

"Technical Note #2:  
Recommended Charging for Yellow Top Batteries"  
Rev. 2 9/1/98  
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## SCOPE

In deep cycling application the proper charging is critical to good performance. The proper charge is a balancing act between undercharging and overcharging. Undercharging will result in gradual losses in capacity and thus early cycle life failure. Overcharging, although achieving full capacity, can also result in a severe loss of cycle life. High voltages ( $>15$  V) must be properly managed. They are required for short periods (1 hour) to fully charge and balance the battery and yet if allowed to continue for longer periods they can cause overcharging and thermal runaway. Thermal runaway is a condition where the battery gets hot during charge resulting in acceleration of gassing and recombination reactions leading to further temperature increase and ultimate venting and damage to the battery.

## CONSTANT VOLTAGE CHARGE

Charge with a 14.7 V limit. After charge has tapered to  $< 1$  A, provide a finishing (balancing) charge of 2 A for 1 hour (no voltage limit). Temperature  $< 60$  C. Problems of overcharging individual monoblocks in a pack may be encountered if batteries are seriously out of balance. No initial current limits as long as voltage and temperature limits are observed.

(Nice graph showing time vs. voltage and amperes)  
(available from Optima)

## CONSTANT CURRENT CHARGE

Return 120% of charge removed on previous discharge. Current = 25 A or less. Temperature  $< 60$  C. Problems may occur due to inability to establish AH of previous discharge or seriously out of balance monoblocks in a pack.

(another nice graph)

## FLOAT CHARGE

Float charge at 13.2 to 13.8 V. Maximum current = 1 A.

CONDITIONING CYCLING (recommended for new batteries or after long storage to quickly attain full capacity)

4 A constant current for 16 hours, no voltage limit. Temperature < 60 C.  
Discharge: 25 A to 10.5 V cutoff. Typically 2-5 cycles. After conditioning, the batteries can either be constant voltage or constant current charged. Note: Continuing this charging method for the life of battery will reduce cycle life by about 50% relative to constant voltage charging.

## TEMPERATURE COMPENSATION

-15 mV / deg. C for temperatures around 25 deg. C. As temperature increases, charging voltage should be decreased.