BACKWOODS SOLAR SUMMER 2007 NEWSLETTER

IN THIS ISSUE:

****

ALL ABOUT BATTERIES Revisited

As we published in our Fall 2005 Newsletter, BATTERY CARE is your primary responsibility with home made electricity. This component is the one part of your power system likely to be harmed by neglect or misuse. Lead-acid batteries, the standard in home energy, should not be discharged more than 50%. Ideally, they should be recharged to 100% promptly. They can be damaged by undercharging, continued overcharging, or contamination.

Common causes of battery failure are sulfate buildup, loss of electrolyte, undercharging, and old age. As batteries discharge, lead sulfate forms on a battery's positive plate. In principle, recharging converts the lead sulfate back to its component material – lead, lead dioxide, and sulfuric acid. However as batteries age, recharging has a more difficult time converting lead sulfate and it can crystallize. This buildup is accelerated by temperatures over 70 degrees; discharging a 2 volt battery cell below 1.75 volts; and extended storage or use without a 100% recharge.

REMEMBER: Do not store batteries without periodic recharging. Continual self discharge when not in use can ruin even a brand new set of batteries.

Loss of water within the electrolyte solution is a natural process which occurs during the recharging process and if not corrected can lead to plate exposure and oxidation. Repeated undercharging causes lead sulfate to harden and crystallize on the positive plates. And as batteries age, plate material sheds and falls to the bottom of the battery eventually shorting the plates. This shedding is accelerated by sulfate buildup.

Proper care begins with proper programming of your solar, wind, and/or micro-hydro's charge controller and your inverter's battery charger. If this programming is a mystery to you, PLEASE call us. It is critical that we enter proper set points on all charging devices. We will happily walk you through these steps.

On a daily basis, Backwoods Solar discusses the state of charge of a battery bank with our customers. On many occasions we hear that a battery meter such as the Trimetric Battery Monitor indicates a battery bank is almost full but loads on that bank are behaving as though the battery state of charge is low. We ask if the Trimetric's reading has been confirmed with an

hydrometer which measures the specific gravity of the battery's electrolyte, and almost universally it has not. This mistake can cause irreversible damage to a battery bank if not detected within a few short weeks.

Please realize that the Trimetric meter is only as good as the programming which gets entered into it. It is critical that an hydrometer is used in conjunction with the Trimetric meter on a routine basis to confirm that the Trimetric is accurately programmed. As the Trimetric and hydrometer readings are compared, the Trimetric's parameters can be fine tuned to insure that what it is telling you is reliable. The Trimetric is a great visual aid and once programmed properly can be relied on for weeks at a time but you should always return to the hydrometer every few months to affirm the Trimetric's readings still reflect the batteries actual state of charge.

The vast majority of the batteries that Backwoods Solar sells are the Trojan flooded lead acid batteries. In an effort to constantly refine our battery care understanding, we occasionally present to Trojan, situations in which Trojan batteries have failed prematurely. These failures are rare and therefore, in our opinion, warrant investigation.

The following correspondence is an example of our working with Trojan and it offers a valuable review of Trojan's recommended battery care.

A system user wrote:

I have a hydro system that generates roughly 20 amps for my 24v system and I use 8 Trojan L16H batteries. The batteries are kept unboxed, in an un-insulated, outside power shed and temps can drop to minus 20 F.

My set of 8 Trojan L16Hs has lasted only 2 years and 10 months and two cells in two different strings have just failed. Using a temperature compensated Morningstar Tristar 45 controller, I have 29.6 bulk and 27.0 volt float settings and an equalization setting of 31.0 volts. Equalization occurs every 60-90 days.

Each set of batteries would fully recharge at least 4 times a week. Maximum depth of discharge: 45% but typically only 30% or less. Load amps can reach

200 as we have an electric hot water heater, toaster, microwave, coffee pot, etc which can run simultaneously but this massive load only lasts for 5-6 minutes (otherwise the inverter shuts down due to overload ☺). Voltage can dip to 23.5 or less in the cold of winter with this 200 amp load in place. Typically the longest running combination of loads is 60 amps and voltages remain above 24.0.

Why do I have cell failure??
1) Are my set points too high and I'm therefore cooking the cells?
2) Should the L16H be deeply discharged occasionally?
3) Is it the cold?
4) Does a battery need a much larger charge rate then I offer (only 20 amps into an "840" amp-hr bank)?
5) Is it the 200 amp load?

And Trojan replied: (Backwoods Solar has highlighted key points)

1) Our recommended charge voltage is 29.6VDC for a 24V system (14.8v for a 12v system and 59.2v for a 48v system), so there is absolutely no harm done in operating/charging at this voltage level. We would expect the 29.6 voltage to be held for a couple of hours prior to it dropping to the float level. 27.0VDC (13.5v for a 12v system and 54.0v for a 48v system) is also the recommended value for float, so there is no damage (or "cooking") of cells being done as a result of the operating float voltage either.

2) I consulted with two design engineers on this question and both of them agreed that only performing shallow discharges (10-15%) does not introduce any harm to the batteries in your system. The daily charge routine of 29.6VDC is perfectly fine with shallow discharges only. Additionally, Trojan has no evidence that an occasional deep discharge provides any added benefits. In both cases, the engineers stressed that equalizing the batteries is the key component to keeping batteries in a healthy state, especially L16's. The values we currently recommend for L16h's in a 24VDC system are 31.0VDC (15.5v for a 12v system and 62.0v for a 48v system) every 30-60 days. If a battery bank is inactive, a periodic light/moderate discharge (15-50% DOD every 90-120 days) then 100% recharge should be performed.

3) The basic rules on hot/cold:

-Cold is known to significantly decrease a battery's capacity (but not life);
-Heat (Temp's 90°F and above) are known to significantly decrease a battery's life.
-Severe cold (-20°F) can freeze a battery (causing severe damage) that is discharged more than 40% of its capacity (60% SoC).

4) The charge rate of 20 amps into a bank size of 840AH is small. The right range of values is 10-20% of your total system capacity (~80 to 160 amps). Although, most Trojan literature will suggest a 10-13% range, over-sizing your charge rate (up to 20%) to compensate for less efficient solar panels (aging, overrated, etc) and lack of sunlight is acceptable. Charging at a low rate can cause undercharging (if proper voltage levels are not achieved). Undercharging batteries (especially L16's) creates an accumulative degrading effect which can be seen anywhere from a few weeks to a few months time. Specifically you will notice:
- decreasing specific gravity values (after charging)
- decreasing (lower than usual) discharge voltages
- decreased runtimes
- eventual cell failures (if neglected over many months time)

However in regards to this issue of adequate charge current, charge rates can be decreased if the following conditions exist:
-Specific gravity values consistently stay above 1.270
-Equalizations occur monthly (every 30 days for L16's)
-Discharge levels remain @30% or below
-Constant monitoring of system voltages, and gravities to ensure system balance.

5) The high discharge rates (of 200+ amps) for 5-6 minutes are perfectly acceptable for L16 batteries (even T105's). There is no concern with the loads (or equipment) you listed. The L16's should easily be able to carry a load of 200 amps for 45 minutes from a 100% SoC. However, I would expect at least a ~2.0V immediate drop in the voltage of the 24V bank. This would coincide exactly with the 23.5V measurement you were seeing.

Craig Quentin Technical Support Engineer
Trojan Battery Company

Backwoods also sells the Surrette line of flooded lead acid batteries and recently, a conversation that took place online between Renewable Energy "wrenches" prompted this response from Jamie Surrette. It also contains valuable battery care details for Surrette batteries.
(Backwoods Solar has highlighted key points)

Hello Wrenches,

Several weeks ago there was a discussion thread involving our (Rolls/Surrette) batteries and some charging difficulties that were being/had been experienced. To all of you that were kind enough to discuss these issues with me, I would like to extend our appreciation for your time, input and transfer of knowledge. These discussions have resulted in the development of a revised Charging Bulletin.

A brief background;

When we entered the RE/Solar market with some vigor in the mid-90's. The resounding requirements put forth by the industry were;

i) Capacity and
ii) Cycle-life/durability

In fairness, these were really a combined request with the feeling that this was "needed" to survive in the RE/Solar market. From this, we tweaked and developed our products over the past decade. However, as we have seen, another major component is the "ability" to charge the battery (bank), which is compromised in order to attain capacity & cycle-life. As systems have grown dramatically, undercharging has become a significant hindrance to battery performance. Essentially, there are only a few ways to over come this hurdle;

i) Increase the charge capacity (not practical)
ii) Increase the charge voltage (described in Bulletin 614 found below)
iii) Lower the internal resistance (we are working on it!).

Earlier charge voltage settings/recommendations were a product of past practice and, as we have found, erred on the side of caution. We feel the guidelines in Bulletin 614 will be of benefit to those who are experiencing any difficulty in attaining 100% SOC with our product and I hope this creates some dialogue.

Regards,
Jamie

James Surrette
Surrette Battery Co. Ltd
****

Surrette 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 and 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 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 to avoid 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 panels (micro-hydro and/or wind turbines) and a battery bank. With these components the following voltage settings are recommended:

Charge Stage	Absorption / Bulk	Equalization	Float
Volts per Cell	Min * Mean * Max	Min * Mean * Max	Min * Mean * Max
2V	2.40 * 2.45 * 2.50	2.58 * 2.63 * 2.67	2.20 * 2.22 * 2.23
12V	14.4 * 14.7 * 15.0	15.0 * 15.8 * 16.0	13.2 * 13.3 * 13.4
24V	28.8 * 29.4 * 30.0	30.8 * 31.6 * 32.0	26.4 * 26.6 * 26.8
48V	57.6 * 58.8 * 60.0	61.6 * 63.2 *64.0	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 voltage 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 be checked 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 (copied below), 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 (as is often the case with most Backwoods Solar customers) (C/20 min) and loads are large then the batteries will require a higher (max) 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 (copied below) 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" as required (when cell specific gravities vary from highest to lowest by +/- 0.015 or once every six months) 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 115°F in temperate climes. (125°F in hot ambient conditions).

Recommended Opportunity Equalization voltage settings are as follows:

	Volts per cell	12V	24V	48V	Duration
Equalization	2.58 -2.67 (max)	15.0-16.0	30.8-32.0	61.6-64.0	2-3 Hours

Grid tied systems-Back up battery banks
(Backwoods Solar does not recommend a flooded lead acid battery for grid-tied systems where the battery bank will rest at a float voltage most of the time.)

Normally these systems see very little cycle service and, at most, are cycled once a month. If cycled, the banks should be charged for 3 hours 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 checked 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

****

From Surrette Bulletin 609, Voltages, 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

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.

Load 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

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. A gravity reading of 1.200 is equal to 50% discharged.
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 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: 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. This procedure 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).

****

From Surrette Bulletin 605:

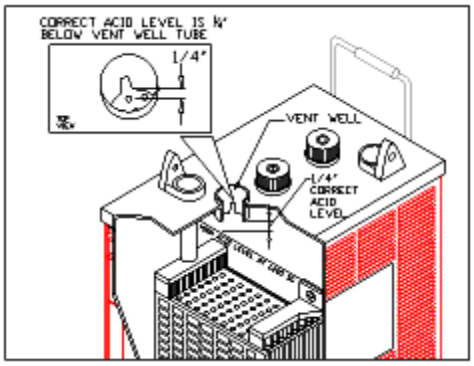
Preventive Maintenance, Charging and Equalization

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 performed 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 the cell electrolyte level for correct acid volume once a month and equalizing as required (when cell specific gravities vary from highest to lowest by +/- 0.015) or at least 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) may be 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 (when cell specific gravities vary from highest to lowest by +/- 0.015) 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.

Recommended Preventive Equalization 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

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

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 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.

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.

1. If you have hydrocaps remove during equalization.

2. Set charging controls to the highest voltage allowable by the charge controller (inverter). (16.4/32.8/65.6v if possible for 12/24/48v systems) 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 125°F.
3. Charge at a low DC current (5 A per 100 AH of battery capacity). If grid or generator 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 115°F (46°C) and approaches 125°F (52°C) remove the batteries from charge. (For temperature measurements 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 125°F (46°C). 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 be 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.

****

In conclusion, we (Backwoods Solar) applaud you for wading through all of this information. At this time, we would ask that you review the highlighted information specific to your make of battery. Now lets double check the various set points that you have programmed into your charge controller and inverter. If you need any assistance, do not hesitate to call us (208-263-4290). We want to insure you understand your batteries and their care.

Now use your hydrometer to measure the specific gravity in every cell; record this information; select a pilot cell; and make a note to measure this pilot cell's specific gravity whenever your batteries are supposedly fully recharged. If you find the specific gravity is not reaching 1.265 or higher, then we need to increase bulk voltage set points and/or absorption times. And finally, insure the connections to the battery posts are tight. Connections can appear snug but may not be tight. Lead is a soft metal, and your connections can loosen over time. Resistance due to a loose connection will adversely affect battery charging and discharging. At least once a year, check those connections. If needed, tighten them.

HYDROMETERS by FRANCIS L. FREAS GLASS WORKS Inc.

Backwoods Solar considers the hydrometer essential to battery care. As a result, we include a free hydrometer with every battery purchase. However not all hydrometers are created equal. Our free hydrometer is good but we have decided to contract with Freas Glass Works to produce an even better hydrometer for us.

Since 1905, Francis L. Freas Glass Works Inc. has manufactured products that are hand made by skilled professionals using only the finest American made materials. All of their products are guaranteed to remain accurate throughout the entire life of the instrument.

The hydrometer they have built for Backwoods Solar is a big, rugged instrument with a clear easy reading scale. The float has bumps to eliminate its sticking to the barrel; a specific gravity scale of 1.100 – 1.300, graduated in 0.002 degree divisions; and is guaranteed accurate. The barrel is a shaped type, well annealed, free from strains, and correctly proportioned. The 2 ounce rubber bulb and end piece are made from the highest grade acid-

resistant rubber. The end piece has a square flange to prevent rolling and a 3" tube. Overall length of this assembled hydrometer is 18 inches.

CALL 208-263-4290 or VISIT our online Catalog to order your
Deluxe Freas Hydrometer: $35.00

****

TROJAN and CONCORDE BATTERY PRICE HIKES

Unfortunately we must adjust our Trojan and Concorde battery prices. Since January 1, 2007 the price of lead has risen 40%. Over the last 4-5 years the price of lead has risen 300%. We have had several price increases since we published our 2007 catalog and find it necessary to finally change our Trojan and Concorde battery prices.

Effective July 1, 2007, the following prices will apply:

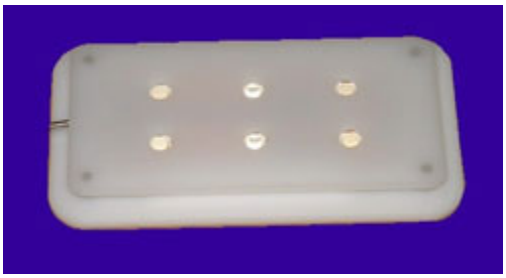
TROJAN: T-105: $112.00; L-16H: $295.00

CONCORDE: B-2580L: $694.00; B-2120L: $486.00; B-2240: $254.00

Additionally, Trojan tentatively plans to raise prices again on August 1, 2007. In our experience, when one manufacturer raises prices, the other manufacturers follow due to the commodity nature of lead. We may need to increase our prices again.

FREE UPGRADE for your E LIGHT 3 and 6 FIXTURES

From the manufacturer:



Dear E Light owner,

Since introducing the E Light we have discovered some ways to improve the product resulting in cooler operation and better LED life span. We are offering to

make these improvements to your E Light and do any general repairs required **free of charge**.

To have your E Light improved and refurbished simply mail it to our address listed below with your return shipping address. We will make the modifications and any needed repairs and mail your light back to you within two weeks.

Please mail your E Light to:
Plan 9, Inc.
Box 1983
White Salmon, WA 98672

Your Return Shipping Address:

Name_____

Address_____

City, State, Zip_____

If you have any questions about our offer please call us at 509 493 3850 or email us at mark@starstik.biz.

Thanks
Plan 9, Inc.

****

RENEWABLE ENERGY "HELPERS" NATIONWIDE NEEDED

Historically, Backwoods Solar has maintained a list of Solar Helpers. This list represents installation services offered by licensed electricians, certified solar experts, etc.

However we have found that the vast majority of our customers want to install their own systems and would actually like to visit or speak with or write a "neighbor"

that has a renewable energy system in place, prior to their installation.

To facilitate this interaction, Backwoods Solar would like to compile a list of people nationwide that have renewable energy systems if they're willing to let interested individuals contact them. We would maintain a list of Renewable Energy Helpers on our website and only release the information approved by the Renewable Energy Helper. This information may include a physical address, a phone/fax number, an email address or any combination of these details. We respect the privacy of anyone willing to share their renewable energy system with others and we want it to happen on their terms.

You may find that your county inspector requires a licensed electrician to sign off on your installation and you may want that electrician's assistance in general. We know that the experience gained by "doing-it-yourself" is invaluable. You will remove the mystery of running your own power station and you will develop an intimate understanding of each component. This familiarity simply doesn't happen if you do not participate in the installation process.

So if you share our opinion and would be willing to open your home to those folks that are new to this renewable energy arena, please let us know.

The photo shows Terry Graybeal (Backwoods Solar employee) and his wife Martha at their hydro intake.

****

SOLAR MODULE AVAILABILITY and WARRANTY UPDATE

Unlike the summer of 2006, Backwoods Solar has a very good supply of the solar modules that are still available to us.

Since we published our 2007 catalog in April, Kyocera Solar has chosen to allocate their KC65 and KC85 modules to another market segment and therefore we can no longer offer them to you. Their supply of the KC130

has improved significantly and our advertised lead times of 2-8 weeks is realistically 1-4 weeks. As usual we do have the KC130 in stock at another distributor for immediate shipping but the price is higher.

Kyocera has also revised their KC-Series limited warranty to include a one year limited PV Module warranty (to be free from defects and/or failures for 1 year from date of sale) and a Limited Power Output Warranty of 20 years (90% of the original minimum rated power specified at the time of sale for 10 years from the date of sale; and 80% of this power for 20 years from the date of sale.)

The Unisolar US64 watt amorphous module is in stock at Backwoods for immediate shipping and we do not foresee a shortage in the near future. The US64 warranty has not changed.

SolarWorld modules are also in stock at our distributors. The SW165 and SW175 continue to ship truck freight so we do need to get a freight quote when these modules are ordered. SolarWorld threatens to produce an 85 watt module but until we see it, we won't believe it. The SolarWorld warranty has not changed.

And unfortunately Evergreen Solar has discontinued their Cedar line of modules. We have sold out of the EV120 modules and we only have a few EV115 modules left in stock.

Photo courtesy of Jay Beedle in SE Alaska. Please visit Jay's website www.harvandmarvs.com to find out more about Jay's off-grid living tours!

****

YOUR STORY for our NEWSLETTER WANTED

Backwoods Solar would like to share your "off-grid" story in our newsletter and we would offer a $150.00 credit on your Backwoods Solar account in exchange for a story that gets published. We would look for a discussion of your renewable energy system and its integration into your way of life. It can be more or less technical and should include photos. Email submissions are preferred but we will happily entertain all forms of entry. If you have any questions, feel free to email us info@backwoodssolar.com or give us a

call 208-263-4290 or mail us: 1589 Rapid Lightning Creek Rd; Sandpoint, ID 83864.

We'd like to thank Marcia Pimentel for submitting the first story which follows and concludes this newsletter.

****

THE PRESENT MOMENT: A RENEWABLE RESOURCE

By Marcia Pimentel
dragonfly.marcia@gmail.com

Living reclusively in the storybook hills of Tennessee has its drawbacks but most days I can't think of what those are. Simplicity and off- grid life go together like a tree and its roots. One feeds the other and one bears fruit. For the past two years, I've lived primarily alone in the woods, toting water to drink from the spring branch that scurries alongside the cabin. What began as a very simple life without electricity or running water in a small Shasta travel trailer has evolved into a simple life in a log cabin wired to a Xantrex 4024 and a solar array presently totaling 1145 watts. I still

only plug in the computer and the telephone but now I've a small Sundanzer refrigerator, and at night a lovely 13 watt compact fluorescent lights up the loft so I can read. A person doesn't need much else.

Simplicity is mindfulness in action, an awareness of the present moment. The cultivation of mindfulness was never as important as it was in kindergarten, until all the talk of being in the present moment started to circulate. For all the buzzing about of "the present moment," few of us speaking realize that we are not in it. Few of us really understand the concept of the present moment, not because it is a matter of quantum mechanics, but because we are naturally resistant to what we understand as inaction. Action and results, we think, give meaning to our time. Time is but a theory however. Einstein said we needed time so that everything didn't happen all at once.

> *The **atomic moment** is a brief stop, a duration of immobility that lasts an estimated 1/64,000 of a second. It is caused by resistance (usually gravity) to the forward movement of the object in motion. During that brief moment all cosmic action is stopped…*[i]

We measure time giving it the illusion of continuous forward movement. Some describe it with a definite beginning and a definite end. Practically speaking, time is the practical solution to an unknown. It is a

convention. It can easily be the duration of non-movement, the state of matter between changes.

> *Each moment is separated by an action we identify as the quantum leap. The length of the leap is variable, depending on the amount of positive force the object has absorbed, thus counterbalancing the moment. Velocity (the leap) then, is variable, while time (the moment) remains constant…It is during the leap that a quantifiable amount of energy is instantly lost, gained or changed in some way. Because change has occurred* ***during*** *the leap, the next moment brings with it a new state of existence…It is the atomic moment that we sense as* ***time*** *or, more aptly,* ***the present****.*

A "quantum leap," is an infinitesimal change in one regard, movement, yet it brings with it a "new state of existence." Consider that each present moment brings with it a new state. The present, as a discontinuous movement, is ever-arising. Departures are ever-arising. This seemingly extraordinary opportunity is accessible to anyone, anywhere, at any moment. In fact it is not extraordinary at all; it is rather ordinary. Being in the present moment is the natural state of the cosmos.

Though the present moment is accessible everywhere at every moment, many of us, cluttered to our eyeballs in obligations and distractions, couldn't find it with a bloodhound at high noon. We have to stop outside of our daily lives in order to orient ourselves at all. And it requires effort. Not a laborious effort, like pedaling a bicycle up a steep grade, but a steady one, like riding the brakes down the hill on the other side.

The present moment is a gift freely given by the cosmos. Freely accepted and cultivated, our gift brings inner peace and clear vision. It can be our gift back to the world. The gift of one person living mindfully and simply gives one more contribution to a world of peace, the only viable way of life. And it can begin right now.

Time, whether measured by a clock, a calendar, or not measured at all can be understood as a continually renewing process. There is a fresh twenty-four hours every day. Each hour has a fresh sixty minutes. Each minute, a fresh sixty seconds and every second has a multitude of opportunities for a new beginning freely available for the taking. Going to the woods, or to the mountains, or the ocean, or lake, or that special place you've created in your mind but have yet to locate geographically, is the first step.[2]

"He who can no longer pause to wonder and stand rapt in awe, is as good as dead; his eyes are closed." (Albert Einstein)

---

[1] Boisvert's Discovery of the Discontinuity of Motion© by Wilfrid Boisvert;
Presented for the Web by Gordon Smith and Adrien Boisvert.
Copyright 1996: Gordon Smith.
http://www.islandnet.com/~gds/Homepage.html#Discontinuity%20of%20Motion

[2] Ditching the television is the second step.