

## How Tough are Solar Modules?



*Incessantly subjected to extreme temperatures, this system provides power for a water pumping system in the US desert.*

The solar industry often talks about the durability of solar modules which are built to operate in rugged, remote environments. They are subjected to every imaginable weather extreme, including large swings in temperature and humidity, severe wind exposure, corrosive salt-air and impact from debris and hail.

The proof of solar module durability is best demonstrated by the warranties. Many modules come with a 25-year performance warranty and a guarantee that 80% of the rated power of the module will still be available after 25 years. There are few other consumer or industrial devices carrying a similar warranty.

How can the solar industry offer such an extensive warranty with confidence? We can offer such warranties because of the rigorous specifications that guide the design of solar modules. Manufacturers select premium materials, deploy solid manufacturing techniques and use thorough testing reproducing harsh environments to create a product that endures a wide range of outdoor conditions.

The Jet Propulsion Laboratories (JPL) in Pasadena, CA first established an industry-wide set of test specifications for modules in the late 1970's. The JPL was commissioned by the US Government to develop a series of tests to ensure that solar modules operate under all expected environmental conditions. The result was the JPL Block V test specification. Here is a run-

down of the tests encompassed by the JPL Block V specification standard:

- Repetitive temperature cycling from -40°C to +90°C
- Temperature humidity freeze test cycling from -40°C to +85°C at 85% relative humidity
- Mechanical load testing with 10,000 cycles at 20 cycles/minute of positive and negative pressure normal to the module surface
- Wind resistance test with upward forces equivalent to 35 lbs/ft<sup>2</sup>
- Twist test with forced deviation from a true flat surface by +/-1/4 inch per ft
- Hail impact test with a 1 inch ice ball traveling at a terminal velocity of 52 mph
- Electrical isolation test with 2,000Vdc applied for one minute to the module terminals with out arcing, flashover or 50 uA DC of leakage current.
- Hot spot endurance test by applying reverse polarity to isolated cells for 100 hours with no delaminating, out-gassing or blistering of encapsulate, and no physical cell damage

The JPL Block V tests equate to the military standard MIL-STD-810 tests in most respects except for the salt-fog exposure test. The MIL-STD-810 is a series of test standards used to verify the ability of outdoor-rated equipment to survive in harsh environmental extremes.



*This Dry Tortugas National Park system has withstood hurricanes and years of salt water spray and continues to power employee housing and potable water production.*

A SunWize employee was involved in the extensive use of solar for military communication and tracking sites in the Gulf of Mexico and off the coast of Okinawa. In order to verify the ability of solar modules to survive exposure to a salt-fog environment, a sample lot of production modules were tested.

Per the MIL-STD-810 standard a 5% salt concentration solution was used and the solar modules were positioned as they would be under their expected deployment



*This SunWize system at a BTS site in a mountainous region in California is subjected to snow and extreme temperatures.*

on the platforms and buoys. The modules went through a 48 hour exposure period and then a 48 hour drying period. This 4-day cycle was repeated four times, for a total 16-day test.

Afterwards the modules were visually inspected for damage and were flash tested in a light simulation chamber in order to verify their current-voltage characteristics. Both the visual and electrical tests came through at 100% - there was no visible damage or corrosion and the modules met the specification electrically.

When the rigorous standards outlined above are considered in combination with the evidence of hundreds of thousands of modules successfully deployed on all seven continents, it becomes clear why the solar industry can claim that solar modules are as durable as any other industrial device you could install in a remote, rugged site.

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