PROPER BATTERY CARE

It is critical to regularly monitor your battery bank to ensure proper performance and longevity. With proper maintenance and care, your battery bank can provide years of reliable and trouble free power. Two proper tools that are critical to battery maintenance: These tools can be had at popular outlets like Canadian Tire for around $30.00

1. A voltmeter-allows to you to measure DC voltage
2. A Hydrometer-allows you to measure the battery's specific gravity.

Hydrometer

It is important to choose a hydrometer with a weighted bulb and cylindrical stem, which will float upright in a glass cylinder. Fluid is drawn into the glass cylinder and the weighted bulb will float and registers the density of the electrolyte.

Voltmeter

This is just a simple voltmeter that allows you to measure DC voltage. Both these tools are critical to monitoring battery voltage. Both the hydrometer and Voltmeter can be purchased for less than $20.00.

It is critical to monitor Specific Gravity (SG), as specific gravity readings provide the battery's charge level and health. It is important that specific gravity test are performed once a month to ensure batteries are properly monitored and any deviations can be corrected before they become a problem.

CHARGING CYCLES

Most modern chargers have a 3-stage charging cycle: 1) Bulk 2)Absorb 3) Float

1. **Bulk**: The bulk cycle applies the full charge capacity to the battery bank until it reaches its bulk voltage setting. Bulk voltage is typically set at 58.8V / 29.4V / 14.7V

2. **Absorb**: During this cycle, the charge current is reduced as needed to maintain the absorb voltage. The Absorb cycle is where is where the battery capacity is fully restored. If the absorb cycle is not long enough, the batteries will experience constant undercharging, resulting in sulfated batteries. The absorb voltage setting is typically 58.8V / 29.4V / 14.7V. Most absorb cycles are set between 120-180 minutes.

3. **Float**: During this cycle, the batteries are considered fully charged, so a slight charge is applied to maintain charge. The voltage setting for this cycle is typically 56.4V / 28.2V / 14.1V

ADDITIONAL NOTES: ABSORB CYCLE

1. While typical absorb times are between 120-180 minutes, it is important to monitor the battery bank to ensure that your particular absorb cycle is correct.

2. How do I know my Absorb cycle is long enough?
   As the battery reaches fully charged, the rate of charge is reduced. For most batteries, a rate of charge (ROC) of C/50 indicates a full battery. As a rule of thumb, once the ROC = C/50, the absorb charge cycle is complete. It is recommended when the system is first put into operation that the batteries specific gravity is checked once a week after the batteries transition to float. The specific gravity should return to 1.260-1.270. If the specific gravity has not reached this level when the absorb cycle is complete, the absorption time needs to be increased.

3. How do I calculate the Rate of Charge (ROC)?
   ROC = Output from the charging source (either the solar array or inverter/charger) AND C = Battery bank capacity
   C/50 = ROC. If you have a 370AH battery bank, the formula is as follows: 370AH/50 = 7.4AH.
   So, with a 370AH battery bank, the charging source needs to remain in absorb until the charge rate reaches 7.4 amps. So, take some time to monitor your system and ensure the absorb cycle remains in absorb until the rate of charge equals C/50.

4. Programming changes. If you need to change the absorb time, modern inverter / chargers can be supplied with a system remote, which will allow system programming changes. All SUNFIND CTTG and SUNFIND HP Systems include the appropriate system remote to make these changes.

It is important that the batteries experience the programmed absorb cycle each charge cycle. The reason for this is if a battery is continually undercharged, it will sulfate and its life will be significantly shortened with a noticeable performance drop. A sulfated battery also requires lengthy equalization cycles to restore the battery. And in some cases, the battery can be damaged beyond recovery. Battery denegation due to improper / undercharging is not covered under warranty! In the winter months, it is important to have the generator set-up to start charging if the batteries reach 50% of charge (48.5V / 24.3V)

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HOW CAN I AVOID THIS MAINTENANCE?!

NEW! 6V AGM Deep Cycle
With the advent of new technology, large, 6V AGM batteries are now available. There are several benefits associated with AGM Batteries: Sealed, maintenance free, non spill able, more efficient. This increased efficiency means it takes the solar array less time to recharge the solar array and less generator run time is required during the winter months.

INSPECTION AND PREVENTATIVE MANTENANCE:
Recommended Items
Distilled Water
Voltmeter Hydrometer
Goggles & Gloves

CAUTION: Always wear protective clothing, gloves, and goggles when handling batteries.

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 the battery manufacturer. 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 according the “equalization schedule” on page 3 . The cells should be watered back to the original acid level which is 1/4 " below the bottom of the vent well. 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 according to the “equalization schedule” on page 3
3. Record the specific gravity readings of the “pilot cell” every month.
4. Record the specific gravity of each cell before and after the equalization in September, December and April.

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. **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.

Specific Gravity Test
1. Do not add water at this time.
2. Fill and drain the hydrometer 2 to 4 times before pulling out a sample.
3. Ensure the hydrometer is not “sticking” to the side of the tube.
4. There should be enough sample electrolyte in the hydrometer to completely support the float.
5. Take a reading, record it, and return the electrolyte back to the cell.
6. To check another cell, repeat the 3 steps above.
7. Check all cells in the battery.
8. Replace the vent caps and wipe off any electrolyte that might have been spilled.
9. Correct the readings to 27 Degrees C (80 F):
   Add .004 to readings for every 10 Degrees C over 80 Degrees F
   Subtract .004 for every 10 Degrees below 80 Degrees F.

9. Compare the readings to the chart:

PROPER BATTERY CARE

TEMPERATURE CONVERSIONS:

40F = 4.4C 50F = 10C 60F = 15.5C 70 F= 21.1C 80F = 26.7C 90F = 32.2C 100F = 37.8C

110F = 43.3C 120F = 48.9 130F = 54.4C

Percentage of Charge	Specific Gravity at 27 Degrees C (80F)	Open Circuit Voltage (No load / no charge)		
		12V	24V	48V
100	1.260-1.270	12.73	25.46	50.93
90	1.245-1.255	12.62	25.24	50.47
80	1.225-1.235	12.50	25.00	50.00
70	1.205-1.215	12.37	24.74	49.49
60	1.180-1.190	12.24	24.48	48.96
50	1.160-1.170	12.10	24.20	48.41
40	1.135-1.145	11.96	23.92	47.83
30	1.110-1.120	11.81	23.63	47.62
20	1.085-1.095	11.66	23.32	46.63
10	1.060-1.070	11.51	23.02	46.03

Temperature Compensation

As batteries are charged, and especially equalized, the temperature can increase significantly. Also, the Increased heat also increases the battery's resistance to a charge. If batteries climb to 46 degrees Celsius, equalization needs to be stopped to allow battery bank to cool.

PREVENTATIVE BATTERY EQUALIZATION SCHEDULE

January: equalize at 62 V / 31V / 15.5V for a minimum of 2 hours or until a Specific Gravity of 1.260-1.270 is reached.

February: equalize at 62 V / 31V / 15.5V for a minimum of 2 hours or until a Specific Gravity of 1.260-1.270 is reached.

April: equalize at 62 V / 31V / 15.5V for a minimum of 2 hours or until a Specific Gravity of 1.260-1.270 is reached.

September: equalize at 62 V / 31V / 15.5V for a minimum of 2 hours or until a Specific Gravity of 1.260-1.270 is reached.

November: equalize at 62 V / 31V / 15.5V for a minimum of 2 hours or until a Specific Gravity of 1.260-1.270 is reached.

December: equalize at 62 V / 31V / 15.5V for a minimum of 2 hours or until a Specific Gravity of 1.260-1.270 is reached.

CORRECTIVE EQUALIZATION

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.

CORRECTIVE EQUALIZATION CONTINUED…

Corrective Equalization can take a very long time depending on the degree of sulfation.

1. Temperature should be monitored very, very closely and keep below 50ºC.
2. Once an hour, measure and record the specific gravity and temperature of a test cell. If the temperature rises above 46ºC and approaches 52ºC remove the batteries from charge. (For temperature measurement choose a center cell, if applicable).
3. If severely sulfated, it may take many hours for the specific gravity to rise.
4. Once the specific gravity begins to rise the bank voltage will most likely drop or the charging current will increase.
5. Continue measuring the specific gravity until 1.260-1.270 is reached.
6. Charge for another 3 hours.
7. 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.
8. NOTE: Adding distilled water will dilute the battery acid and alter specific gravity readings. It may be necessary to equalize the batteries a couple of times before the added distilled water is fully recombined with the battery electrolyte.

IMPORTANT: WHEN ADDING DISTILLED WATER, ONLY ADD WATER TO BRING THE ELECTROLYTE BACK UP TO THE *ORIGINAL* LEVEL. ADDING TOO MUCH WATER WILL DISTORT SPECIFIC GRAVITY READINGS

To avoid this situation it is recommended that a specific gravity reading of one pilot cell is measured and recorded once a month when 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.

BATTERY CHARGE AND EQUALIZATION LOG

Step 1: Baseline

It is important to record the specific gravity of all the cells when the battery bank is first put into service and equalized for the first time.

NOTE: TO ENSURE PROPER PERFORMANCE, IT IS **HIGHLY** RECOMMENDED THE BATTERIES ARE EQUALIZED WITHIN 7 DAYS OF BEING PLACED IN SERVICE.

This will ensure the batteries are healthy and ready to perform. This will also allow us to catch any potential problem.

BATTERY VOLTAGE – DATE: BATTERY TEMPERATURE (From System Meter):

Cell 1:	Cell 2:	Cell 3:
Cell 4:	Cell 5:	Cell 6:
Cell 7:	Cell 8:	Cell 9:
Cell 10:	Cell 11:	Cell 12:
Cell 13:	Cell 14:	Cell 15:
Cell 16:	Cell 17:	Cell 18:
Cell 19:	Cell 20:	Cell 21:
Cell 22:	Cell 23:	Cell 24:
Cell 25:	Cell 26:	Cell 27:
Cell 28:	Cell 29:	Cell 30:
Cell 31:	Cell 32:	Cell 33:
Cell 34:	Cell 35:	Cell 36:
Cell 37:	Cell 38:	Cell 39:
Cell 40:	Cell 41:	Cell 42:
Cell 43:	Cell 44:	Cell 45:
Cell 46:	Cell 47:	Cell 48:

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NOTE: Before any data is entered, it is recommended several copies of this page are made for future use.

Step 2: STANDARD SPECIFIC GRAVITY READING

Before the first battery bank equalization, it is important to fully recharge the batteries. This means the batteries will reach the stage. Once the batteries have been fully recharged, check the specific of each cell.

BATTERY VOLTAGE:

Cell 1:	Cell 2:	Cell 3:
Cell 4:	Cell 5:	Cell 6:
Cell 7:	Cell 8:	Cell 9:
Cell 10:	Cell 11:	Cell 12:
Cell 13:	Cell 14:	Cell 15:
Cell 16:	Cell 17:	Cell 18:
Cell 19:	Cell 20:	Cell 21:
Cell 22:	Cell 23:	Cell 24:

BATTERY TEMPERATURE (From System Meter):

Cell 25:	Cell 26:	Cell 27:
Cell 28:	Cell 29:	Cell 30:
Cell 31:	Cell 32:	Cell 33:
Cell 34:	Cell 35:	Cell 36:
Cell 37:	Cell 38:	Cell 39:
Cell 40:	Cell 41:	Cell 42:
Cell 43:	Cell 44:	Cell 45:
Cell 46:	Cell 47:	Cell 48:

Step 3: EQUALIZED SPECIFIC GRAVITY READING

1. Ensure battery bank is fully charged (float)
2. Initial equalization process
3. Equalize for 2-3 hours; monitor specific gravity cell using pilot cell
4. Once equalization is complete, measure specific gravity (remember to factor in temperature compensation)
5. If specific gravity is not between 1.260-1.270, equalize once again.
6. Once specific gravity is reached, shut down the equalization process.
7. Ensure battery bank is regularly checked and that the preventative maintenance schedule is followed. By following the maintenance schedule, expensive and time consuming corrective equalization will be avoided.

BATTERY VOLTAGE:

Cell 1:	Cell 2:	Cell 3:
Cell 4:	Cell 5:	Cell 6:
Cell 7:	Cell 8:	Cell 9:
Cell 10:	Cell 11:	Cell 12:
Cell 13:	Cell 14:	Cell 15:
Cell 16:	Cell 17:	Cell 18:
Cell 19:	Cell 20:	Cell 21:
Cell 22:	Cell 23:	Cell 24:

BATTERY TEMPERATURE (From System Meter):

Cell 25:	Cell 26:	Cell 27:
Cell 28:	Cell 29:	Cell 30:
Cell 31:	Cell 32:	Cell 33:
Cell 34:	Cell 35:	Cell 36:
Cell 37:	Cell 38:	Cell 39:
Cell 40:	Cell 41:	Cell 42:
Cell 43:	Cell 44:	Cell 45:
Cell 46:	Cell 47:	Cell 48:

The first month with the system up and operating will require the most attention and monitoring. The system may need initial adjustments for maximum performance to be reached. All adjustments can be made via the System Control Panel quickly and effortlessly. If you need to make any adjustments, or come across any problems, please refer to the system manuals as they are designed so you can walk through step-by-step to make any changes or diagnose any problems. If you feel that the product manuals are not providing you with the information you require, please contact a Sunfind Solar Products' representative.

Congratulations! Your Solar System is now providing you reliable, renewable electricity. Thank-you for choosing Sunfind Solar Products. If any questions or problems should arise, please feel free to contact a customer service representative.

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