Surrette

Activating Instructions Dry Charged Batteries

1. Inspect the cell for damage, Read Warning Label On Cell Before Proceeding.
2. Remove vent caps, fill each cell above the top of the splash guard (protection mat covering separators) with approved 1.265 specific gravity battery grade electrolyte.
3. Keep sparks and flames away from battery at all times. Allow electrolyte to saturate plates and separators for 30 minutes. Temperature of electrolyte will rise and specific gravity will drop. Add electrolyte if not visible. Check for correct polarity with a voltmeter.
4. Place on charge at the finishing rate (5% of the 8 or 20 hour rate). The rate may be increased if the battery does not begin to gas. Do not let the cell temperature exceed 115° F (46° C) If the temperature becomes excessive or the cells begin to gas vigorously, reduce the rate of charge. Continue charging until the cell (or cells) reach within .005 points of the specific gravity of the filling electrolyte corrected for 77° F (25° C)
5. Top up or remove electrolyte as necessary for proper level. Never add electrolyte (only approved water) after activation.
6. Replace vent caps and remove any spillage of electrolyte. If necessary clean with bicarbonate of soda and water (100 grams of soda to one liter of water) Rinse with water and wipe dry. Insure that soda solution does not get into cells.

Shelf life of a dry charge battery is five years plus. Store in a cool dry area. The positive plate has an unlimited shelf life. The negative plate will revert to lead oxide when in the presence of water and oxygen. If this should happen, the battery is not ruined, but activation will take considerably longer!

The electrolyte temperature will rise dramatically during activation. Do not place on charge until the temperature drops below 115° F. Activation may take several days!

Before installing the batteries, clean the contact surfaces of the lead terminal post and battery terminals with a wire brush. Apply a thin coat of Vaseline to all contact points and connector bolts. After all connections have been securely tightened, they should be gone over and tightened a second time.

Preventive Maintenance (for more information see bulletin #509)

1. Check the height of the electrolyte twice a month. If necessary replace with approved water only. Many times domestic water is satisfactory. Water with a high mineral content is not satisfactory.
2. Do not use water that is difficult to create a lather when washing your hands with soap and water.
3. Never fill the cells above the bottom of the vent well. Over filling will cause loss of electrolyte and reduce the battery capacity.
4. Never add acid to the battery. (Only during activation)
5. Avoid over discharging of the battery as the useful life will be reduced. The rule of thumb is not to exceed 80 percent of the capacity of the battery. On a 12 volt system this would be approximately 11 volts. Remember over discharging or low voltage will also reduce the life of most electrical equipment.
6. Battery capacity is based on each cell having an electrolyte temperature of 77° F (25° C). Temperatures below 77° F reduce the battery's effective capacity and lengthen the time to restore to full capacity. Temperatures above 77° F will slightly increase capacity, but will also increase self discharge and shorten battery life.

The state of charge of a battery can be measured with a hydrometer. The chart below shows the approximate "percent of charge" corrected for temperature at various specific gravity values.

Charged	Specific Gravity	Open Circuit Voltage

100%	1.265-1.275	12.6
75%	1.225-1.235	12.4
50%	1.190-1.200	12.2
25%	1.155-1.165	12.0
0%	1.120-1.130	11.7

Determining state of charge by voltage is more difficult as there must be no load or surface voltage present.

When taking specific gravity measurements, it is important to correct for temperature to get a true reading. As a rule of thumb, specific gravity will change by 0.003 for each ten degrees Fahrenheit change in temperature above or below 77° F (25° C). Below 77° F subtract from readings and above 77° F add to the readings. As an example a reading of 1.250 at 67° F corrected for temperature would be 1.247 and a reading of 1.250 at 87° F corrected for temperature would be 1.253.

It is recommended that fully charged gravity and voltage readings be taken of each cell every month and compared with readings from the preceding period. The readings will indicate any marked difference in battery condition as well as differences between cells. A good rule of thumb is if there is 0.025 points or less between the high and low cell the battery is not defective. Low readings would indicate the battery being discharged.

The charging system can have a profound effect on the life of the battery. A high voltage setting can cause excessive gassing and water loss. Eventual damage to the battery system will take place. A low setting will leave the batteries in an under charged condition resulting in a loss of capacity and eventually the battery system may not take a charge. A proper setting will result in a minimum of water consumption and still able to maintain the batteries at full charge.

ROLLS BATTERY ENGINEERING

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The positive power choice

Bulletin 614, PM, Charging and Discharging Batteries;

Renewable Energy Applications

Introduction

Charging recommendations for flooded lead acid batteries have been based on past practices and often presented as general statements. In actuality, charging practices should be based on system applications and availability of charging sources. Rolls / Surrette Batteries are designed with thick plates, high density active material; for cycling service and to minimize the impact of heavy charging. These two design parameters, coupled with other design features, require more lead per unit which increases battery life in high cycle applications. The disadvantage of this design is marginally lower charge acceptance. This bulletin addresses this and clearly states that Rolls/ Surrette batteries should be charged at higher voltage settings depending on RE System design and are designed for cycling use.

Charging Parameters

Bulk/ absorption set points have been derived from the automotive industry and are for two reasons only. 1) The batteries do not get excessively hot and 2) the batteries do not use excessive amounts of water. These charging regimes also assume that excess power is available from a constantly running internal combustion engine. Because of these reasons the charging voltages can be increased as long as temperature does not get excessive and batteries do not consume large amounts of water causing undue amounts of maintenance.

Automotive batteries are 12V and in general the batteries cells are in a 2 x 3 layout and reside in a high temperature environment. Rolls/ Surrette batteries generally have cell layouts of simply single cells, 1 x 2 or 1 x 3 layouts. Heat transfer (away from the plates into the acid and out of the battery case) is much better than in standard layouts or with steel trays. This means more aggressive charge regimes (higher bulk absorption settings) can be used.

Consideration of application of use is important and will affect how the charge regime that should be used. In most alternative energy applications, maximum charge application is only available for 6-8 hrs. Meaning, the majority of charging has to be completed during this time frame to avoid reliance on an auxiliary generator further reduction in the battery's state of charge (SOC). Consideration has to be given also to whether the system is grid tied for back up power or stand alone.

Off Grid Systems

Off grid systems generally consist of solar PV panels and a battery bank. With these components the following voltage settings are recommended:

Charge Stage	Volts per Cell (VPC)	12V	24V	48V
	Min – Mean – Max	Min – Mean – Max	Min – Mean – Max	Min – Mean – Max
Absorption / Bulk	2.40 – 2.45 - 2.50	14.4 – 14.7 – 15.0	28.8 – 29.4 - 30	57.6 – 58.8 - 60
Equalization	2.58 - 2.63 - 2.67	15.0 – 15.8 - 16.0	30.8 – 31.6 – 32.0	61.6 – 63.2 –64.0
Float	2.20-2.22 -2.23	13.2 – 13.3 - 13.4	26.4 – 26.6 – 26.8	52.8 – 53.2 - 53.5

When a voltage setting is chosen the length of time the bank is being held at constant voltage is to be considered. If only a short absorption time is possible then the voltages settings should be at the higher levels. If a long absorption time is possible then the voltages should be lowered.

For example with a large PV array, small battery bank and minimal loads the lower settings should be chosen if it is apparent the battery bank can be held at the bulk/ absorption voltage for a minimum of fours hours. When the battery bank is put through the first 10 normal cycles the specific gravity (SG) of a pilot cell should check and recorded and if the bank is receiving full charge each cycle the SG should be slightly increasing as the battery gasses and loses water due to overcharge. Please refer to bulletin 609, Voltages, Specific Gravity and State of Charge for further info on determining cycle depth and full charge.

If the battery bank is large in relation to the PV array (C/20 min) and loads are large then the batteries will require a higher voltage setting. Also the battery should be cycled deeply (i.e. to 50%) before starting an auxiliary charge source such as a generator. Once every three months the bank should be discharged to the low voltage set point before starting the generator. This is usually dependent on the cut-off of the inverter which is usually 11 volts on a 12V system. The batteries are designed to be cycled and a deeper discharge forces electrolyte deeper into the active plate material and helps open up fresh reaction sites. With large battery to PV systems, it is imperative that the battery bank is returned to 100% SOC once every 30 days. Full charge can be determined by charge acceptance, which is ~2% of capacity at 100% SOC.

Opportunity Equalization

Systems with smaller PV arrays in respect to the battery bank should be also equalized more often. Bulletin 605 describes the differences between "preventive" and "Corrective" equalization. "Corrective" equalization should be avoided as it is bothersome, time consuming and can increase generator run time. It is recommended to "opportunity equalize" the batteries when it is known sun will be available at a convenient time. The auxiliary charging source (generator) should be started in the morning, with minimal loads running and bank brought to the bulk/ absorption voltage. The bank should then be put on an equalization charge and brought up to a specific gravity of 1.265. This should be continued until the SG is at 1.265 or the electrolyte temperature reached 115ºF in temperate climes. (125ºF in hot ambient conditions).

Grid tied systems-Back up battery banks

Normally these systems see very little cycle service and, at most, are cycled once a month. If cycled, the banks should be charge for 3 hrs at the mean voltage setting. After charging, the water level should be checked and a specific gravity reading taken. If the specific gravities are not 1.265 the bank should be further charged.

Commissioning a Battery Bank

When a bank is first put into service the electrolyte levels and specific gravities should be check and recorded. As a battery is charged, water is electrolyzed into hydrogen and oxygen gas. Original electrolyte levels should be noted and replacement water should be added back to this level.

The battery bank should be placed on a bulk / absorption charge and voltage settings should be set at the maximum level of the above table. This voltage should be held for 6 hours and final current, if monitored, should be 2% of the 20 hour capacity rating. If not the bulk / absorption charge should be continued.

Technical Assistance

Surrette Battery has built our business on providing direct and timely customer support / assistance. Please call our technical Assistance line if there are any questions or concerns;

T: 1 800 681 9914

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Lead Acid Safety

Batteries store electrical energy chemically and can be used and operated safely but caution and some basic principals should be kept in mind:

1. Batteries can cause ELECTRICAL SHOCK. Do not lay tools, wires or conducting materials across the tops of the batteries such that the positive and negative post or connectors can make an electrical short circuit. Always replace removed safety shrouds on batteries with external connectors.
2. Battery acid can cause SEVERE ACID BURNS. At a minimum, always wear approved safety glasses and rubber gloves. If handling large amounts of acid, such as when filling a dry-charged battery, wear goggles and a rubber apron. Wear a face shield if available or when very large quantities of acid are being transferred. Always add acid to water NEVER water to acid.
3. Lead acid batteries produce hydrogen, which can cause EXPLOSIONS. Never smoke or allow open flame around a battery on charge. Proper charge settings and procedures must be used and followed. See bulletin #507. Batteries should be vented when charging.
4. Lead acid batteries are extremely heavy and proper lifting procedures must be used to avoid personal INJURY. It is recommended steel toe shoes be worn when working around a battery.
5. Only fill batteries with distilled water or approved soft water. Fill to original level. NEVER fill batteries with seawater, as DEADLY CHLORINE GAS will be liberated.
6. If you ever have any questions, comments or concerns please call your dealer or Rolls directly at 1-800-681-9914 for assistance. MSDS's are available upon request.

Surrette

Measuring Specific Gravity

The most accurate and direct way to test the state of charge of a battery cell is to determine the specific gravity of the battery electrolyte. The higher the specific gravity of the electrolyte the higher the state of charge. The best way to truly monitor your system over it lifetime is to regularly take and record specific gravity readings.

Unfortunately hydrometers are not easy to use. Testing can be time consuming, there are possibilities for error and safety must be considered. For these reasons we present this bulletin.

Hydrometer Types

Hydrometers come in many sizes and shapes. We recommend a hydrometer with a float, contained in a glass vessel with a rubber bulb to draw the acid into the tube. Stay away from floating colored balls as the extra inaccuracy results in very subjective testing. The hydrometer should give you a numeric reading directly from the instrument. A good hydrometer is accurate to +/- 0.005 points so 1.265 could read from 1.260-1.270. The instrument accuracy should be known.

Checking Calibration

As with all measuring equipment drawing conclusions from the results is not worth the effort if the equipment is not calibrated.

The correct way to check the calibration of a hydrometer is to test the hydrometer against a known master that is accurate to one more decimal point. These hydrometers are; however, very expensive ($100-150 USD) and can be easily broken.

The simplest and cheapest way, when facilities exist, is to measure out a volume of acid and weigh it. A small graduated cylinder and an electronic balance are perfect. The specific gravity is then calculated as follows:

SG = Mass (g) / Volume (ml)

The metric units must be used to convert to the specific gravity scale based on water. The hydrometer is calibrated if it agrees with the sample within its manufacturing tolerance.

Method of Use

Exact procedures is instrument dependent and this is given as a general procedure and assumes a hydrometer with glass float and body.

1. Put on eye protection and rubber gloves. See bulletin 607, Basic Lead Acid Battery Safety Principals
2. It is recommended to disconnect the battery especially if on a high rate of charge / discharge.
3. Remove vent cap. Carefully insert the hydrometer into cell, not pushing down on the top of the plates.
4. Carefully draw liquid into the hydrometer and avoid "bumping" the hydrometer. Be careful the float is not flooded (too much liquid) or sticking to the sides of the glass tube.
5. Obtain a reading by looking directly at the float.
6. Repeat steps 3-5 to reconfirm reading.
7. RECORD the cell number and result.
8. If it is very warm or very cold correct the specific gravity for temperature. If the ambient temperature is fairly consistent and original gravities are taken when the batteries are put into

service temperature correction is not as critical and only necessary if problems arise. Make sure electrolyte is not hot if just taken out of service. Let it reach room temperature.

An easy procedure is to number the cells starting with the positive cell and move from cell to cell towards the negative terminal. If this is part of a preventive maintenance program it is helpful to number the batteries.

Temperature Correction

SG of acid is temperature dependent. If the temperature is very cold or very hot this can lead to incorrect readings. To correct for temperature use the following equations the equations or below 70ºF subtract points (0.03 per 10ºF) and above 70ºF add points.

- Correction factor = (0.331 x T/ºF - 23) / 100 or 0.03 pts per 10 ºF
- Correction factor = (0.595 x T/ºF - 12.5) / 100 or 0.03 pts per 5 ºC

This is valid for 0-130ºF or -17.8- 54.4ºC

Surrette

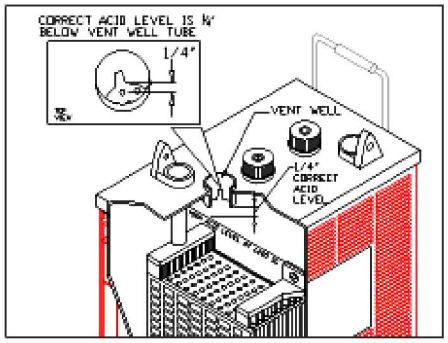
PM Charging & Activation

This bulletin describes preventive maintenance and recommended charging procedures to maximize battery life. The leading cause of premature battery failure is improper charging and poor battery maintenance.. To avoid battery sulfation, a lead acid battery must be equalized or given a controlled overcharge on a regular preventive basis. Equalization is very important and must be preformed correctly but only as required.

Preventive Maintenance

When a battery is first received the cell acid levels should be checked and the battery should be put on charge. After removing from charge the specific gravity readings of each cell should be recorded and kept for the life of the battery.. If the electrolyte levels are low before the battery is put into service do not add water but contact your dealer or Surrette Battery Company Limited. Only add water as it is consumed.

Preventive maintenance involves, at a minimum, checking th cell electrolyte level for correct acid volume once a month and equalizing once every six months. The cells should be watered back to the original acid level which is 1/4 - 1/2" below the bottom of the vent well (tube inside the battery cell with slots on each side). Distilled water is preferred but local water (not chlorinated) maybe acceptable if it is not "hard" or does not contain high iron levels. Use of non-distilled water can cause mineral build-up in the battery cell.



The minimum recommended preventive maintenance program is summarized as follows:

1. Water each cell to original level as required
2. Equalize as required or once every six months
3. Record the specific gravity readings of each cell every three months.

Occasionally cleaning the battery terminals and case / cover is a good practice and recommended. A weak solution of household baking soda and water can be used to neutralize any spilled acid (100 g per liter or 4 Oz per pint). Make sure the vent caps are securely tightened and NO soda solution gets into the battery cells.

Good record keeping is stressed as review of these records can help to determine the "health" of the battery and can prove invaluable if system problems develop.

When the bank is first put into service a pilot cell should be monitored to assure the batteries are being properly charged. Measure and record the specific gravity of the pilot cell when the battery is thought to be fully charged (after the bulk charge) and compare this with the previous reading.

State of Charge and Charging

The truest measure of a battery's state of charge is the SPECIFIC GRAVITY of the battery acid. The following shows the approximate state of charge at various specific gravities at 77ºF / 25ºC.

Charged	Specific Gravity
100%	1.265-1.275
75%	1.225-1.235
50%	1.190-1.200
25%	1.155-1.165
0%	1.120-1.130

Hydrometers can be difficult to use and at best accurate to +/-0.005 points. Please see Bulletin 606 for correct hydrometer use. Voltage can be used to estimate state of charge but caution must be taken when interpreting voltage readings. See, Bulletin 609, Voltage, Specific Gravity and State of Charge.

We recommend a three step charging procedure. Recommended voltage settings are as follows:

	Volts per cell	12V	24V	48V
Equalization	2.58 -2.67 (max)	15.5-16.0	31.0-32.0	61.9-64.1
Absorption/Bulk	2.37-2.45 (max)	14.2-14.7	28.4-29.4	56.9-58.8
Float	2.20-2.23 (max)	13.2-13.4	26.4-26.8	52.8-53.5

To calculate the correct settings for another battery bank voltage divide the total nominal voltage by two and use this number as a multiplier. For example a 18V system, 18/ 2 = 9, equalization preferred = 9 x 2.58 = 23.2 V

Caution: The ideal float voltage is the lowest voltage setting that will maintain the battery at full charge. The higher the voltage the more water the cell will consume. The minimum equalization voltage is highly recommended unless it is suspected a sulfation problem exists and a corrective equalization is required.

Absorption times are dependent on the battery series (4000 or 5000). The recommended times are general guidelines and the optimum time is dependent on absorption (bulk) voltage settings, charging current and should be adjusted such the batteries are brought back to full charge and use a small amount of water (approximately 5 ml (1/8OZ) of water per 100 AH of battery capacity per cycle assuming a 10% overcharge).

Absorption Time 4000 series		2 hours
Absorption Time 5000 series (CS, KS plate types)		3 hours
Equalization Time - Preventive		2-3 hours

Equalization - Corrective

Corrective equalization needs to be performed if symptoms arise such as a constantly running generator (low capacity) or the battery bank will “not hold a charge”. These symptoms are typical of a heavily sulfated battery. If a battery is not being fully charged on a regular basis or limited equalization is performed using a generator (see Bulletin 611, Generators, Inverters and Equalization) sulfation will occur from “deficit” cycling. This undercharge condition can take months before it becomes a major and noticeable problem. This under charge condition is caused when batteries are deficit cycled. The bank receives less of a charge each cycle and starts to sulfate. Eventually the sulfate will cause a resistance to charge and a “false high voltage” reading will occur. The “false high voltage” is measured by the charge controller, which further lowers the charging current to maintain the voltage set point. This further increases the undercharge condition. This is one reason why specific gravity measurements are so important as “false high voltage” readings can be misleading. See Bulletin 609, Voltage, SG and State of Charge for information on how to correctly interpret voltage readings.

Amperage hour meters can compound the problem and cause people to believe they are returning the correct amount of energy back into the batteries to maintain a good state of charge. Amp-hr meters should be thought of as simply a fuel gauge that does not measure state of charge directly but indirectly. The state of charge is determined by using an equation (peukert's equation). Sometimes there can be fundamental errors with factors used in these calculations. You should always confirm, at least initially, state of charge by taking a specific gravity measurement of one cell when it is thought the bank is fully charged.

Corrective Equalization - Method

Corrective Equalization can take a very long time depending on the degree of sulfation. It is not recommended to equalize with a generator as some generators produce low grade AC that is not properly filtered by the inverter. This is especially true at higher voltages.

1. If you have hydrocaps remove during equalization.
2. Set charging controls to the highest voltage allowable by the charge controller (inverter). If the bank is severely sulfated or available current is very limited, charge control can be removed or by-passed. Temperature should be monitored very, very closely and keep below 125ºF.
3. Charge at a low DC current (5 A per 100 AH of battery capacity). If grid power is not available use solar panels or a good DC source when possible. At high voltages, charging with generator can be difficult and hard on the inverter.
4. Once an hour, measure and record the specific gravity and temperature of a test cell. If the temperature rises above 115ºF (46ºC) and approaches 125ºF (52ºC) remove the batteries from charge. (For temperature measurement choose a center cell, if applicable).
5. If severely sulfated, it may take many hours for the specific gravity to rise.
6. Once the specific gravity begins to rise the bank voltage will most likely drop or the charging current will increase. The charging current may need to be lowered if temperature approaches 125ºF (46ºC). If the charge controller was by passed, it should now be used or put back in line.
7. Continue measuring the specific gravity until 1.265 is reached.
8. Charge for another 3 hours. Add water to maintain the electrolyte above the plates.
9. Allow bank to cool and check and record the specific gravity of each cell. The gravities should be 1.265 ± 0.005 or lower. Check the cell electrolyte levels and add water IF necessary.

To avoid this situation it is recommended that a specific gravity reading of one pilot cell is measured and recorded on a regular basis when it is thought that the bank is fully charged. The measurement should be compared to previous readings. If the measurement is lower than the previous reading a longer absorption time and higher voltage setting should be used. Note as stated above, the longer the absorption time and the higher the bulk voltage, the more water will be consumed but less equalization will be required. Note: the specific gravity should rise as the cells use water. Look for trends in the specific gravity over a period of time and make very small adjustments as necessary.

Caution: If you have HYDROCAPS, remove during equalization.

Pulse Charging

Pulse charging, has shown, that banks do not get as severely sulfated as ones with traditional 3 step charging when subjected to the same undercharge conditions. Pulse charging will lower the degree of sulfation but it will not eliminate the need for a controlled, preventive equalization. The benefit of pulse charging, is the bank will need less overcharge and hence less maintenance.

Battery Additives

Most battery additives are mainly a form of a common preservative, EDTA. These additives help to increase the solubility of the sulfate in the electrolyte (common salt effect). Some additives contain cadmium sulfate and this could cause disposal problems in the future. These additives are not beneficial and are not recommended.

Surrette

Specific Gravity and State of Charge

This bulletin describes how to correctly use and interpret both specific gravity and voltages readings and how to determine when your battery bank requires charging.

Specific Gravity Readings – "True" State of Charge

The specific gravity (SG) of the battery acid or electrolyte is the truest and most absolute measure of a battery's state of charge. The SG reading is NOT greatly or adversely affected by the load on the battery. Basically if a battery is 50% charged, it will read a specific gravity of 1.200 (see Table 1), regardless of whether the battery is on charge, being discharge or being stored. This is not the case for voltage readings.

Table 1. SG vs. Voltage

% Charged		Specific Gravity
100%		1.255 – 1.275
75%		1.215 – 1.235
50%		1.180 – 1.200
25%		1.155 - 1.165
0%		1.110 - 1.130

Voltage Readings

Voltage readings will vary and are greatly affected and dependent on whether the battery is being charged, discharged or in storage (rest or "open cell" voltage). There are two terms for voltage readings:

1. Load voltage (voltage under load or on charge)
2. Open cell voltage.

Charge Voltage: When a battery is charged the plates will polarize and develop a resistance to the charge (surface charge). This resistance will add to the battery voltage and therefore using this voltage reading will not reflect the true state of charge. All the so-called "surface charge" will be removed when the battery is being discharged. In general, the battery voltage will recover or increase when the load is removed. This is especially true if the load is very high.

Open Cell Voltage is determined by taking all the loads off of the battery and letting the battery stand for at least 4 hours before taking a reading. This allows the surface charge to dissipate. To get around this problem either use table 2 or determine the 50% state of charge as described.

Determining the 50% state of charge Voltage Reading

Most three steps chargers or inverters monitor the voltage and have an adjustable set point that determines when the batteries are low (50% discharged) and should be charged. Once this set-point is reached the inverter will either sound an alarm or start a generator or tie the battery bank back into to grid power. The voltage set-point maybe factory set but could require verification. Consult your inverter manual for the section on “Cut-off voltage” or “Over discharge protection”. Since the voltage will change depending on whether or not the bank is on load the set point can be determined by a specific gravity reading. A gravity reading of 1.200 is equal to 50% discharged.

Battery cable lengths, system set-up and other variables can affect the voltage readings as well. Below is a procedure to verify the 50% mark and table 2 gives approximate cut-off voltages at various state of charge. Notice 100% is given as an open cell voltage and all other as under load.

When using a generator with a low voltage cut-off, set the generator to start at the 50% mark given by table 2 and put the bank into service (11.6 V for a 12V system). When the generator starts-up measure the specific gravity of one cell in the bank. Compare this to the table 1, Specific gravity versus state of charge. If the measured specific gravity indicates the state of charge is more than 50%, decrease the low voltage cut-off setting. Similarly if the specific gravity indicates the state of charge is lower than 50%, increase the low voltage cut-off setting. Note: 50% is the desired depth of discharge but it does not have to be exactly 50%. For practical purposes a range of 45-55% is acceptable. The actual battery voltage corresponding to 50% will change with a change in load. In general, the higher the discharge amperage, the lower the corresponding voltage.

To determine or verify the 50% voltage set point:

1. Put all or as many loads as possible on the battery. Disconnect any in coming current inputs such as panels / windmills and grid power. Contact your dealer for specifics.
2. Take the specific gravity of one cell.
3. Take another reading 15 minutes and ½ hr later this should give you an indication of how fast the batteries are dropping.
4. Continue to take readings until 50-55% state of charge is reached according to the specific gravity readings.
5. Take and record voltage readings (when on load) of any meters to be used for monitoring the state of charge and take a voltage reading across the terminals of one battery.
6. Compare to table 2.
7. These readings will then give you a very accurate voltage reading which can be used in the future either as a set point for the inverter or as a day to day monitoring parameter.

Table 2.

% Charged	Single Cell	12V	24V	32V	48V	
100%	2.10	12.60	25.20	33.60	50.40	OPEN CELL
75%	2.01	12.06	24.12	32.16	48.24	UNDER LOAD
50%	1.93	11.58	23.16	30.88	46.32	UNDER LOAD
25%	1.84	11.04	22.08	29.44	44.16	UNDER LOAD
0%	1.75	10.50	21.00	28.00	42.00	UNDER LOAD

Note: This will give you a very good idea on how your battery bank will behave and how long it will last with no power inputs. New batteries will give about 75% of the specified capacity until the battery has been cycled 40-60 times (1-3 months of service).

Surrette

Warranty

We build one mean battery and we back them with comprehensive warranties that lead the industry in length of coverage. We're confident that our batteries will perform time after time, year after year. But should a problem arise, you can be confident that you're covered better than any other battery warranty in the business.

Surrette, herein referred to as the Company, warrants that batteries sold by it are merchantable and free of defects in workmanship and material at the time they are shipped from the Company's factory.

In the event that the Company makes a drop shipment to a distributor's customer, that customer must be instructed to perform an inspection of the goods BEFORE signing the delivery slip. The Company is not responsible for damaged product reported after shipment has been signed "Received in Good Condition". NOTE: ALL SHIPMENTS SHOULD BE THOROUGHLY INSPECTED FOR DAMAGE BEFORE SIGNING THE DELIVERY SLIP.

The Company will replace or, at its option, repair any Rolls Marine Battery sold by it that fails to conform to the warranty stated above on a NO CHARGE BASIS as follows:

SERIES 3000

Failure within 18 months from the date placed in service yields FREE REPLACEMENT, not including freight charges from the factory to the applicable destination. After the first 18 months of service, defective batteries will be adjusted for a period of up to 48 months prorated from the date first in service at prices in effect at time of adjustment.

SERIES 4000

Failure within 24 months from the date placed in service yields FREE REPLACEMENT, not including freight charges from the factory to the applicable destination. After the first 24 months of service, defective batteries will be adjusted for a period of up to 60 months prorated from the date first in service at prices in effect at time of adjustment.

SERIES 5000

Failure within 36 months from the date placed in service yields FREE REPLACEMENT, not including freight charges from the factory to the applicable destination. After the first 36 months of service, defective batteries will be adjusted for a period of up to 120 months prorated from the date first in service at prices in effect at time of adjustment.

To claim a manufacturing warranty, proof of purchase must be presented, showing the date of purchase and the battery's serial number. The battery must be tested by an Authorized Battery Outlet for actual defect, and upon confirmation of the defect, the warranty will be administered.

The Warranty does not cover shipping damage, cracked covers, cracked cases, bulged cases from heat, freezing or explosion, discharged batteries, the use of undersized batteries damaged from electrical equipment. This warranty covers only manufacturing defects.

The Company makes no warranty with respect to its batteries other than the warranty stated above. All implied warranties of merchantability and all expressed and implied warranties of any other kind are hereby excluded.