

The following troubleshooting tips are for general diagnosis of battery issues only. There may be issues that occur within the batteries that aren't addressed in this section. For help with this section and interpreting the results, contact our technical support group by [filling out the support form](#).

- **Internal Resistance** (i.e. C.C.A testers) and carbon pile discharge testers are not suitable testing methods for deep-cycle batteries.

8.1 TEST PREPARATION

- **Check that all vent caps are securely installed on the battery**
- **Properly clean the top of the battery**, terminals, and connections with a cloth and/or wire brush. Electrolyte should be cleaned with a baking soda and water solution in order to neutralize the acid.
- **Check the battery cables and connection integrity.** Ensure all connections are tightened to the correct torque per the torque [Table 1](#).
- **For flooded lead acid batteries**, check that the electrolyte is at the correct level per the fill [Diagram 4](#).
- **Fully charge the batteries** before testing in order to obtain meaningful results.

8.2 SPECIFIC GRAVITY TESTING

- **Use a hydrometer to test the specific gravity.**
 - A hydrometer is a tool that extracts the electrolyte into a vessel that contains a calibrated float. The float is measuring the specific gravity or the density ratio of acid to water.
- **Hydrometers must be corrected for temperature**
 - Add 0.004 points for every 10°F(5°C) above 80°F(27°C)
 - Subtract 0.004 for every 10°F below 80°F(27°C)
 - If every cell within the battery is below 1.250 then the battery may be undercharged. If so, recharge batteries.
 - If any battery has a specific gravity variation of more than 0.015 between cells you should equalize the set.
 - If the specific gravities still vary then you may have a bad battery.
 - If a single cell within a battery is more than 0.050 points off from the others it is safe to assume it is a bad cell.

8.3 DISCHARGE TESTING

- **Ensure that all charging sources and loads** are disconnected from the battery.
- **Connect and start the discharger** at the desired discharge rate.
- **Record the runtime when the discharger is finished.**
- **The runtime has to be corrected for temperature** since the ratings that will be used for comparison were determined at 80°F. Temperatures above and below 80°F will affect the overall runtime.
- **Temperature Compensation**
 - Fahrenheit
 - $T_c = T_r[1 - 0.005(F-80)]$
 - Celsius
 - $T_c = T_r[1 - 0.009(C-27)]$
 - Where,
 - T_c = Corrected discharge time.(Corrected to 80°F(27°C))
 - T_r = Recorded discharge time.
 - F/C = Battery Temperature at the end of discharge(Fahrenheit, Celsius)
- **If the corrected discharge time is greater than 50%** of the rated capacity at that rate then the pack is still usable.
- **Restart the discharger** to observe the individual battery voltages while under a load.
- **If a battery voltage within a pack** is more than 0.5V lower than the highest voltage battery then it may be a bad battery.

8.4 ON-CHARGE VOLTAGE TESTING

- **Disconnect and reconnect DC plug to restart charger.**
- **While the batteries are on-charge** record the current in the last half hour of charge and measure the battery pack voltage.
- **If the measured current is below 5 amps** compare the measured pack voltage to the table below. If the measured voltage exceeds the “End-of-Charge Threshold Voltage,” proceed to the next steps.

TABLE 6

	On-Charge Test Voltage					
System/Battery Voltage	6V	8V	12V	24V	36V	48V
End-of Charge Threshold Voltage	7V	9.3V	14V	28V	42V	56V

8 TROUBLESHOOTING

- **If the end-of-charge voltage** does not exceed the values above, check the charger to ensure the proper output is being maintained. Recharge the batteries and measure again. If the pack voltage is still low, you may have a bad battery.
- **While the pack is on charge**, measure the individual battery voltages and compare to the table below. If the minimum voltage is not attained and/or the variance between the batteries is greater than the allowable variation, the low battery may be failing.

TABLE 7

On-charge Test Threshold		
Nominal Battery Voltage	Minimum Voltage Threshold	Allowable Variation within a Set
6V	7V	0.5V
8V	9.3V	0.7V
12V	14V	1.0V

8.5 OPEN CIRCUIT VOLTAGE TESTING

This is the least preferred method of evaluating the condition of your battery due to the misleading nature of open circuit voltages.

- **For accurate voltage readings, flooded lead acid batteries should remain idle for at least 4-6 hours. AGMs should remain idle for at least 24 hours.**
- **Measure the individual battery voltages.**
- **If any recorded voltage** differs from another battery within the set by more than 0.3V, you may have a failing battery.

TABLE 8

Flooded Lead Acid Battery State of charge vs Specific Gravity and Open Circuit Voltage									
Depth of Discharge	State of Charge	Specific Gravity Corrected to 80°F	Open-Circuit Voltage						
			6V	8V	12V	24V	36V	48V	108V
0%	100%	1.270	6.37	8.49	12.73	25.46	38.20	50.93	114.7
10%	90%	1.246	6.31	8.41	12.62	25.24	37.85	50.47	113.6
20%	80%	1.221	6.25	8.33	12.50	25.00	37.49	49.99	112.5
30%	70%	1.197	6.19	8.25	12.37	24.74	37.12	49.49	111.4
40%	60%	1.172	6.12	8.16	12.24	24.48	36.72	48.96	110.2
50%	50%	1.148	6.05	8.07	12.10	24.20	36.31	48.41	108.9
60%	40%	1.123	5.98	7.97	11.96	23.92	35.87	47.83	107.6
70%	30%	1.099	5.91	7.88	11.81	23.63	35.44	47.26	106.4
80%	20%	1.074	5.83	7.77	11.66	23.32	34.97	46.63	104.9
90%	10%	1.050	5.75	7.67	11.51	23.02	34.52	46.03	103.5
100%	0%	1.025	5.68	7.57	11.35	22.70	34.05	45.4	102.2
		#Cells	3	4	6	12	18	24	54

TABLE 9

AGM Battery State of Charge vs Open Circuit Voltage									
Depth of Discharge	State of Charge	AGM Battery Open-Circuit Voltage							
		6V	8V	12V	24V	32V	48V	108V	
0%	100%	6.50	8.67	13.00	26.00	39.00	52.00	117.0	
10%	90%	6.44	8.58	12.87	25.75	38.62	51.50	115.9	
20%	80%	6.37	8.50	12.75	25.50	38.24	50.99	114.7	
30%	70%	6.31	8.41	12.62	25.24	37.87	50.49	113.6	
40%	60%	6.25	8.33	12.50	24.99	37.49	49.98	112.5	
50%	50%	6.19	8.25	12.37	24.74	37.11	49.48	111.3	
60%	40%	6.12	8.16	12.24	24.49	36.73	48.98	110.2	
70%	30%	6.06	8.08	12.12	24.24	36.35	48.47	109.1	
80%	20%	6.00	7.99	11.99	23.98	35.98	47.97	107.9	
90%	10%	5.93	7.91	11.87	23.73	35.60	47.46	106.8	
100%	0%	5.87	7.83	11.74	23.48	35.22	46.96	105.7	
		#Cells	3	4	6	12	18	24	54

QUICK TIP

SINGLE POINT WATERING KITS: ARE A GREAT WAY TO REDUCE THE AMOUNT OF TIME IT TAKES TO MAINTAIN YOUR FLOODED BATTERIES. ALL BATTERIES CAN BE WATERED FROM ONE SOURCE. THE VALVES ENSURE THAT ELECTROLYTE LEVELS ARE PROPERLY MAINTAINED. FOR MORE INFORMATION VISIT WWW.USBATTERY.COM

