Signal Training Bulletin

COMMITTEE G: Education & Training

Communication Signal Section, AAR

Approved October 1973

B-3 Secondary Battery Lead-Acid Storage Type

Description: The basic parts which make up one complete cell of lead-acid storage battery are positive and negative plates, separators, containers, cover and electrolyte. In the lead-acid battery, fully charged, the positive plate is lead peroxide, the negative plate is sponge lead (Pb). Figures 1, 2, and 3 illustrate three different types of plates. The electrolyte is dilute sulphuric acid, with a specific gravity of 1.21 to 1.22, or about four parts water to one part acid by volume. The state of charge of the battery can be determined by measuring the specific gravity.

Purpose and Application: The lead-acid storage battery is used as a dc power source at locations where an ac charging source is available. It can be used for track circuits, signals, highway crossing protection or for any railway signal appliance or circuit that requires direct current.

General Information: Some factors affecting the amount of energy that may be obtained from a lead-acid battery are temperature, specific gravity and final voltage. A battery's capacity is highest at higher temperatures. The standard reference temperature is 25C (77F). The higher the specific gravity, the greater the battery capacity. High specific gravity, however, tends to increase standing loss and shorten battery life.

The nominal voltage of a lead-acid cell is 1.75 to 2.00 volts depending upon temperature, discharge current rate and state of exhaustion.

Some general rules for storage battery installation and maintenance:

(a) Check polarity and connection when installing.
(b) Maintain proper charge.
(c) Maintain proper electrolyte level by adding water but do not overfill.
(d) Keep battery dry and clean.
(e) Avoid flames or sparks around battery since discharged gases might explode.
(f) Keep vent plugs in place and tight.

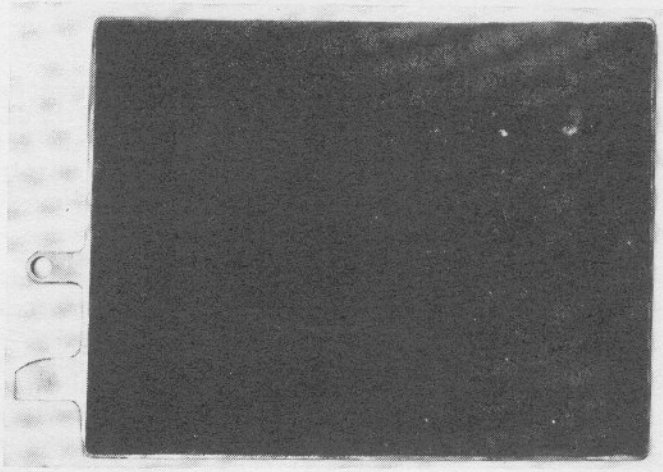


Figure 1: Lattice

Definition: (a) Secondary Battery: A combination of two metals or metalloids immersed in an electrolyte which in itself will not produce electrical energy without first having the metallic portion of the element decomposed by the passage of electric current.

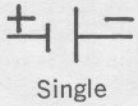
(b) Storage Cell: A secondary cell for storing electrical energy at one time for use at another time.

(c) Charging: The process of putting energy into a battery.

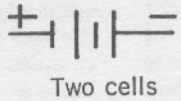
(d) Discharging: The process of taking energy out of a battery.

(e) Electrolyte: The fluid surrounding the elements of the battery.

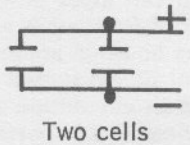
Symbol:



Single cell

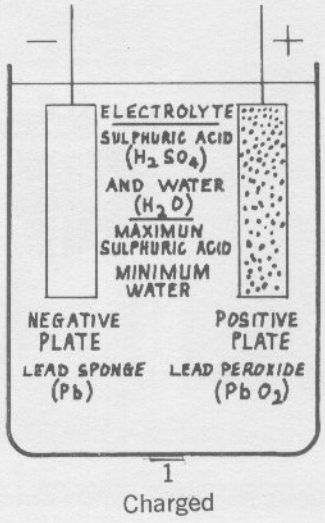


Two cells in series



Two cells in parallel

Figure 4



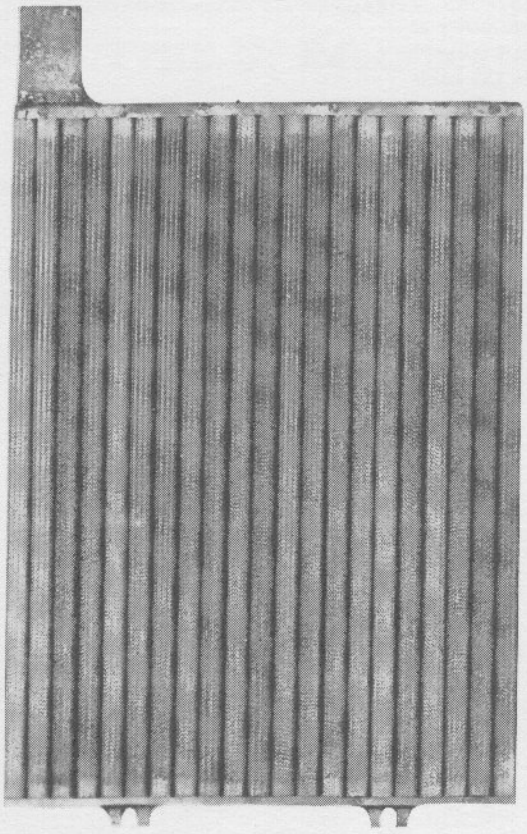


Figure 2: Tubular

(g) Check terminal nuts at regular intervals and tighten if necessary.

(h) Keep terminals coated with grease as specified by railroad maintenance instructions.

(i) Never add acid to a cell to bring the electrolyte to the proper level.

(j) Battery should not be left in a discharged state.

(k) The electrolyte is acid and is injurious to skin and clothing. If spilled, it can be neutralized with the application of a solution of baking soda followed by rinsing with water.

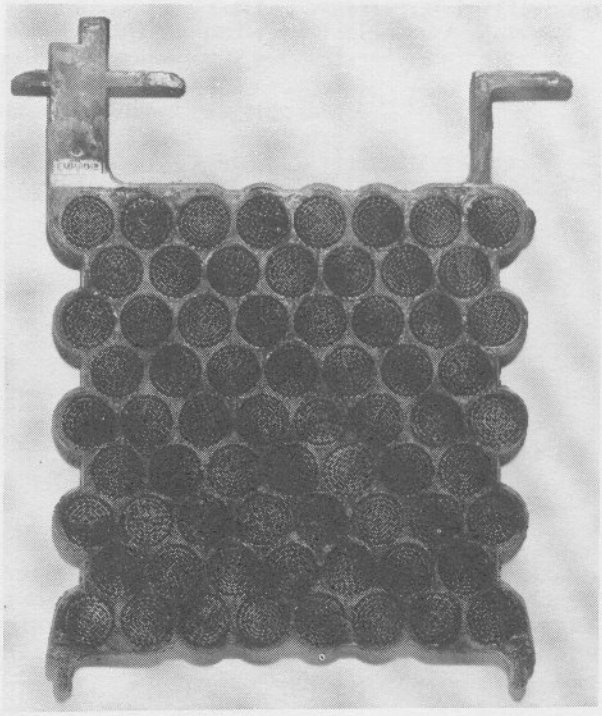
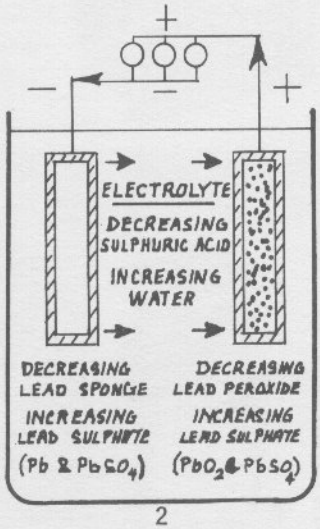


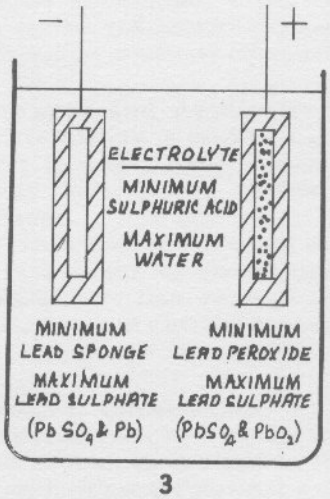
Figure 3: Spiral Button

Detailed Operation: See Figure 4: As the cell is discharged, the electrolyte divides into hydrogen and sulphate. The hydrogen combines with oxygen, formed at the positive plate, to produce water, and the sulphate combines with the lead of both plates to form lead sulphate. The more the battery discharges, the more dilute the electrolyte becomes and the greater the amount of lead sulphate formed on the plates.

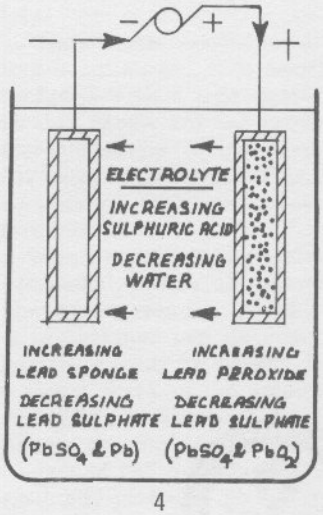
When the battery is put on charge, this entire procedure reverses and when fully charged, additional charging will not raise the specific gravity any higher. As the cells approach full charge, all the energy of the charging current cannot be absorbed and this current separates the hydrogen and oxygen components of the water which leave the cells as gases.



2
Discharging



3
Discharged



4
Charging