The nickel-cadmium battery is usually interchangeable with the lead-acid type. When replacing a lead-acid battery with a nickel-cadmium battery, the battery compartment must be clean, dry, and free of all traces of acid from the old battery. The compartment must be washed out and neutralized with ammonia or boric acid solution, allowed to dry thoroughly, and then painted with an alkali resisting varnish.

The pad in the battery sump jar should be saturated with a three percent (by weight) solution of boric acid and water before connecting the battery vent system.

General Maintenance and Safety Precautions

Refer to the battery manufacturer for detailed service instructions. Below are general recommendations for maintenance and safety precautions. For vented nickel-cadmium cells, the general maintenance requirements are:

1. Hydrate cells to supply water lost during overcharging.
2. Maintain inter-cell connectors at proper torque values.
3. Keep cell tops and exposed sides clean and dry.

Electrolyte spillage can form grounding paths. White moss around vent cap seals is potassium carbonate (K_2CO_3). Clean up these surfaces with distilled water and dry. While handling the caustic potassium hydroxide electrolyte, wear safety goggles to protect the eyes. The technician should also wear plastic gloves and an apron to protect skin and clothes. In case of spillage on hands or clothes, neutralize the alkali immediately with vinegar or dilute boric acid solution (one pound per gallon of water); then rinse with clear water.

During overcharging conditions, explosive mixtures of hydrogen and oxygen develop in nickel-cadmium cells. When this occurs, the cell relief valves vent these gases to the atmosphere, creating a potentially explosive hazard. Additionally, room ventilation should be such as to prevent a hydrogen build up in closed spaces from exceeding one percent by volume. Explosions can occur at concentrations above four percent by volume in air.

Sealed Lead Acid (SLA) Batteries

In many applications, sealed lead acid (SLA) batteries are gaining in use over flooded lead acid and Ni-Cad batteries. One leading characteristic of Ni-Cad batteries is that they perform well in low voltage, full-discharge, high cycle applications. However, they do not perform as well in extended standby applications, such as auxiliary or as emergency battery packs used to power inertial reference units or stand-by equipment (attitude gyro).

It is typical during the servicing of a Ni-Cad battery to match as many as twenty individual cells in order to prevent unbalance and thus cell reversal during end of discharge. When a Ni-Cad does reverse, very high pressure and heat can result. The result is often pressure seal rupture, and in the worst case, a cell explosion. With SLA batteries, cell matching is inherent in each battery. Ni-Cads also have an undesirable characteristic caused by constant overcharge and infrequent discharges, as in standby applications. It is technically known as "voltage depression" and commonly but erroneously called "memory effect." This characteristic is only detectable when a full discharge is attempted. Thus, it is possible to believe a full charge exists, while in fact it does not. SLA batteries do not have this characteristic voltage depression (memory) phenomenon, and therefore do not require scheduled deep cycle maintenance as do Ni-Cads.

The Ni-Cad emergency battery pack requires relatively complicated test equipment due to the complex characteristics of the Ni-Cad. Sealed lead acid batteries do not have these temperamental characteristics and therefore it is not necessary to purchase special battery maintenance equipment. Some manufacturers of SLA batteries have included in the battery packs a means by which the battery can be tested while still installed on the aircraft. Ni-Cads must have a scheduled energy test performed on the bench due to the inability to measure their energy level on the aircraft, and because of their notable "memory" shortcoming.

The SLA battery can be designed to alert the technician if a battery is failing. Furthermore, it may be possible to test the failure detection circuits by activating a Built in Test (BITE) button. This practice significantly reduces FAA paperwork and maintenance workload. *Figure 12-199* shows a SLA battery.

Lithium Ion Batteries

Lithium ion batteries are the primary type of battery for many consumer type of equipment, such as cell phones, battery-powered tools, and computers, but now they are also being used in commercial and military aircraft. The FAA has certified lithium ion batteries to be used on aircraft and one of the first aircraft to utilize the lithium ion battery is the

Figure 12-199. *Sealed battery.*