

Look

Black Cell Color

Glossy Piano Black Frame

Design & Feel

Soft & Safe edges

Cable Clip

17,3 kg light weight
(industry leading)

Fit

Precise Dimension Control

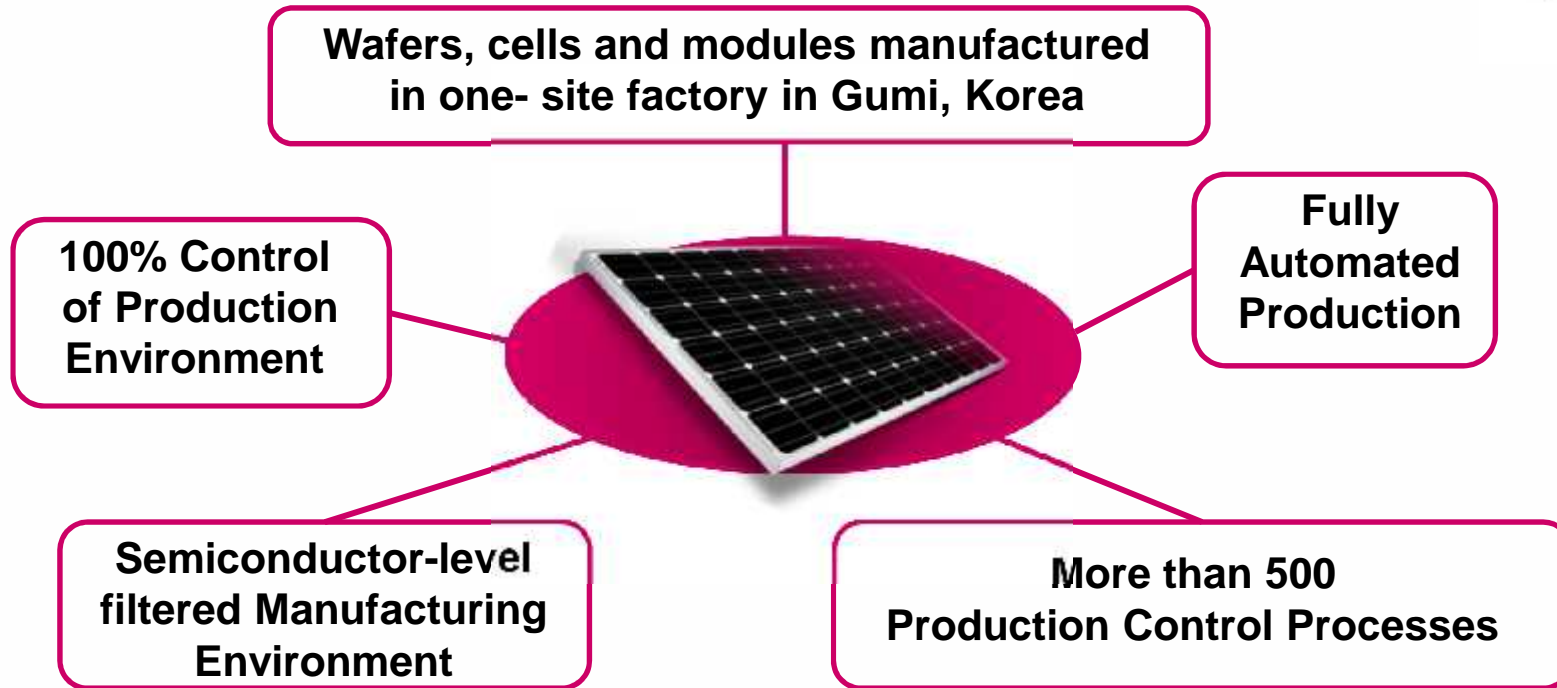
Screwed Frame

Special Water Drain Design

Limiting the accumulation
of dust on the glass



LG's Manufacturing Process Excellence



Extensive Module Testing



LG through its TUV and UL certified testing laboratory undertakes a very wide range of tests to ensure our modules stand the test of time.



Hail Impact Test



Brine Spray Test



Outdoors Field Test



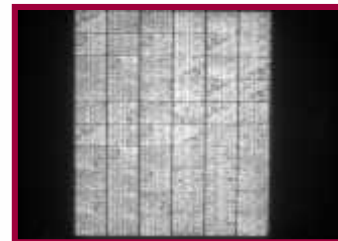
Backing Sheet Stress Test



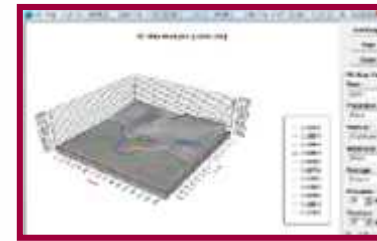
UV Exposure Test



Mechanical Load Test 1



Micro Crack Test



Wafer Resistance Test



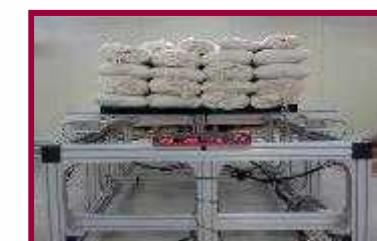
Thermal Cycle /
Damp Heat Test



Impact Test



Wafer Impurity Test



Mechanical Load Test 2



Our modules pass key longevity tests



Mono X™ & NeON

Pass for VDE registration



Pass for Ammonia Resistance Test



Pass for Salt Mist Corrosion Test



Pass for PID Test

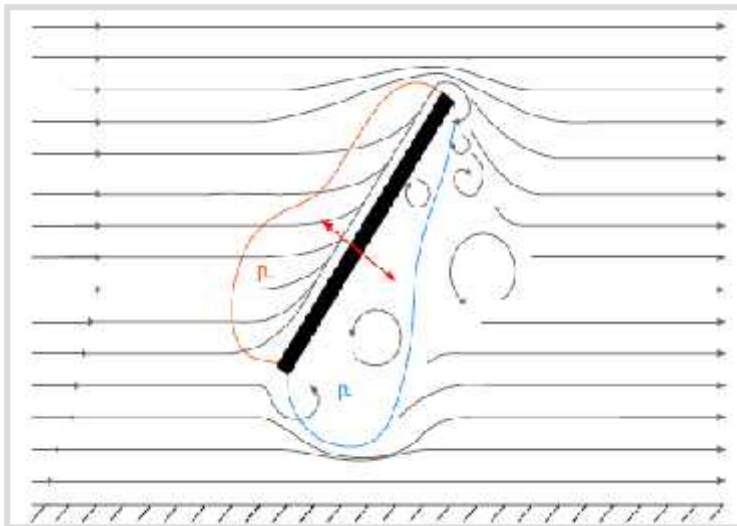


Our modules pass key longevity tests



Dynamic Mechanical Load test **Pass**

Dynamic M/L Test



What is DML (Dynamic Mechanical Load) test ?

Durability - prolonged vibration

- Durability at vibration by air turbulence
- Material/Frame stress test

Pass

Static M/L Test



Durability - static load

- Frame and module test

Pass



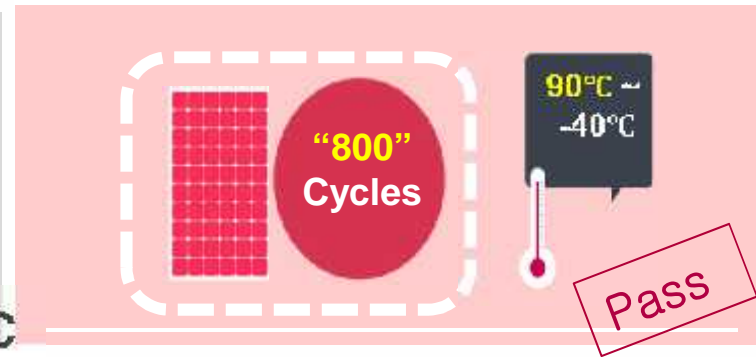
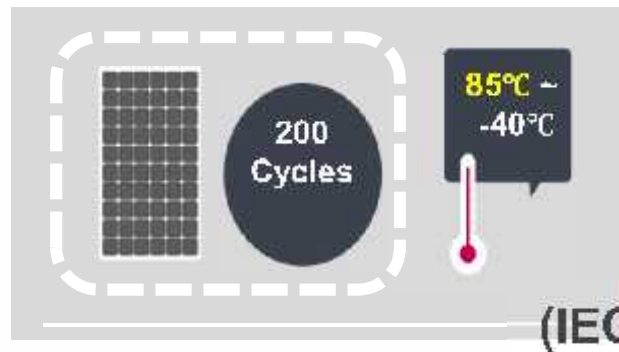
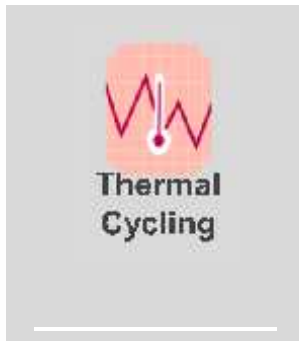
Thermal Cycle Test



Test type

International Standards (IEC)

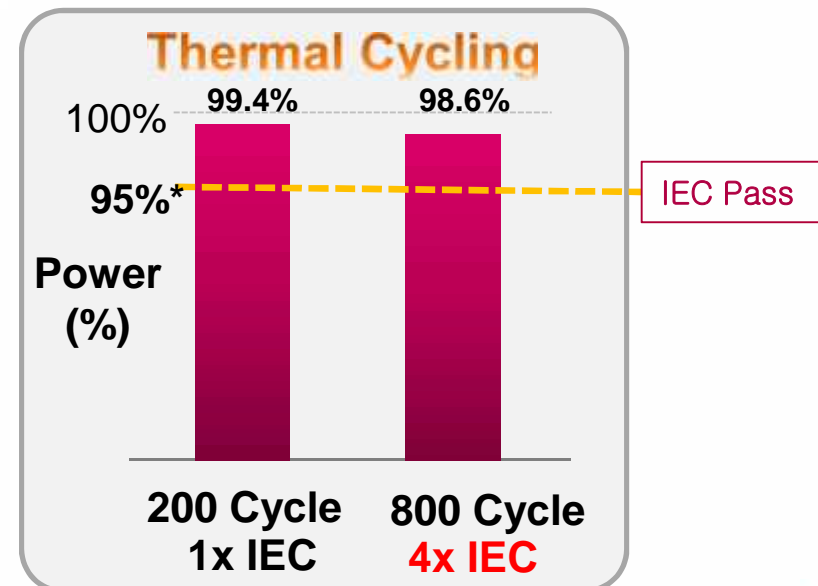
LG Test



Many manufacturers test their panels to pass IEC standards (see above in grey box).

LG is testing our panels **4 times** to IEC standard to ensure maximum longevity.

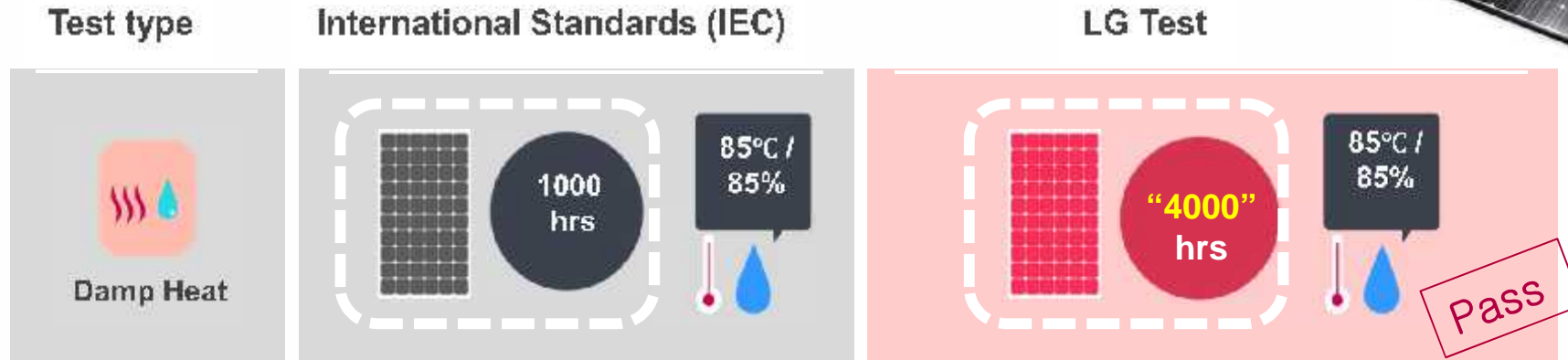
At the Thermal Cycling Test we also test to **higher temperatures** than IEC standards



* Criteria of 1x IEC standard for pass

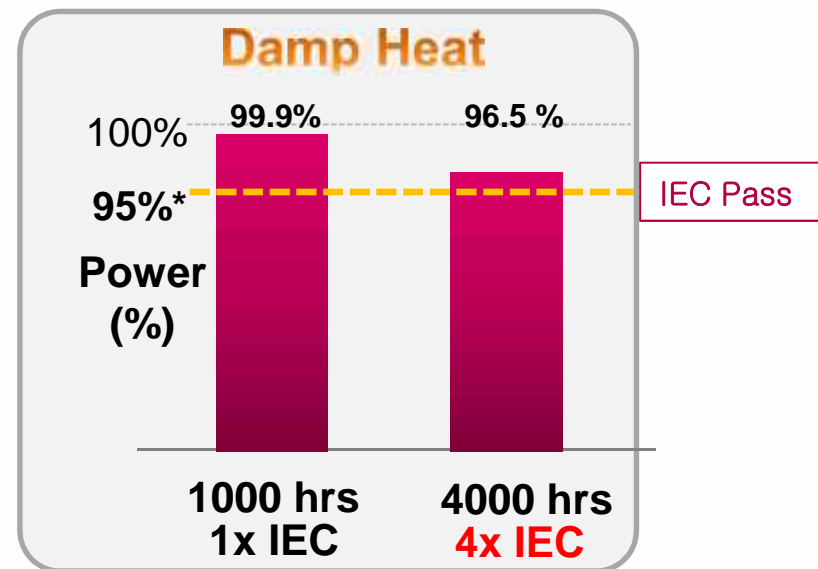


Damp Heat Test

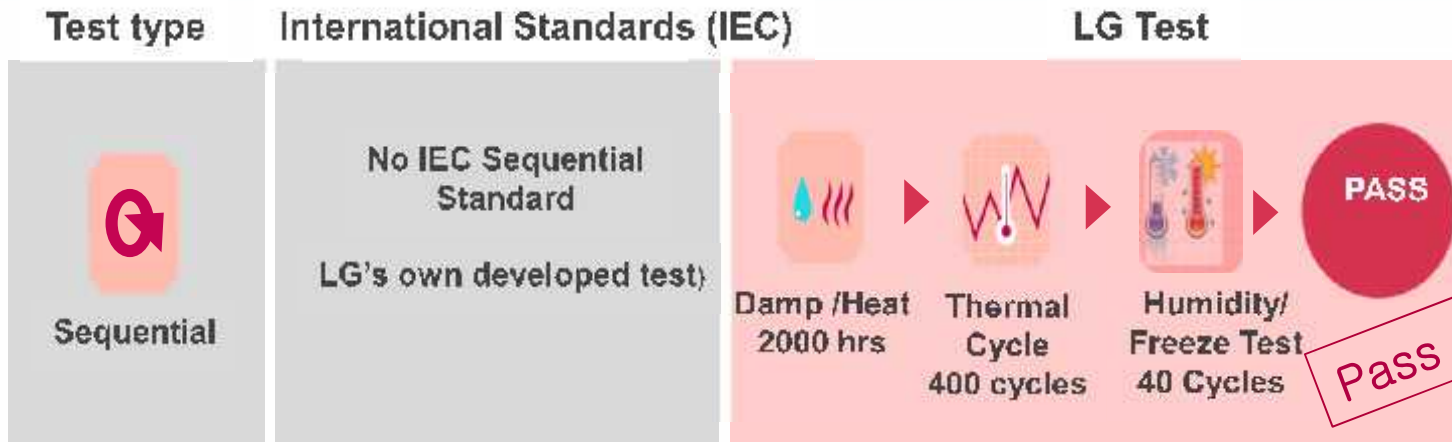


The Damp / Heat test is designed to evaluate a module's performance under high temperatures and high humidity.

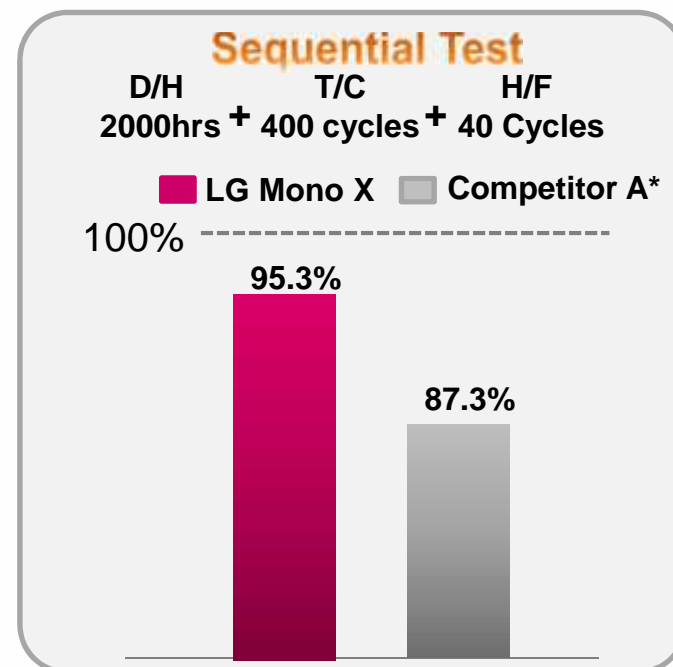
LG's Damp Heat Test consists of **4 x IEC standard** being 4000 hours.



Sequential Test



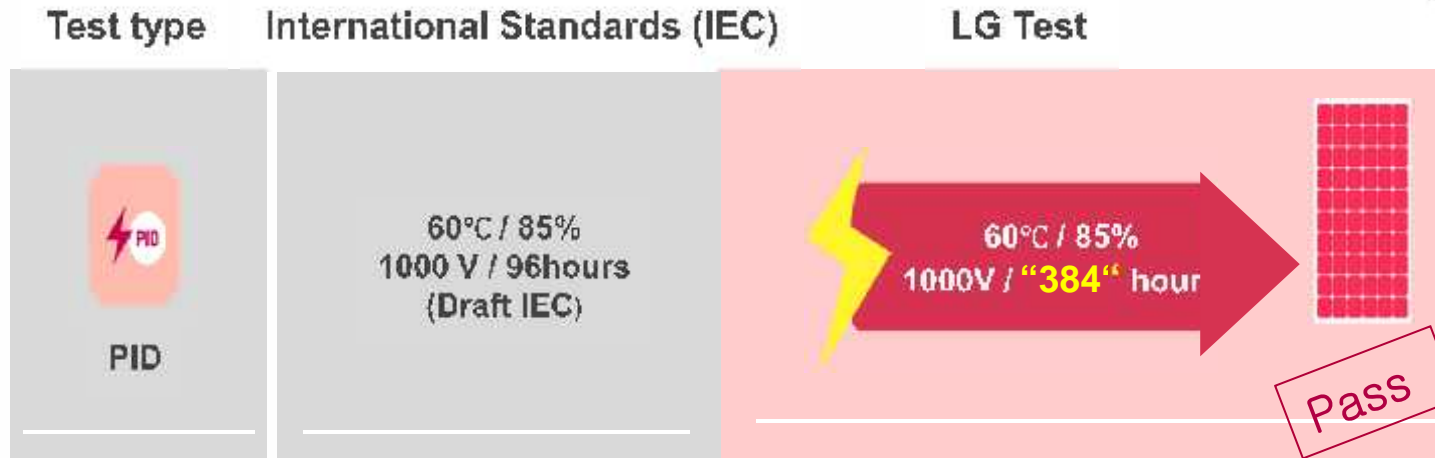
LG is undertaking a extreme sequential Damp/Heat, Thermal/Cycle & Humidity/Freeze Test for our Mono X and NeON modules to replicate extreme and prolonged weather conditions.



* Quality European Brand Panel

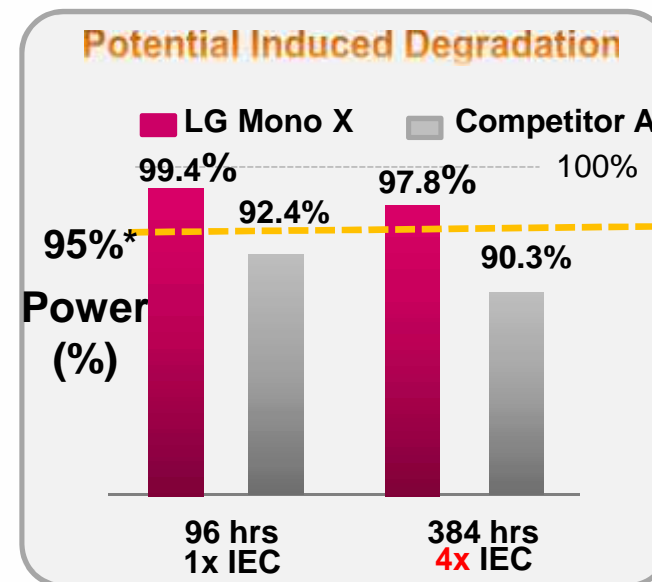


PID* Test



***Potential Induced Degradation is a power degradation from exposure to High Voltage Stress.**

At the internal PID test, LG tests 4 times the proposed IEC standard.



* Quality European Brand Panel



PID Test Result for

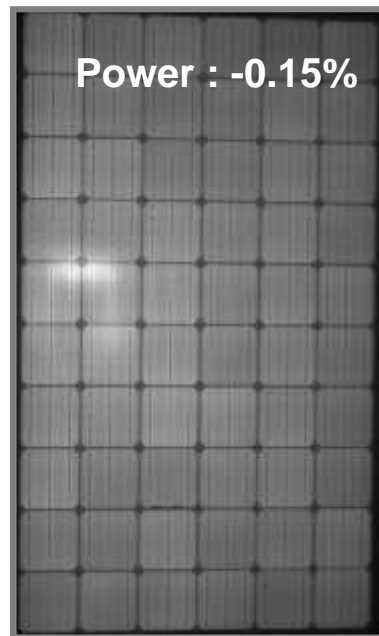
MonoX™ & NeON



Power Degradation & Electro Luminescence Test Result

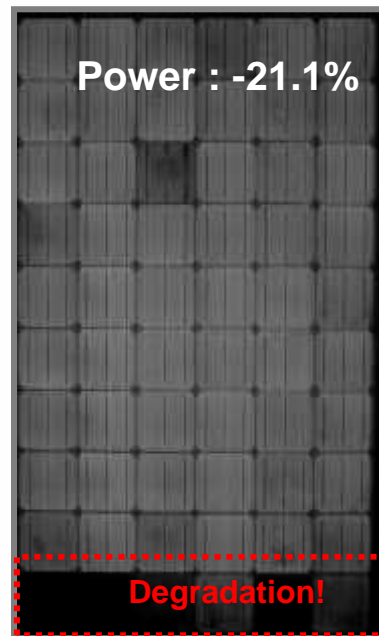
LG

Competitor A*



Power : -0.15%

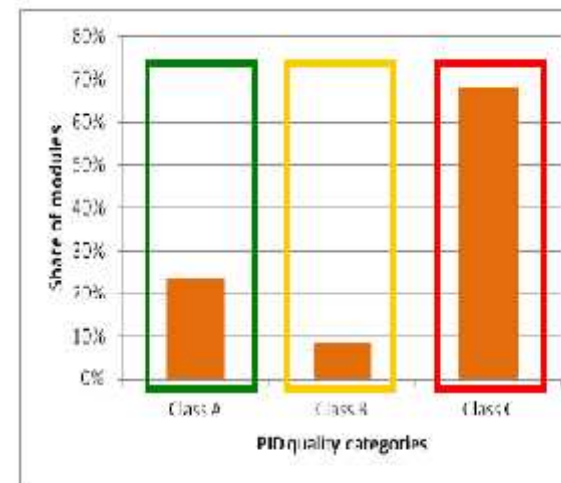
Pass: Class A



Power : -21.1%

Fail: Class B

PI Berlin Standards



PID quality categories:

Class A → $\Delta P < 5\%$

Class B → $5\% < \Delta P < 30\%$

Class C → $\Delta P > 30\%$

Fig.8: Summary of -50 modules tested with PID standard test sequence

LG Modules are classified as Class A by the PI Berlin Standards

Result: LG solar modules are resistant to PID**

**Detailed test reports available upon request



* Quality European Brand Panel



PID Test Pass from 3rd party



PID Test* Results

구분	Mono X (S1C-B3)	
	Min.	Max.
Power Drop	- 0.05%	- 0.50%
EL images		

Pass



* IEC Standard : 60°C, 85% R/H, 1000V, 96Hrs / Pass : < 5%

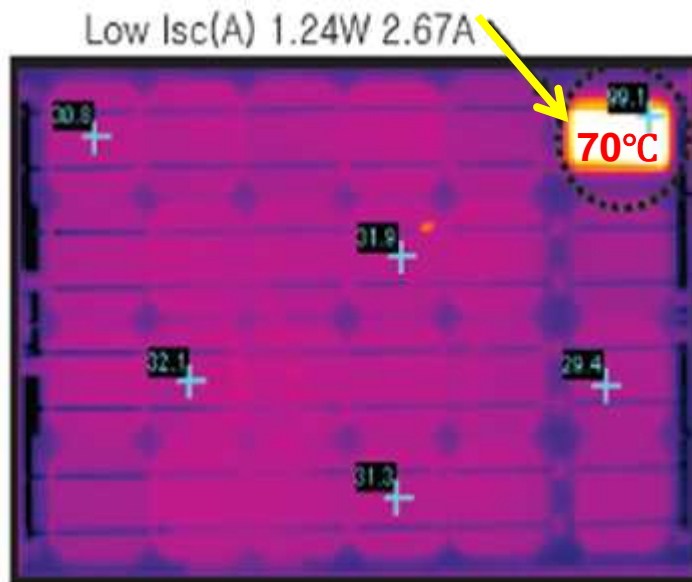


What are “Hot Spots” in modules?



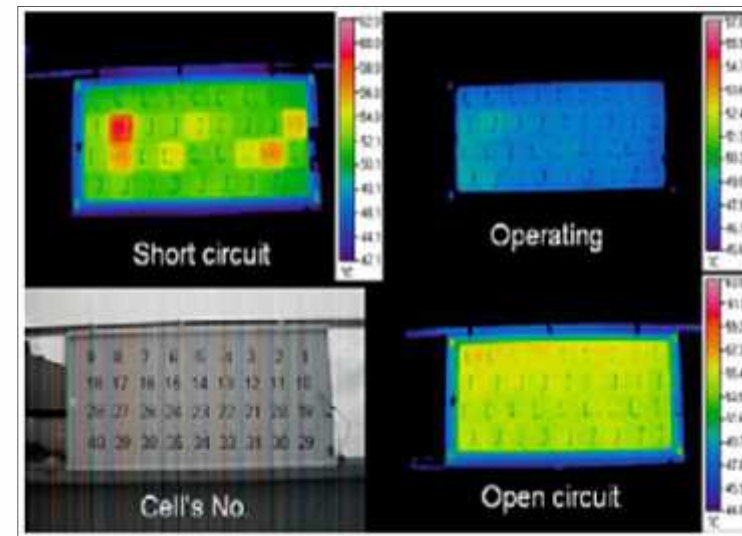
Variations in currents between cells can cause inverse voltage which generates high temperature and hotspots on the module. Mismatched cells contribute to a risk of Hot Spots. Hot spots over time can lead to complete module failure and fire risk.

Hotspot Effect



Competitor A

Mismatch losses in PV cell



Competitor A



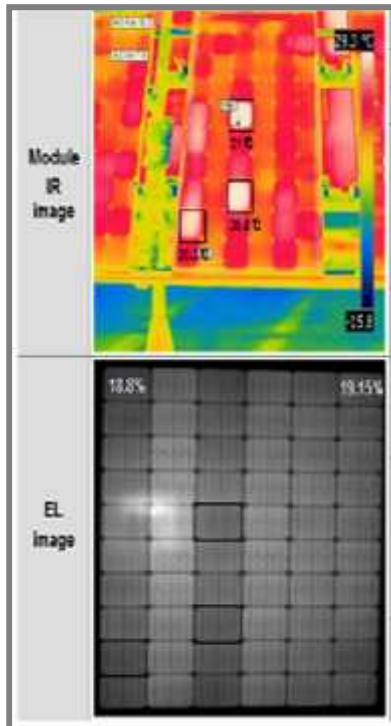
Low Hot Spot Risk due to Cell Sorting



LG solar modules are made with cells which are pre-sorted and deliberately matched within 0.4A. Lots of cheaper modules do not undertake this process

There is no discernable hot spot effect if the cell current difference is 0.4A*.

<LG's Hot Spot Test Result Image>



시험명	K21121002781		
조건	VL: 9.5V, Itest: 8.3A		
Location	1-9	3-5	3-8
Cell image			
Back image			
Cell IR image			
Max Temp (°C)	136.5°	137.9°	136.1°
판정		OK	

Pass

* Reference : Comparative LG study of solar cells characteristics by temperature measurement.



Low Hot Spot Risk due to 2 EL Tests



During the production process, LG uses EL (Electroluminescence) tests prior and post lamination process to find defects, such as micro cracks in the module, to ensure a long lasting module.

	Soldering Check	Micro Crack Check
Image		
Details	Missing soldering spots between the ribbon and cell surface may cause hot spots	Micro-cracks in the cell can make the current mismatch and it alters front Ag paste color and material characteristics.



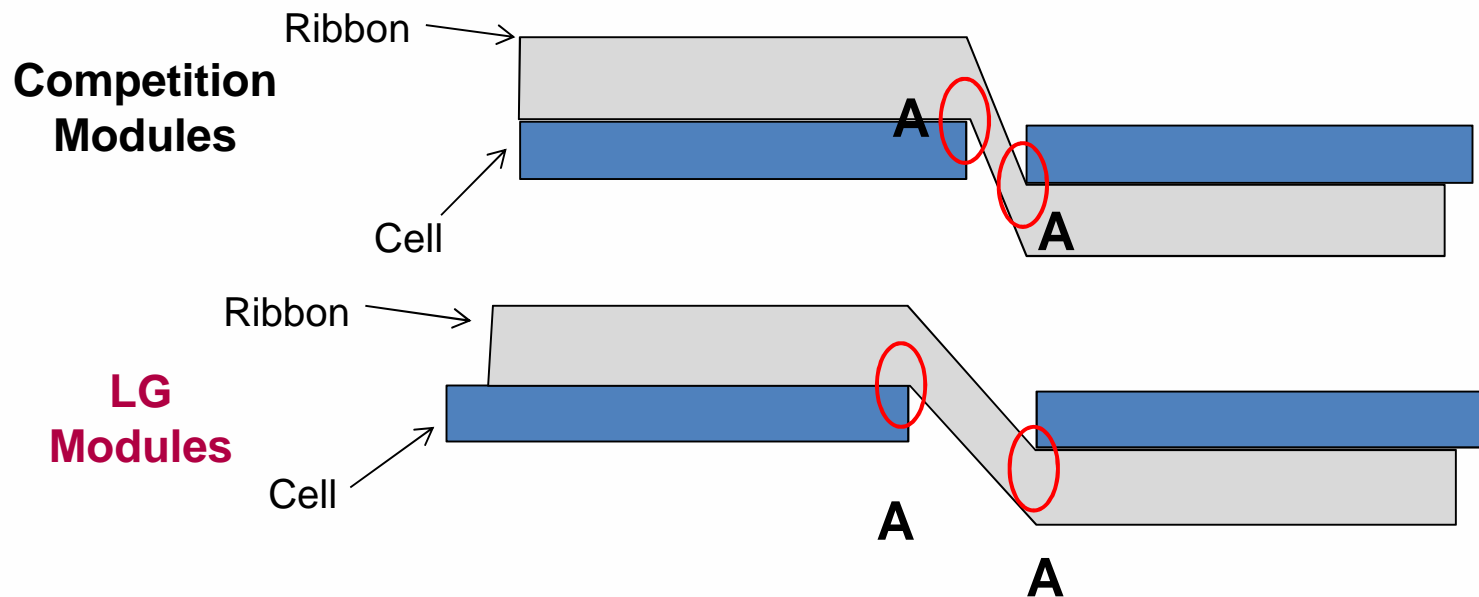
Low Hot Spot Risk through Module Design



Bigger Cell to Cell Gap = Lower Hot Spot Risk

LG reduces the probability of hot spot by widening the Cell to Cell gap in order to lower the stress on the cell edge.

Gap of cell to cell: 2mm standard increased to →3,5mm → Lower stress point A → more reliable



For both MonoX™ & NeON

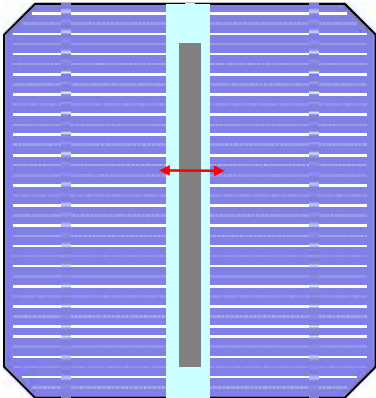
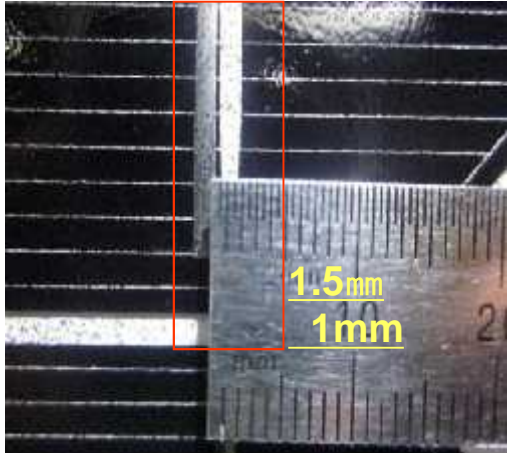



Low Hot Spot Risk due to precise built



Lower quality solar panels are still soldered together via manual labor. LG panels are manufactured in a automated factory, with tight quality control processes.

To reduce the chances of hot spots, LG manages the Bus-Bar and Ribbon tabbing alignments to very low tolerances.

Bus-Bar and Ribbon alignment	Fail Image Samples (not from LG product)	
 <p>Align \leq 1mm, ok</p>	 <p>1.5mm 1mm</p>	





Mono X™ & NeON modules

are extensively tested for decades long performance

- PID Test – TUV, Fraunhofer & LG Lab test – **Pass**
- Hot-spot Free
- Corrosion Tested
- Extensive Additional Testing

= Peace of mind quality





LG
Life's Good



Thank you

Markus Lambert and Grant Rollo

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<https://lgenergy.com.au/>

