

ROLLS AGM BATTERY CHARGING INSTRUCTIONS

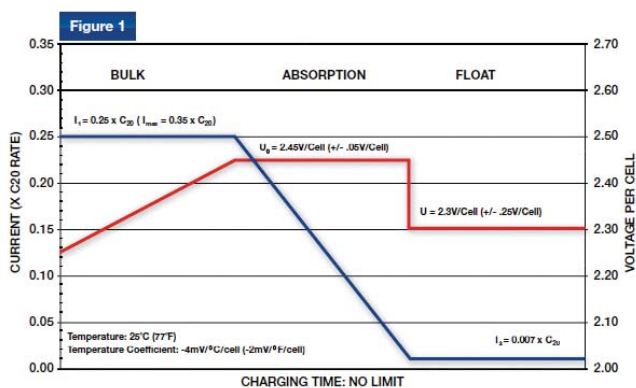
To maximize the life of your Rolls battery, it is important that it is properly charged. Over and under-charging a Rolls battery will result in shortened service life. The best protection from improper charging is the use of a quality charger and routinely checking that the charger current and voltage settings are maintained. Please review the following Rolls Battery Charging Instructions.

Charger Inspection - The charger cabling should be insulated and free of breaks or cuts. The cable connectors should be clean and properly mate with the battery terminals to ensure a snug connection. The charger's AC cord should be free of breaks or cuts and the wall plug should be clean.

Charging Guidelines - Fully charge batteries after each use. Charge in a ventilated area as gasses may be released through the pressure relief valve if the batteries are excessively over-charged. Never charge a frozen battery. Ideal charging temperatures: 32°F – 104°F (0°C – 40°C).

Charging Characteristics - If the charger has a setting for AGM, use this setting to charge your Rolls battery. To maximize your battery life a voltage regulated charger with temperature compensation is strongly recommended. See Figure 1 for the recommended voltage regulated charge profile.

Voltage Regulated Charger - IUU



Bulk Stage - the charger should deliver the initial current I_1 until the voltage limit U_0 is reached.

Absorption Stage - the charger should maintain the voltage U_0 until the current tapers to I_2 .

The initial charge current is recommended to be set at $I_1 = 0.25 \times C_{20}$ ($I_{max} = 0.35 \times C_{20}$) in order to fully charge the batteries within a reasonable amount of time. It can be set lower, however please be aware that charge time will increase so make sure the batteries have enough time to fully charge before being put back into service. Rolls batteries have a low internal resistance allowing them to be charged at a higher current, therefore faster, than conventional flooded/wet batteries.

Float Stage and Termination - the charger can maintain the current I_2 indefinitely or until the charger is shut off or unplugged. This stage is ideal to maintain battery state of charge. Make sure the temperature compensation is programmed as specified in Figure 1 (-4mV/°C/cell or -2mV/°F/cell) or manually adjust the voltage setting for temperatures varying from 25°C (77°F). As the temperature decreases, the voltage should be increased and as the temperature increases the voltage should be decreased.

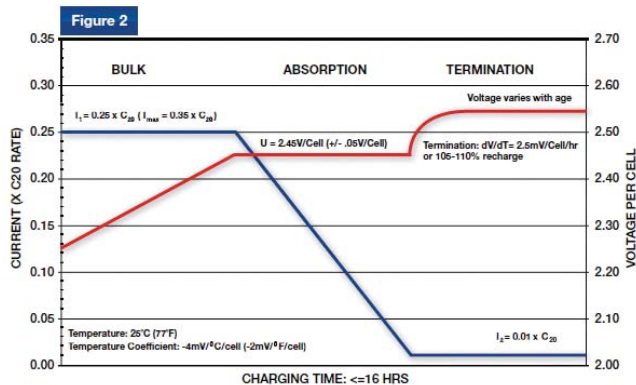
The profile in Figure 1 can be used with or without the float stage. Without the float stage, recharge can be terminated based on time (this will need to be determined as it will vary with depth of discharge and charge current) or percentage recharge (~105%-110%).

Charge Voltage Quick Reference

12 V Battery	32°F (0°C)	50°F (10°C)	68°F (20°C)	77°F (25°C)	86°F (30°C)	104°F (40°C)
Charge Voltage	15.30	15.06	14.82	14.70	14.58	14.34
Float Voltage	14.25	14.01	13.77	13.65	13.53	13.29

Constant Current Charger - IUI

A constant current charger can also be used, however it is important to adhere to the termination criteria mentioned below to minimize the chance of excessive over-charge. See Figure 2 for the recommended constant current charge profile.



Bulk Stage - the charger should deliver the initial current I_1 until the voltage limit U_0 is reached.

Absorption Stage - the charger should maintain the voltage U_0 until the current tapers to I_2 .

Termination - If the charger can be programmed, the charge should terminate when the voltage stops increasing over time. This is called a dV/dT termination. The charge should terminate when the dV/dT is equal to 2.5mV/cell/hour. The charge time in the final phase should not exceed 8 hours and the total charge time should not exceed 20 hours. The percentage recharge should be between 105%-110%.

Refresh Charge - If Rolls batteries are properly charged they should never require an equalizing charge. If they were not properly charged and there is a decrease in capacity, recharge the batteries and make sure they complete the entire charge cycle. If the batteries are stored for extended periods of time, recharge them as follows

Storage Temperature	Refresh Charge Interval
Below 68°F (20°C)	9 Months
68°F (20°C) - 86°F (30°C)	6 Months
Higher than 86°F (30°C)	3 months

Cycle Life vs. Depth of Discharge:

