

SUNGEL[®] & ENERGEL[®]

Advanced Gel Technology

Sealed Lead Acid Batteries

Installation & Operating Instructions

Battery Energy Power Solutions Pty Ltd

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Fairfield NSW 2165
Australia**

ABN 83 003 325 139

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This Manual should remain with the battery and be referred to for periodic and scheduled maintenance.

Information recorded by the installer in this document will be required should there be a system failure.

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<p>1. Introduction</p>	<p>The Battery Energy Energel Battery was developed in conjunction with CSIRO and Telstra from 1993 to 1996 with the product being commercially launched in late 1996. This Australian made Gel battery belongs to the category of Valve Regulated Lead Acid battery or VRLA, also known as recombination batteries or sealed batteries. Within this classification, there are two types of battery, Absorbent Glass Mat (AGM) and Gel. The performance and characteristics of these two battery types are quite different. The Energel Battery is designed predominantly for float standby application. The Sungel Battery is designed predominantly for Solar cycling applications.</p> <p>The general nomenclature used is:</p> <ul style="list-style-type: none"> ❑ A number denoting the number of volts e.g. 6 EG 150 is a 6V block. ❑ Battery type i.e. EG = Energel. SG = Sungel. ❑ Capacity at the relevant discharge rate, C10 (10H rate) for Energel, C120 for Sungel. This refers for instance to the capacity obtained when the discharge lasts for 10H. ❑ All ratings are at a nominal 25 ° centigrade.
<p>2. Safety</p>	<p><u>General</u></p> <p>Under normal operating conditions, Gel Batteries vent very little gas and emit no acid fumes. The product when supplied, in common with all other gel cells and many AGM cells, will not be completely dry and will continue to lose water over the first few years of service. They are considered to be fully office compatible. Under abusive conditions, such as a charger malfunction or physical damage to the container cover, they can emit dangerous acid fumes and for this reason full precautions should be taken. As the gel encapsulates the free acid, there is no major risk of acid spillage but the solid gel itself is still corrosive and is subject to the usual precautions. Although the vent contains an explosion proof ceramic filter that should prevent ingress from a naked flame, the use of such in the vicinity of the battery is not recommended.</p> <p><u>Protective Equipment</u></p> <p>The following equipment should be available for personnel working with these batteries.</p> <ul style="list-style-type: none"> (a) Instruction manual or other appropriate instructions (b) Insulated tools (c) Fire extinguisher (where appropriate) (d) Bicarbonate of soda or soda ash <p><u>Safety Precautions</u></p> <p>The following precautions should be observed at all times.</p> <ul style="list-style-type: none"> (a) Metal objects should not be allowed to fall across the terminals. Although the short circuit current of these batteries is about a half of AGM batteries, it is still a major hazard. For instance, the 6 EG 150 has a short circuit current of around 2500A. <p>The wearing of metallic objects such as watches or jewellery should be avoided.</p> <ul style="list-style-type: none"> (b) Insulated tools should be used at all times. (c) Personal static build up should be neutralised by touching a grounded surface prior

<p>2. Safety</p> <p>Con't</p>	<p>to working on the battery.</p> <p>(d) For load testing, make sure there is short circuit protection and that test leads are of sufficient length to avoid arcing in the vicinity of the battery.</p> <p>(e) Do not under any circumstances remove the battery cap to add water or acid. This automatically invalidates the warranty.</p>
<p>3. Operating Principles</p>	<p>Valve regulated lead acid batteries operate on what is called the oxygen cycle, that is, when the charging process is almost complete, oxygen from the positive electrode moves over to the negative electrode and is converted to water. This recombination reaction is controlled in AGM batteries by having the fibreglass mat only partially saturated, leaving air gaps, and with gel batteries by cracks in the gel.</p> <p>With vented batteries, the oxygen, together with hydrogen from the negative electrode is vented during the gassing process with the net result that water addition is required on a regular basis to make up for the losses. This topping up process is not required for valve-regulated batteries. The valve acts as a safety feature, venting only when the pressure in the cell reaches a certain point (120 KPA) and resealing again at a lower pressure to avoid further water or gas loss. Some pressure build up over time is inevitable as the hydrogen recombination rate on the positive is very low and does not cover hydrogen evolved due to self-discharge.</p>
<p>4. Transport</p>	<p>The transport of Energel and Sungel batteries is classified as non-hazardous within Australia and can be transported by road, rail or air without any special precautions. The UN number is 2800, class 8, as with other sealed batteries.</p> <p><u>Packaging</u></p> <p>The gel cells are packaged in cardboard cartons packed in crates. Export packaging is available on request at an extra cost.</p>
<p>5. Unpacking</p>	<p>Upon receiving a shipment of batteries, it is strongly advised that an inspection for external damage and delivery against the delivery docket is carried out. Battery Energy requires formally to be notified within 7 days of the receipt and unpacking of the batteries if the contents have not arrived at the destination in good order or the contents do not correlate with the delivery docket. Damaged items must be kept available for inspection by the carrier's or Battery Energy's representative.</p>
<p>6. Description of contents</p>	<p>Apart from the battery itself, the following items would be included in every unit. The metal items are contained in a sealed plastic bag.</p> <ul style="list-style-type: none"> <input type="checkbox"/> Semi transparent shroud to cover the entire top of the battery in the smaller format batteries and a clip on shroud for the link for the larger batteries. <input type="checkbox"/> Plated copper links for either diagonal inter-cell connection for a 6v unit (long) or cell to cell for others or series connection of 6V units (short). <input type="checkbox"/> Plated brass bolt for the connections (2/link) <input type="checkbox"/> Stainless steel spring washers (1/bolt M10 bolts only) <input type="checkbox"/> Plated Brass Washers for M8 bolts (1/bolt) <input type="checkbox"/> Installation and maintenance instructions (1/shipment) <p>Thus for the 6 SG 200 (Telstra item number 177/270), there will be 6 standard short bolts, 1 long bolt for takeoff, 6 brass plated washers, 2 large flat brass plated washers, and three links, two long and one short. (Telstra only)</p>
<p>7. Handling</p>	<p>Sungel and Energel are shipped fully charged and must be treated with care at all times. If the battery has to be moved out of the packaging in situ, there are other special methods of handling. Battery Energy should be consulted. Do not lift batteries by posts under any circumstances.</p>

<p>8. Storage</p>	<p>If the battery cannot immediately be installed, it should be stored, preferably still in the crate, in a clean cool dry area.</p> <p>The average storage temperature should not exceed 35 degrees centigrade if possible.</p> <p>If the storage period exceeds 6 months at 25 degrees or 3 months at 35 degrees or the cell voltage on open circuit drops below 2.10v, then a refresher charge should be given to the batteries (see charging)</p>												
<p>9. State of Charge</p>	<p>A good indication of the state of charge of the battery can be gained from the open circuit voltage of the battery. This must be measured after a minimum of 24 hours at rest with no charge input. The following values can be used as an approximate guide.</p> <table border="1" data-bbox="456 533 1443 856"> <thead> <tr> <th data-bbox="456 533 919 585">State of charge</th> <th data-bbox="919 533 1443 585">Voltage per cell</th> </tr> </thead> <tbody> <tr> <td data-bbox="456 585 919 638">100%</td> <td data-bbox="919 585 1443 638">2.135</td> </tr> <tr> <td data-bbox="456 638 919 690">90%</td> <td data-bbox="919 638 1443 690">2.120</td> </tr> <tr> <td data-bbox="456 690 919 743">80%</td> <td data-bbox="919 690 1443 743">2.105</td> </tr> <tr> <td data-bbox="456 743 919 795">70%</td> <td data-bbox="919 743 1443 795">2.090</td> </tr> <tr> <td data-bbox="456 795 919 856">60%</td> <td data-bbox="919 795 1443 856">2.075</td> </tr> </tbody> </table>	State of charge	Voltage per cell	100%	2.135	90%	2.120	80%	2.105	70%	2.090	60%	2.075
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80%	2.105												
70%	2.090												
60%	2.075												
<p>10. Installation</p>	<p><u>Room requirements (general standby)</u></p> <p>The battery should be installed in a clean, cool dry room. It should be noted that there is a relationship between average temperature and projected life of the battery, which almost halves for every increase of ten degrees in the temperature, so the temperature should be as low as is practicable, preferably in the range 20-25 degrees, as with temperatures below this, capacity is reduced.</p> <p>Care should be taken in providing adequate floor loading capability and aisle width etc. These are covered in more detail in AS 2676 and AS 3011.</p> <p>Access where appropriate should be limited to qualified personnel.</p> <p><u>Solar Installations</u></p> <p>In these circumstances, it is essential to minimise the temperature differences between cells and to operate at a low temperature as possible. Direct sunlight on the cells must be avoided at all costs. The surface on which the cells rest must be clean and perfectly flat to avoid stressing the connections.</p> <p><u>Racks/stands</u></p> <p>Battery Energy provides a range of powder coated steel stands that are normally made to order. These are designed according to the Australian Standard to give significantly less than 3mm deviation on load. The assembly of these stands is extremely rapid and easy; with the stainless steel bolts provided bolting through from the underside of the steel beams through the welded tubular leg sections.</p> <p>Please contact Battery Energy direct if further information on these designs is required.</p> <p><u>Cabinets</u></p> <p>Both the Energel and Sungel batteries can be placed in cabinets if required. The following design criteria should be taken into account when designing the cabinet.</p> <p>10. Installation</p> <p>(1) Good ventilation is extremely important, with ventilation openings required at the base</p>												

<p>Con't</p>	<p>of the cabinet.</p> <p>(2) Good thermal management is required; the temperature in a cabinet should not exceed 35 degrees; maintaining the gap between cells at the recommended 10mm and allowing for at least 100 mm headspace as well as adequate ventilation will achieve this.</p> <p>The recombination reaction does generate heat. This should not be a major problem particularly as the float current on these cells is much lower than conventional AGM cells which can operate at a temperature of about 3 degrees above ambient.</p> <p><u>Battery Placement</u></p> <p>(This is for sizes up to and including EG 510 and SG 650)</p> <p>After installation of the stand, lift the battery onto the rails. Lift off the outer cardboard sleeve.</p> <p>Then position the battery as required. Remove the links and bolts from the plastic bag provided. Position the links such that a minimum of 6mm gap exists between the cell covers of adjacent cells. 10mm would be recommended where thermal management is important.</p> <p>Fit the washers and screw the bolts into the female insert. The bolt has been designed under normal conditions to be shorter than the female thread, but there could be situations where longer bolts have been provided for take offs for additional outputs and under these circumstances the torque must be limited to 8-10NM.</p> <p>When assembling six-volt batteries, special care must be taken NOT to short out the connections.</p> <p>In the pack for the 6SG200 (177/270), a long bolt has been provided. This is ONLY to be used for the end take off together with the big flat washers. If it is used in any other place or without the washers, it will bottom out on the thread and can cause damage to the cell if tightening is still attempted.</p> <p>Fit the clear shroud after all the solid connections have been tightened and the lid surface has been wiped cleaned. The clear shroud has inserts that provide additional inter-cell insulation when bent upwards to form a bridge over the link.</p> <p>The shroud material is quite flexible. The shroud is kept in place by the ridges on the cell cover, with access for voltage probes through the cover. It can, however, be removed if access to the top cover is required.</p> <p>For the large format cells, the same operation is carried out, except that a clip on U shaped shroud protects the links.</p> <p>Inter-row connections would normally be by flexible cable, which would also be supplied by Battery Energy if requested.</p> <p>The torque pressure required for the bolt is 8-10 NM.</p>
<p>11. Battery Numbering</p> <p>11. Battery Numbering Con't</p>	<p>The number of the battery is affixed in two places.</p> <p>The manufacturing date and number of the battery is stamped into the top of the ABS cover.</p> <p>The type of the battery and batch number is placed on a small label under the large label (assuming the battery is in the normal vertical orientation). These numbers would</p>

	normally be required for warranty purposes as it relates directly to Battery Energy Quality records.
12. Temperature	Maintaining an even temperature across the whole bank is important to maximise life. There should be no more than a three-degree variation in temperature across the bank. A thermocouple probe on the side of the battery would normally measure this.
13. Orientation	Gel products can normally be placed in several orientations outside the standard vertical upright used for vented products. Battery Energy only recommends that the plates are positioned in vertical positions in the cell. All warranties and guarantees are extinguished if the plates are in a horizontal position. If positions other than the vertical upright are preferred, then Battery Energy should be consulted prior to ordering the batteries, as minor modifications are required to the cells.
14. Charging	<p>Float Operation</p> <p>Constant Voltage chargers should only be used with Energel batteries in standby mode. The recommended voltage is in the range 2.25 - 2.28V, with an optimum at 2.27v at 25°C. If the temperature is more than 5°C outside this range, then temperature compensation should be used at a value of +/- 4mV/degree, i.e. the voltage should be reduced at higher temperatures. The float current under these circumstances should be of the order of 40 mA/100 Ah after a period on float.</p> <p>The variation in voltage for long strings would normally be of the order of +/- 20mV, although this could increase if cells from different batches are included.</p> <p>It is expected that this difference will increase in the first years of operation as the cell slowly dries out and then come together again.</p> <p><u>Equalisation Charging</u></p> <p>As gel cells, unlike AGM cells, do not stratify, the requirement for equalisation is somewhat less. Charging of Battery Energy gel cells can be carried out at voltages up to 2.5V. As the water consumption is low and the water content of the cell significant, regular equalisation charges will not harm the battery.</p> <p>Equalisation should be carried out if some cells in the string are at voltages of 2.17V or less. The normally recommended voltage is 2.45V for a period of 8-12H.</p> <p><u>Cycling Operation</u></p> <p>Under these circumstances, which are typically observed under solar/photovoltaic operation, the battery should be charged to 2.45-2.5V every cycle at which point the battery should be switched into float mode. Every six to eight weeks the battery should be given an equalisation charge as outlined previously.</p> <p>When calculating voltages, temperature compensation, as set out below should be used.</p> <p><u>Ripple</u></p> <p>As a cycling battery with a very low float current and a good thermal mass, the Energel and Sungel ranges are better equipped to resist high ripple than the normal AGM battery.</p> <p>Under these circumstances, the voltage regulation of the system can vary by up to 5%(+/- 2.5%) from 5 to 100% load.</p> <p>Care has to be taken that the current flowing through the battery under float conditions does not reverse into the discharge mode. This will only be a problem with very high ripple conditions.</p>

15. Maintenance and Testing

General

Standard operating procedures as for all sealed batteries must be observed with the Energel and Sungel ranges.

This includes: - (this applies more to float/standby applications than solar/cycling applications.)

Quarterly Checks

All cell voltages (and temperature if appropriate equipment available)

Overall string voltage

Battery cleanliness

Corrosion or leakage at posts, vent, and cover.

Physical integrity – cracks, bulges, distortion etc, of both battery and stand.

All cell impedances (where recommended)

Temperature of pilot cell.

Yearly Checks

Test tension of terminal connections/bolt.

Discharge Test (where recommended)

Cleaning

The batteries can be cleaned with a soft dry cloth or water moistened soft cloth. Under no circumstances should the batteries been cleaned with any product containing organic or inorganic solvents. Do not use abrasive cleaning materials to clean the batteries.

Discharge testing

In terms of discharge tests, a short high current test is thought to be adequate in the first few years of life. If visits to the site are infrequent, then this can be reduced during the first 6 years of life to a test every two years (i.e. installation, 2 years, 4years and 6 years) followed by annual testing.

Testing would normally be carried out at the three-hour rate although other rates can be employed as appropriate. Temperature correction factors as set out below should be used. Thus the time of discharge is taken and multiplied by the factor to get the correct value at 25 degrees.

For more details see Australian Standard AS4029 part 2.

Temperature °C	Factor
0	1.15
5	1.12
10	1.08
15	1.04
20	1.02
25	1.00
35	0.94
40	0.91

<p>16. Battery Life</p>	<p>The expected life of the Energel battery in well-regulated conditions is in excess of 15 years.</p> <p>The normal criterion for deciding that the end of life has been reached is that the capacity on test is less than 80% of nominal. The batteries should be fully charged prior to any test. If there is any doubt then the battery should be boost charged prior to any discharge test.</p> <p>The Sungel battery if restricted to a daily depth of discharge not exceeding 20% of the C120 rate should have an expected life in excess of 10 years. The same criteria for determining end of life as the Energel should be used. It is expected that the Sungel battery would operate acceptably for a further one to two years after the 80% capacity is established.</p>
<p>17. Battery Disposal</p>	<p>The battery must be disposed of in an environmentally acceptable method. This means using a registered scrap merchant.</p> <p>Please contact Battery Energy for advice if there are any problems in this context.</p>

18. Sizes.

Technical Specifications								
Energel	Nominal Ah Cap. @ 25°				Overall Dimensions			
Cell/Battery Type	Volts	1 hr Rate to 1.7 VPC	3 hr Rate to 1.8 VPC	10 hr Rate to 1.8 VPC	Length mm	Width mm	Height mm	Weight Kg
6EG100	6	56	65	100	276	184	265	28
6EG125	6	75	86	125	276	184	265	33
6EG150	6	94	107	150	276	184	265	38
2EG180	2	112	140	190	109	184	265	15
2EG210	2	131	150	210	184	276	265	20
4EG210	4	131	150	210	276	276	265	33
4EG240	4	150	171	240	276	184	265	38
2EG270	2	169	193	270	184	276	265	23
2EG330	2	206	236	330	184	276	265	26
2EG390	2	244	278	390	184	276	265	33
2EG450	2	281	321	450	184	276	265	37
2EG510	2	319	364	510	184	276	265	40
2EG650	2	327	411	650	145	206	680	52
2EG750	2	416	504	750	145	206	680	58
2EG1000	2	572	693	1000	210	191	680	76
2EG1200	2	676	819	1200	210	233	680	89
2EG1500	2	832	1008	1500	210	275	680	107

Technical Specifications											
SUNGEL		Nominal Ah capacity @ 25°C						Overall Dimensions			
CELL TYPE SUNGEL	Nominal Voltage	C1 to 1.70 Vpc	C3 to 1.75 Vpc	C10 to 1.80 Vpc	C24 to 1.80 Vpc	C100 to 1.80 Vpc	C120 to 1.80 Vpc	Length mm	Width mm	Height mm	Weight Kg
6SG200	6	75	93	125	150	195	200	276	184	265	32.5
2SG250	2	94	117	156	187	245	250	109	184	265	13
4SG320	4	150	171	240	288	305	320	276	184	265	38
2SG450	2	169	210	270	324	440	450	184	197	265	23
2SG650	2	244	306	390	468	635	650	184	276	265	32
2SG875	2	260	357	542	650	850	875	145	206	680	49
2SG1000	2	312	429	650	780	1030	1050	145	206	680	54
2SG1200	2	399	547	832	998	1157	1200	210	191	680	62.5
2SG1400	2	416	570	867	1040	1350	1400	210	191	680	71
2SG1750	2	519	714	1083	1300	1705	1750	210	233	680	87
2SG2000	2	624	855	1300	1560	2050	2100	210	275	680	103
2SG2400	2	724	992	1508	1560	2377	2450	220	400	815	120

19. Relevant Standards

The relevant standards for the selection, installation and Maintenance of batteries are:

Float/standby applications

AS 2676.2 1992 Guide to the Installation, maintenance, testing and replacement of secondary batteries in buildings.

Part 2: Sealed cells

AS 3000 1991 Electrical Installations - Buildings, structures and premises.

AS 3011.2 1992. Electrical Installations - secondary batteries installed in buildings.

Part 2 Sealed cells.

AS 4029.2 2000 Stationary batteries - lead acid.

Part 2: Valve regulated type.

Stand alone Systems (solar/RAPS)

AS 4509.1 1999 Stand alone power systems

Part 1: Safety requirements

AS 4509.2 TBA

AS 4509.3 1999 Stand alone power systems

Part 3: Installation and maintenance.

AS 4086.1 1993 Secondary batteries for use with stand alone power systems

Part 1: General requirements

AS 4086.2 1997

Part 2: Installation and maintenance.

Battery Energy sealed product, stands etc comply with all these standards.

These standards can be obtained from Standards Australia.

Address: GPO Box 1055, Sydney NSW 2135

Phone: (02) 8206 6000

Fax: (02) 8206 6001

Email: mail@standards.com.au

Also: Standards New Zealand

Level 10 Radio New Zealand House

155 The Terrace, Wellington 6001

Phone: (04) 498 5990

Fax: 04) 498 5994

Email: snz@standards.co.nz

<p>20. Contact Information</p>	<p>For further information on any of the above, Battery Energy should be contacted on:</p> <p>Head Office 96 Fairfield St, E. Fairfield</p> <p> Phone 02-9 681 3633</p> <p> Fax 02-9 632 4622</p> <p> E-mail besp@batteryenergy.com.au</p> <p>Queensland P.O box 334, Toowong</p> <p> Qld 4066</p> <p> Phone 07-3371 1622</p> <p> Fax 07-3371 1655</p> <p> E-mail ian.watson@batteryenergy.com.au</p> <p>VIC/Tas/S. A. Phone 03-9550 1893</p> <p> Fax 03-9560 3008</p> <p> E-mail adrian.edgar@batteryenergy.com.au</p> <p>Western Australia Phone 08-9419 6449</p> <p> Fax 08-9491 6449</p> <p>Or on toll free number 1800 819 829.</p>

21. Quick Spec Data Page

1	Connecting bolt sizes: Sungel 100ah to 650ah Energel 100ah to 510ah Sungel 875ah to 2100ah Energel 650ah to 1500ah	M8 x 16mm plated brass. M10 x 16mm plated brass.
2	Connecting bolt tension	M8 = 8 – 10 nm M10 = 10 – 12 nm
3	Vent Release pressure – Self sealing	8 – 10 Kpa
4	Self Discharge @ 25°C	2 – 3% per month increasing with temperature
5	Short Circuit Current Sungel 100ah to 650ah Energel 50ah to 510ah Sungel 875ah to 2100ah Energel 650ah to 1500ah	17 x C10 Capacity 13 x C10 Capacity
6	Flame Retardant Standard	UL94V-O, BS6334FVO
7	Australian Standards	AS4029.2 – Energel AS4086.1 – Sungel, Suncycle AS4029.3 -- Enerlyte
8	O/C Voltage after min 24hrs rest	2. 135 to 2. 01vpc 100% to 20% Charged
9	Float Voltage	2.25 – 2.29 (2.27vpc preferred)
10	Boost Voltage	2.45vpc
11	Boost Time	6-hours
12	Temperature Compensation	+/- 4mv/°C from 25°C
13	Recharge Interval for Storage	6 Months @ 25°C, 3 Months @ 35°C Do not exceed 35°C.

