



Flooded lead-acid cells  
with tubular positive plates

Manufacturing site of tested  
product and test location :  
EnerSys SARL, Arras, FRANCE

	Name	Service	Date
Person in charge of tests	Daniel COSTE	Engineering Europe. Reserve Power. EnerSys SARL, Arras	12 Mar. 2014
Established by	Christian LEMOINE	Engineering Europe. Reserve Power. EnerSys SARL, Arras	12 Mar. 2014
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# IEC61427-1 APPROVAL TESTS

Edition 1.0 : 2013-04  
"Secondary cells and batteries for renewable energy storage  
General requirements and methods of test  
Part 1 : Photovoltaic off-grid application"

12 Mar. 2014

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**PowerSafe TS RANGE**

Flooded lead-acid cells with tubular positive plates for renewable energy applications

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 According to IEC 61427-1 : Edition 1.0 2013-04

Clause & Test		Requirements	Results
<b>General requirements</b>			
5.1	Mechanical Endurance	Batteries for photovoltaic application shall be designed to withstand mechanical stresses during normal transportation and handling	<p>The following relevant design features shall be pointed out :</p> <ul style="list-style-type: none"> <li>. Stable and durable transparent SAN container sealed to the stable ABS lid to ensure no electrolyte leakage</li> <li>. Thermal resistance</li> <li>. Container thickness is between 6 to 10mm</li> </ul> <p>No crack of container and no leakage of electrolyte during normal transportation and handling (operated strictly in accordance with our handling, installation and operating instructions)</p>
5.2	Charge efficiency	Values of battery Ah-efficiency at different states of charge	
5.3	Deep discharge protection	The batteries shall be protected against deep discharge to avoid capacity loss due to irreversible sulphation	The installations will be equipped with a controller/regulator whose voltage threshold values will protect against deep discharge :
5.4	Marking	<p>Cells shall follow the instructions of IEC 60896-11 standard :</p> <p>The following information shall be permanently marked on the cell : voltage, manufacturer's type reference, capacity, manufacturer's name, electrolyte specific gravity, date of manufacture</p> <p>Marking polarity : Stationary battery cells shall carry the polarity marking at least of the positive terminal</p>	<p>The following details are permanently marked on the cell : voltage (2V), cell type (PowerSafe TS), capacity in Ah (<math>C_{120}/1.85V/25^{\circ}C</math>), manufacturer's name (EnerSys), electrolyte specific gravity (1.240 at 25°C at max. level), date of manufacture (year and week).</p> <p>The positive polarity symbol is moulded into the lid near the positive terminal post.</p>
5.5	Safety	Refer to the manufacturer's instructions for procedures to be observed during installation, commissioning, operation, taking out of service, and disposal.	<p>Refer to the Energys documentations : The instructions are described in our Powersafe TS operating guide for solar applications and in the documentation "Filling and charging Moist charged flooded batteries".</p> <p>Batteries should be installed in accordance with safety standard EN50272-2, IEC62485-2 and <u>national regulations</u>. Check the rules and the standards in the country where the batteries will be installed.</p>
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5.6	Documentation	<p>Refer to the manufacturer's documentation for transport and storage, commissioning, putting into service, operation and maintenance.</p> <p>The manufacturer shall advise if there are special considerations for the initial charging of batteries with only the solar array available as the power source.</p>	<p>Refer to the EnerSys documentations :          The instructions are described in our Powersafe TS operating guide for solar applications and in the documentation "Filling and charging Moist charged flooded batteries".</p> <p>With no external source available for recharging, connect the batteries to the solar panel regulator (before switching the system on) : Ideally 1 to 2 weeks on solar panels.          For this type of charge, set the charging controller to the voltage values given in our technical guides and check regularly the battery state of charge.</p>
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**Functional characteristics**

8.1	Capacity test	<p>Capacity test shall be performed at the 10 hours rate to 1.80Vpc.          Capacity test shall be performed at 120 hours rate to 1.85Vpc.          Determination of the actual capacity Ca          Ca = 0.95 Crt at the first cycle</p>	<p>Capacity tests in C<sub>10</sub>, C<sub>120</sub> have been checked : The cells have more than 95% of the rated capacity at the first cycle</p>
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8.2	Generic cycling endurance test	<p>The cells have been cycled according to IEC 60896-11 standard :          Continuous cycles are carried out on Powersafe TS cells, it consists of :          A 3h discharge with a current = <math>0.2C_{10}</math> (DOD = 60%) followed by 21h charging time with 2.40Vpc.          Every 50 cycles a capacity test in <math>C_{10}</math> is done.</p> <p>The minimum requirement shall be <b>100 cycles</b> before the capacity <math>Ca</math> drops below <math>0.95C_{10}</math>  <b>Optionally</b>, the manufacturer may state the number of cycles to <math>Ca = 0.8C_{10}</math></p>	<p>Ca after 50 &amp; 100 cycles is &gt; 95%          Ca after 1000 cycles is still &gt;100%</p>
8.3	Charge retention test	<p>The cells shall follow the procedures of the IEC 60896-11 standard :          After <b>90 days</b> of storage          The minimum value <math>Cr</math> shall be in accordance with the data indicated by the manufacturer</p>	<p>Result :  <math>Cr = 92.5\%</math> equivalent to a self discharge of 2.5% per month (we stated 3% per month)</p>
8.4	Cycle endurance test in photovoltaic application (extreme conditions)	<p>The cycle endurance test shall be conducted by submitting the cells to a period of 150 cycles (50 cycles with the phase A "shallow cycling at low state of charge" and 100 cycles with the phase B "shallow cycling at high state of charge")          Maintain the battery at <b>40°C</b> during the test          The cycle life shall be expressed in number of 150 cycles (A+B)</p> <p>Note according to this standard : One set of 150 aggregate cycles is approximately equivalent to 1 year service in a PV energy storage application.</p> <p>Requirements : The minimum number of completed A+B phase cycle sequences (150 cycles each) shall be not less than 3.</p>	<p>3300 cycles achieved (= 22 cycle sequences of 150 cycles each)</p>

Conclusion :

The results obtained with the **PowerSafe TS RANGE** are fully compliant with the requirements of the IEC 61427-1 : Edition 2013-04 "Secondary cells and batteries for renewable energy storage – General requirements and methods of test – Part 1 : Photovoltaic off-grid application"

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