

# NICE Modules Certification According to IEC-61215 and 61730

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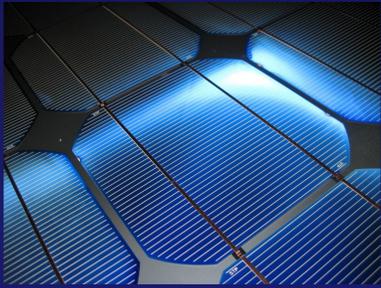
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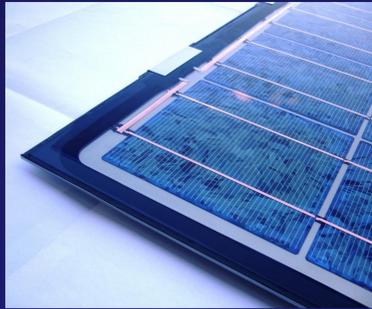
## Apollon Solar's NICE Module Technology

**Objectives:**  Production costs <0,30 €/Wc Module Cost

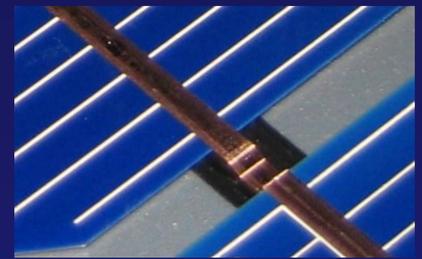
Module Lifetime: 30 years



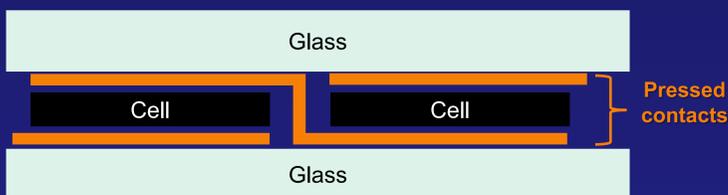
- No EVA
- No Lamination
- No Soldering



- Air and humidity tight sealing around module perimeter
- 100% automatic in-line operation



- Under pressure inside the module for electrical series connection of cells
- High module fill factors and low series resistances



- Prototype Line at INES for Process Optimization (since 2008)
- TÜV Validation (June 2010)
- 2 Industrial Lines under Tuning and Optimizing (2011)



## Certification Process by TÜV Rheinland:

### NICE-80X Modules passed all relevant tests according to IEC-61215 and 61730

Test-modules: 36-cells NICE modules produced on the prototype line (125x125 mm<sup>2</sup> cells)

Humidity Freeze	-0.22
	-0.31
Thermal Cycling 200	-2.01
	-1.20
Damp Heat	-0.92
	+2.26
Mechanical Load (2400 Pa)	+1.61

Bypass Diode Thermal test	+0.48
Hot-spot endurance test	+0.64
UV preconditioning test	+1.42
	+1.83
Robustness of terminations	+0.48
Hail Impact	-1.60

Module ID	Power Variation (%)
1	+0.16
2	+1.23
3	+1.37
4	+0.70
5	-2.01
6	-1.20
7	+0.71

➤ **Ageing Tests : Power Variation (%)**  
Maximum Power Decrease: **2.01%**

➤ **Normalized Tests: Power Variation (%)**  
Maximum Power Decrease: **1.60%**

➤ **Maximum Power Decrease after Complete Certification Process: 2.01%**

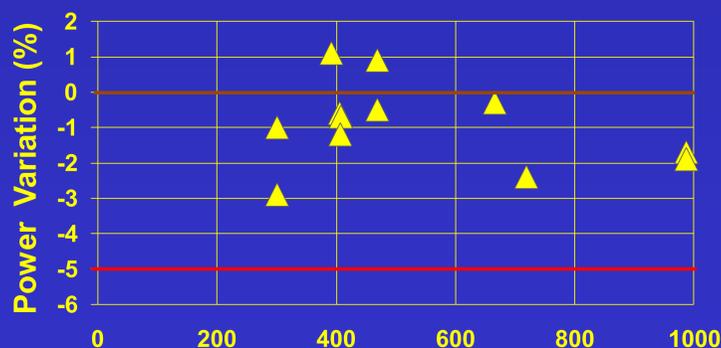
## Highly Extended Ageing Test

### Outdoor Exposure



- 24 modules monitored on the INES rooftop
- Consistent energy production
- No resistance degradation after 7 months
- NOCT: 42.6 (Source: TÜV)

### Thermal Cycling (-40°C to +85°C)



- Despite under-pressure variation : no significant losses
- **1 000 Cycles with Power Degradation <2%**

### Alternative Mechanical Loads ± 2 000 Pa

	Tensile load	Pressure load
Maximum bending at module centre (mm)	10	6
Circuit interruption	No	
Power Variation	-0.57 %	

- 100 Cycles
- Performed by TÜV



Resistance to wind load" – DIN-12210 & DIN-12211

## Conclusion:

- Contrary to EVA-laminated modules, damp heat test = No difficulty for NICE modules (PIB=excellent barrier)
- Hardest Ageing Test for NICE: Thermal Cycling and 1000 Cycles achieved according to IEC 61215
- Next Step in Hard Ageing Test: Test-To-Failure Protocol at NREL with industrial 60-Cells Modules (2011)



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