The Care and Feeding of Your Lead-Acid Batteries

By: Kenneth Finnegan, W6KWF
http://blog.thelifeofkenneth.com

Lead-Acid is the standard Amateur Radio battery chemistry

What makes lead-acid popular?

- Pros
  - It's a very old battery chemistry (Gaston Planté, 1859)
  - Lead is cheap (I.e. The Romans used it for plumbing)
  - It's relatively rugged
  - It has a high power density
- Cons
  - Lead is "bad," and freaking heavy.
  - Low energy density; lots of power for a short time.

Used in Field Day and other Emergency Operations

Kenneth Finnegan, W6KWF Backup Battery Bank

Phil Verinsky, W6PK

Why are they always 12V?

- Each Lead-acid battery cell is 2.1V
  - "12V Batteries" are really 6 * 2.1V = 12.6V
- Amateur radio equipment has standardized on running off of 12.6V lead-acid batteries, as have many other things (cars, boats, etc).
  - The manuals say 13.8V because that's the "float voltage" that you store lead-acid batteries at
- They come in other voltages (2.1V D cells, 6V SLAs, 8V flooded locomotive batteries, etc).

Battery Specifications

- Battery voltage (X cells * 2.1V per cell)
- Amp-hour rating (Number of hours it can deliver 1A to a load before being “discharged”)
- “Starting” battery vs. “Deep-cycle” battery
- How the acid is held in the cell:
  - Flooded cells
  - Sealed Gel cell
  - Absorbent Glass Mat

Various Battery Sizes

“Cyclon” Absorbent Glass Mat D Cells – Used in 48V Telecom ops

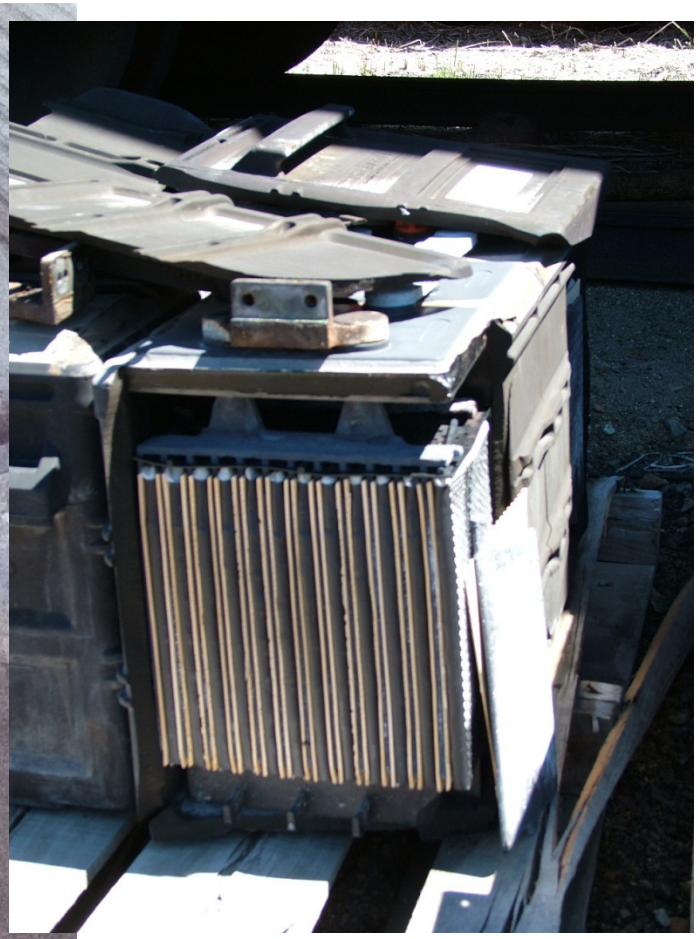
Various Battery Sizes

4x 6V flooded deep-cycle batteries used in fork lifts, scissor lifts, etc

Various Battery Sizes

8x 8V flooded starting batteries used in diesel-electric locomotives

Various Battery Sizes



8x 8V flooded starting batteries used in diesel-electric locomotives

Battery Discharge Chemical Reaction

Negative Plate

$$Pb_{(s)} + HSO_{4\,(aq)}^{-} \rightarrow PbSO_{4\,(s)} + H_{(aq)}^{+} + 2e^{-}$$

Positive Plate

$$PbO_{2\,(s)} + HSO_{4\,(aq)}^{-} + 3H_{(aq)}^{+} + 2e^{-} \rightarrow PbSO_{4\,(s)} + 2H_2O_{(l)}$$

Electrons are driven out the negative plate,
through the load, and back into the positive plate.
Blame Benjamin Franklin for that misfortune.

Standard Lead-Acid Charge Cycle

- Fully charged - 12.6V open circuit
- Fully discharged – 11.7V open, 10.5V loaded
- Recharging consists of:
  - Constant current
  - Constant voltage – (e.g. 14.2V)
  - Floating voltage – (e.g. 13.8V)

- *Exact values depend on specific model of battery, battery temperature, etc.*

Designing Your Own Lead-Acid Charger

- What are you going to power the charger with?
- How big of a battery are you charging?
- Which parts of the battery charging curve are most important to your application?
- How efficient/fast does the charger need to be? (switching vs. linear regulator, etc.)