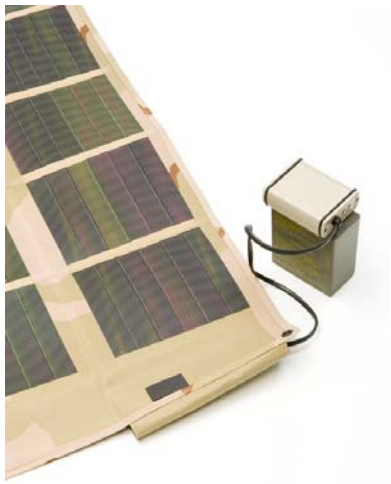
Global Solar P3 Flexible Solar Chargers
MIL-STD-810E Compliance



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GLOBAL SOLAR

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Global Solar Energy has designed and built lightweight *Portable Power Packs*™ (P3s) for the Military for over ten years, having developed the first lightweight foldable solar panels for the United States Marine Corp beginning in 1998. Current designs are a result of continuous interaction and field demonstrations. Our lightweight products have been designed for rapid field recharging of 12v deep cycle/lead-acid, BB390 and BB590 nickel-metal-hydride (NiMH), and BB2590 lithium ion (Li-ion) rechargeable batteries. In 2003, the product was tested and approved by CECOM (Communications – Electronics Command) and subsequently they deployed over 770 solar panels for recharging the Bren-tronics BB2590 soldier battery pack. To date, there have been over 10,000 P3 modules sold worldwide through integrators, distributors, and government organizations. Global Solar has averaged less than a 1% rate or return per year for all P3 modules sold.

Global Solar's P3's are rugged and durable. They have passed the United States Army's series of standard environmental tests, MIL-STD-810E.

MIL-STD-810E evaluates a product's durability in the harsh environments experienced in military applications. The P3 solar chargers have passed all sections of this standard.

Immersion in Water	✓
High Temperature Storage	✓
Altitude	✓
Vibration (Loose Cargo Transportation)	✓
Blowing Sand and Dust	✓
Low Temperature Storage	✓
Transit Drop	✓
Thermal Shock	✓

Not only do Global Solar P3 materials withstand the varied environments soldiers face, their photovoltaic performance meets or exceeds 90% (27.0 watts) of the rated power even after exposure to multiple harsh environmental conditions.

Module	Power Rating (watts)	Immersion in Water	High Temp Storage	Altitude	Vibration Loose Cargo	Sand & Dust	Low Temp Storage	Transit Drop	Thermal Shock
1	30.0	29.043			28.496			27.329	
2	30.0	29.633			29.397			28.429	
3	30.0	29.545			28.802			27.297	
4	30.0		31.915			30.23			
5	30.0		27.477			28.328			
6	30.0		27.611			27.835			
7	30.0			31.689			31.035		29.848
8	30.0			29.945			29.717		28.989
9	30.0			31.25			30.698		30.243

Note: All power values are after light soak.

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MIL-STD-810E Testing Methods and P3 Solar Charger Results

The United States Army Development Test Command issued the MIL-STD-810 series of standards to establish guidelines for various environmental tests to ensure that equipment will survive tough field conditions. Global Solar P3 solar chargers were tested according to the MIL-STD-810E procedure. Since then, the test methods have been updated in the MIL-STD-810F revision. **Products that comply with either the E or F standard meet the US Military's current standards for "rugged" equipment.**

The test methods simulate the harsh environments the equipment will be subjected to in military applications. The test objective is to assess equipment suitability for the environmental conditions the equipment will experience during its life expectancy.

Test Methods

National Technical Systems Arizona Division performed the test for Global Solar's P3 Portable Power Pack solar chargers. Test methods used for certifying the Global Solar P3 Portable Power Pack included Immersion, Transportation Vibration (Loose Cargo Transport), High Temperature Storage, Low Temperature Storage, Thermal Shock, Altitude, Blowing Dust, and Transit Drop. The Global Solar P3 product passed every test performed thereby certifying that the units would stand up to military field use. It can also be said that the P3 products are durable enough for anyone to use outdoors.

Immersion Test

Three Global Solar P3 units were placed in a chamber for precondition prior to the immersion exposure. The chamber temperature was adjusted to +40°C to provide an internal temperature "approaching +45°C" at the time of the immersion. The units were allowed to stabilize in the +40°C environment for approximately five hours. After removing the P3 units from the chamber, the units were immersed in +21.3°C water to a depth such that one meter of water was above the P3 units. The units remained immersed for a period of thirty minutes. After thirty minutes the P3 units were removed from the water and visually inspected for any irregularities. No irregularities were detected.

High Temperature Storage

Three Global Solar P3 units were placed on a rack in the chamber. The chamber controller was set to provide seven cycles of temperatures between the extremes of +33°C and +71°C. The chamber door was closed and sealed. After the P3 units were exposed to the temperature cycles they were removed from the chamber and inspected for any irregularities. No irregularities were detected. (Fig. 2)

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MIL-STD-810E Testing Methods and P3 Solar Charger Results (cont.)

Altitude

Three Global Solar P3 units were placed on a rack in the altitude chamber. The chamber controller was set to provide the pressure equivalent of an altitude of 40,000 feet. The chamber door was closed and sealed. Once the chamber stabilized at a pressure of 40,000 feet the P3 units were kept in the chamber for one hour. After the hour was complete the P3 units were removed from the chamber and inspected for any irregularities. No irregularities were detected.

Transportation Vibration (Loose Cargo Transport) Test

Three Global Solar P3 units were mounted in the cargo shaker unit, configured to each of the three required axes. The P3 units were subjected to fifteen minutes of loose cargo vibration according to each axis in three different fifteen minute intervals. After completion of the three configurations the P3 units were inspected for any irregularities. No irregularities were detected. (Fig. 1)

Blowing Dust

Three Global Solar P3 units were used to test in two different environments one at ambient temperature and one at +71°C. For each test the P3 units were positioned in the dust chamber. The dust chamber was infused with silica flour. The dust concentration was adjusted to 10.6 ±7 g/m3. The chamber airflow was adjusted to between 1680 and 1700 FPM. The P3 units were subjected to a one hour exposure for each of the six sides of the solar module at each of the temperature ranges. After each of the six sides completed the hour exposure at each temperature the P3 units were removed from the chamber and inspected for any irregularities. No irregularities were detected. (Fig. 3)

MIL-STD-810E Testing Methods and P3 Solar Charger Results (cont.)

Low Temperature Storage

Three Global Solar P3 units were placed on a rack in the chamber. The chamber controller was set to provide a constant environment of -40°C, for a period of seventy-two hours. The chamber door was closed and sealed. After the P3 units were exposed for seventy-two hours, the chamber temperature was changed to +24°C and held to allow for stabilization. After stabilization at +24°C the P3 units were removed from the chamber and inspected for any irregularities. No irregularities were detected.

Transit Drop

Three Global Solar P3 units were used for four corner drops; four edge drops and two surface drops due to the characteristics of the units. For each test the P3 unit was mounted in the drop tester. The drop tester table was positioned forty-eight inches over a concrete impact surface. At the release of the drop table the P3 would impact. After the completion of the total exposure the P3 unit was inspected for any irregularities. No irregularities were detected. (Fig. 4)

Thermal Shock

Three Global Solar P3 units were placed in a perforated tray and placed in the thermal shock chamber. The chamber controller was set to provide one cycle of one hour, at the temperature extremes of -40°C and +70°C. Once the hot zone temperature stabilized the P3 units were transitioned into the +70°C zone. The P3 units stayed in the hot zone for one hour. After the one hour cycle in the hot zone the P3 units were transitioned into the -40°C cold zone where the units stayed for a one hour cycle. This transitioning procedure was duplicated four times. When the exposure requirement was complete the P3 units were inspected for any irregularities. No irregularities were detected.

References:
1. MIL-STD-810E from U.S. Army Development Test Command
www.dtc.army.mil/publications/milstd.html
2. National Technical Systems Arizona Division – Test Report 7120-4807
3. Wikipedia – MIL-STD-810 http://en.wikipedia.org/wiki/MIL-STD-810

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