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# Microcell™ carbon foam Battery Charging Recommendations.

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### Carbon Foam Battery Charging Recommendations

1. Maximum Charging Voltage – 2.4V/cell at 25°C.
2. Charging Temperature Compensation

Charge Temperature Compensation							
Operating Temperature	°C	-20	-5	10	25	40	55
	°F	-4	23	50	77	104	131
Absorption charge Voltage(V)	2V	2.6	2.5	2.45	2.4	2.35	2.33
	4V	5.2	5	4.9	4.8	4.7	4.66
	12 V	15.6	15	14.7	14.4	14.1	13.98

3. Due to the high surface area of Carbon Foam electrodes, Firefly batteries have a very high Charge Acceptance Rate and hence can be charged very quickly. The Maximum Charge Current, however, should not exceed the current in the data sheet.
4. Firefly batteries can be fully discharged. To get long life, we recommend that the Firefly batteries be operated between 10% SOC to 90% SOC. In this range, the charging of the batteries will also be very efficient. Firefly batteries are highly resistant to sulfation so they can be operated in this range for extended periods without any irreversible capacity loss. It is also recommended to charge the batteries completely once in 20-30 days to remove any hard sulfation.
5. Firefly batteries should be charged with a combination of CC-CV mode charging or CV mode. Once charging voltage reaches the voltage limit of 2.4V/cell(@ 25°C), the charging current can be reduced in 3-4 steps to reduce the voltage to 2.25-2.3V/cell so that required Ah is put in without causing excessive heating/water loss. Recommended charging profile is given in Fig.1.

Step	Charging Current(A)	Charging Method	Control Limit
1	0.5C <sub>10</sub> Amps or Maximum current Specified	Constant current	≤2.4 V/cell
2	0.3C <sub>10</sub> Amps	Constant Current	≤2.4 V/cell
3	0.1C <sub>10</sub> Amps	Constant voltage(2.4V/cell)	Until the current drops to 3% of C <sub>10</sub> Amps

6. Once 95% of required Ah is put in, CV charging should be started. When the charging current drops to about 3% of C<sub>10</sub> rating, charging should be discontinued.
7. As Firefly batteries use AGM, the self-discharge is less than 2% per month and so frequent charging is not required. If the OCV drops below 2.0V/cell, the cell/battery should be charged with 0.1 to 0.2C<sub>10</sub> Amperes to remove sulfation with a constant voltage of 2.4 V/cell. OCV after fully charging will be in the vicinity of 2.15 to 2.20 V/cell.

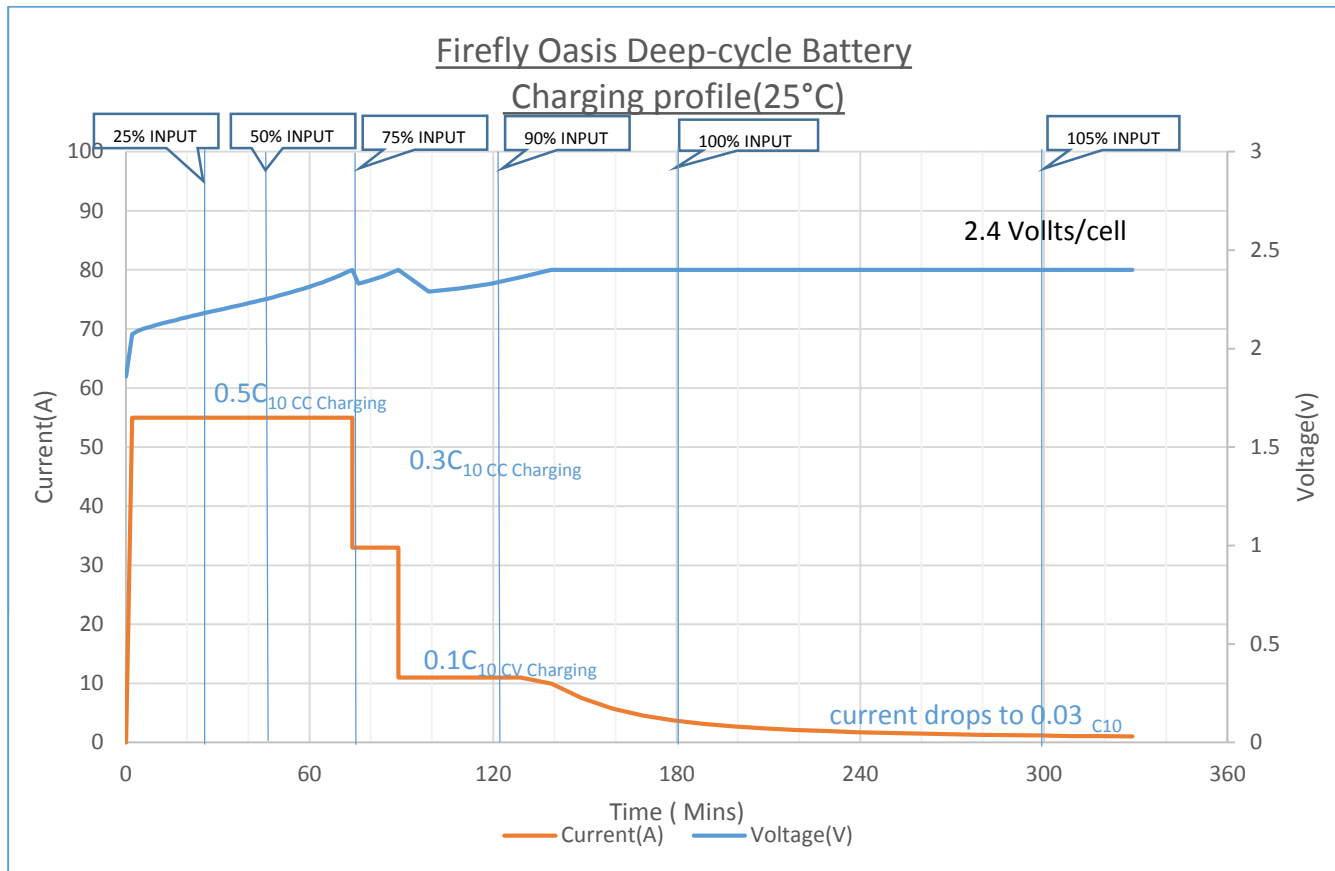


Figure 1 Charging profile shown for Firefly Microcell™ Carbon Foam Battery.

8. Floating any VRLA battery causes some water loss. As Firefly Batteries have a long life, water loss should be reduced. We recommend no float charging of Carbon Foam Batteries. The charging current to MCF Batteries should be switched off. However, in case the OCV drops below 2.0V/cell, the battery should be recharged as per step 7.
9. Cutoff voltage during discharge depends on the load current. However, a cut-off voltage of 1.85V/cell is a safe limit to ensure that cells are in 10-20% SOC range at C<sub>1</sub> to C<sub>20</sub> currents.
10. While charging, high currents can be used keeping charging voltage limited to 2.4V/cell.
11. While charging, cell/battery temperature should not exceed 50-55 ° C.
12. Charging Recommendations for “Oasis” Carbon Foam Batteries 12V , 4V & 2V

Battery	Model-Oasis	Nominal Voltage (V)	Capacity @ C <sub>20</sub>	Absorb Voltage (V)	Float Voltage (V)	Cut-off Voltage (V)	Maximum Continuous Charge current(A)	Recommended operating DOD Range
AGM Gel	12V E31/G31	12	116	14.4	13.5	11.1	66	90- 10%
AGM Gel	4V L16	4	450	4.8	4.5	3.7	200	90- 10%
AGM Gel	2V L16	2	900	2.4	2.25	1.85	400	90- 10%

Note: We can provide specific test results on request.

