



# First Solar 3<sup>rd</sup> Party Reliability and Certifications to Support 25 Year+ Module Lifetime and Durability for Series 6 Modules

For over a decade, the PV industry has relied on accelerated lab testing protocols for evaluation of PV modules. IEC 61215 type approval standards, along with the IEC 61730 safety standard, have provided a framework of pass/fail certification testing assuring a common minimum level of test performance that has become de facto in the industry. Conventional IEC 61215/IEC 61730 standards define a parallel sample test protocol where one group of sample modules are exposed to one stressor (i.e. 200 Thermal Cycles), while a different group of modules are exposed to an alternate stressor (i.e. 10 Humidity Freeze cycles).

In recent years, industry stakeholders have recognized the need to further differentiate PV modules, and evaluate 25 year+ lifetime durability by developing extended test durations, sequential testing protocols, and application-specific tests which give additional insight to the long term performance, reliability, and durability of PV modules. First Solar’s modules possess an industry-leading portfolio of independently evaluated extended reliability and durability results.

**Table 1: Certification Listings for First Solar and Competitor Modules**

		FSLR	Canadian Solar	LONGI	Jinko Solar	Hanwha Q Cells	JA Solar	Risen	Trina	Yingli	GCL	LG	Jolywood	SunPower
Chemical Environments	IEC 61701: Salt Mist Corrosion	X	X	X	X	X	X	X*	X	X	X*	X	X	X
	Ammonia Resistance	X	X	X	X	X	X	X*	X	X*	X*	X		X
Certification Testing	IEC 61215: Damp Heat (1000 hrs)	X	X	X	X	X	X	X	X	X	X	X	X	X
	IEC 61215: Temp Cycle (200 Cycles)	X	X	X	X	X	X	X	X	X	X	X	X	X
	IEC 61215: Humidity Freeze (10 cycles)	X	X	X	X	X	X	X	X	X	X	X	X	X
	IEC 60068: Desert Sand Resistance	X	X*		X				X*	X	X			
	IEC 61730/UL1703: 1500V	X	X*	X*	X		X		X	X*			X	X
	IEC 62804: PID Free (-1000V)	X	X		X	X	X	X*	X	X	X	X	X	X
IEC 62804: PID Free (-1500V)	X			X	X					X*		X		
Extended Durability	IEC 61215: Damp Heat (2000 hrs)	X		X		X	X	X				X	X	X
	IEC 61215: Temp Cycle (600 Cycles)	X		X		X	X	X				X	X	X
	IEC 61215: Humidity Freeze (40 cycles)	X						X				X		
Long-Term Reliability	Independent Thresher Test Certification	X					X							
	TUV Long-Term Sequential Test	X						X				X		
	DNV GL Reliability Scorecard Top Performer	X		X	X	X			X	X			X	X
	CSA/ANSI C450-18	X												

\* Specific Module Types Only

**Table 2: Quality and Durability Test Descriptions and First Solar Module Pass Dates**

Test	Description	Most Recent Pass Date
*IEC Damp Heat 85 °C/85%RH	IEC certification requires 1000 hours. First Solar <i>doubles this requirement</i> by surpassing 2000+ hours.	November 2018 (S6)
*IEC Temp Cycle -40 to +85 °C	IEC requires 200 cycles. First Solar <i>triples this requirement</i> by successfully passing 600 cycles.	November 2018 (S6)
*IEC Humidity Freeze	IEC requires 10 cycles. First Solar <i>quadruples this requirement</i> .	November 2018 (S6)
Thresher Test	Comprises of 3 sequences: 600 temp cycles, 2000 damp heat hours, and UV exposure followed by 50 temp cycles and 30 humidity freeze cycles	October 2018 (S6)
Long-term Sequential Test	Thresher and long-term by definition are 2x-4x IEC intensity. 2000 damp heat hours, 50 temperature cycles followed by 40 humidity freeze cycles.	November 2018 (S6)
IEC 60068 Desert Sand Resistance	Test against blowing sand/sandstorms.	May 2019 (S6)
IEC 61701 Salt Mist Corrosion	Test for resistance to salt mist corrosion. First Solar modules are certified to Level 6 (highest)	May 2019 (S6)
IEC 62716 Ammonia Resistance	Test for corrosion in pollutant conditions.	May 2019 (S6)
IEC 62804 PID Resistance	Tested at positive and negative 1500V at 85 °C and 85% RH for 336 hours, exceeding IEC 62804 of 96 hours @ 60 °C and 85% RH.	January 2019 (S6)
CSA/ANSI C450-18	PV module testing protocol for quality assurance programs (See Appendix A for Test Sequence)	December 2018 (S6)

\*Extended Durability Testing Results

In addition to the extensive third party reliability and durability testing, First Solar performs its own internal quality checks at the end of the production line. These quality checks are outlined in Table 3:

**Table 3: First Solar Internal Quality Checks**

End of Line Quality Check	Description of Check	Frequency	Pass/Fail
Simulator	Test to indicate the wattage for the warranted period of the panel with the long-term linear degradation rate.	100%	Measurements completed at Standard Test Condition (STC – 25C temperature corrected)
HiPot	Safety test to verify that there is not current escaping the module that will exceed the UL/IEC standard for leakage current.	100%	Measurements compared to the UL/IEC standards for leakage current.
Inline Visual Inspection	High optical quality visual inspection of 100% of modules by vision systems for high quality optical defects as modules are processed through the production line to the boxing operation.	100%	If a high quality optical defect is identified, module will be auto scrapped and removed from the production line by routing logic. If no defect is found, module continues down production line to boxing operation.
Shift Inspection Audit	Delivery of one module once a shift to manual inspection leg for visual inspection.	Hourly	If a high quality optical defect is identified, module must be pulled and documented as scrap. If no defect is found, module returned to production line to be boxed for shipment.
Final Module Inspection	Randomly pull one module from one pallet in the set and repeat full line visual inspection.	Daily	If high quality optical defect is identified, NCP defected modules and hold pallet set for further investigation. Any modules identified with defects are to be scrapped and replaced with non-defective modules.

**Appendix A: Test Sequence for CSA/ANSI C450-18**

