Application Manual

Zinc Air ($Zn/0_2$)

System Description:

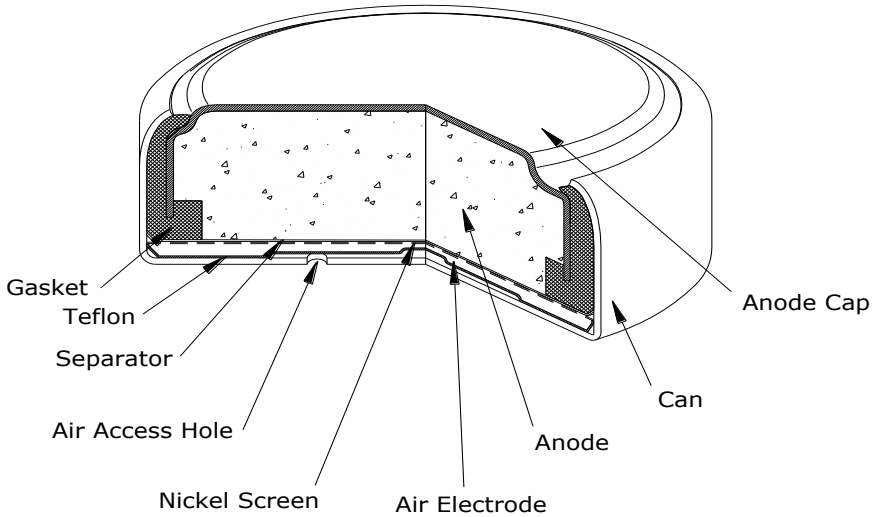
Miniature zinc air batteries are primarily designed to provide power to behind-the-ear, and in-the-ear miniature hearing aids. In most hearing aid applications, zinc air batteries can be directly substituted for silver oxide batteries and will typically give the longest hearing aid service of any common battery system.

General Characteristics:

- Highest capacity-to-volume ratio for miniature batteries.
- Relatively flat discharge curve.
- Essentially constant internal resistance.
- Activated by removing covering (adhesive backed tab) from air access hole.
- Most effective in applications that consume battery capacity in a few weeks.
- Must have access to air (oxygen) to operate.
- Nominal voltage of 1.4
- Excellent service maintenance prior to tab removal.
- Available in common hearing aid battery sizes.
- Contains no added mercury.

Battery Construction:

The electrodes in "Air Cell" batteries are gelled zinc powder anodes and catalyzed carbon cathodes. A hole in the battery container allows oxygen from the air to enter the cathode and be reduced on the carbon surface. At the same time, the zinc in the anode is oxidized in the same way as in a miniature silver oxide battery. A cutaway of an "Air Cell" battery is illustrated in the following diagram:



Battery Construction: (continued)

Cathode: Catalyzed carbon which reduce oxygen from the air.
Anode: Gelled mixture of zinc powder and electrolyte.
Electrolyte: Highly conductive solution of KOH in water.
Separator: Materials to prevent migration of solid particles between the electrodes.
Insulating and sealing gasket: Molded nylon.
Exterior battery surface: Nickel is used to resist corrosion and to insure good electrical contact.

Electro-Chemistry:

The electrode reactions for a zinc air battery are as follows

Anode: $Zn + 2OH \rightarrow ZnO + H_2O + 2e$
Cathode: $O_2 + 2H_2O + 4e \rightarrow 4OH$

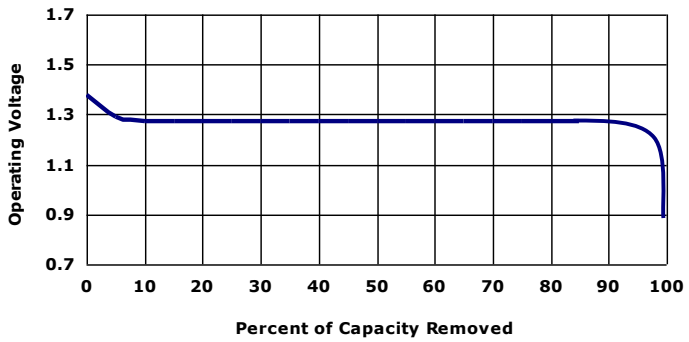
Overall: $2Zn + O_2 \rightarrow 2ZnO$

While typical voltage resulting from this reaction is 1.4, it will vary with current drawn from the battery and with depth of discharge.

The air must have an unobstructed path through the device and into the cathode so that the oxygen in the air is available to discharge the cathode. A hole (or holes) is provided in the battery container to allow the necessary oxygen into the battery. Because excessive moisture transport can degrade battery performance, the container hole is sealed by an adhesive backed tab prior to consumer use. This tab must be removed when the battery is put into service.

The zinc air system provides the highest capacity to volume ratio of the various miniature battery systems. It has a relatively flat discharge curve and is less rate sensitive than mercuric oxide or silver oxide miniature batteries. "Air Cell" batteries have essentially constant internal resistance.

Typical Discharge Curve:



Electro-Chemistry: (continued)

The key to miniature zinc air battery shelf life is the tab seal. This seal should not be removed until the battery is put into service. Miniature zinc air batteries stored at room temperature with the tabs left in place and subjected to typical hearing aid service tests show 95% of initial service after one year and 90% after two years. Accelerated testing indicates that room temperature service maintenance at three years should exceed 85%.

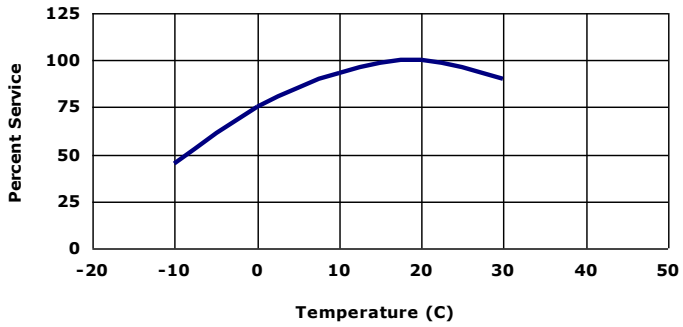
To activate air cell battery remove tab. For maximum power, allow the battery to be aired for 30 seconds before placing in device.

The activated (tab off) air cell batteries have an expected fresh capacity maintenance, depending on cell size, of 50% after 3-12 weeks at 20°C (68°F). Beyond 20 weeks, at 20°C (68°F), fresh capacity maintenance drops to 0-10%. It is therefore very important to keep the tab seal in place until usage.

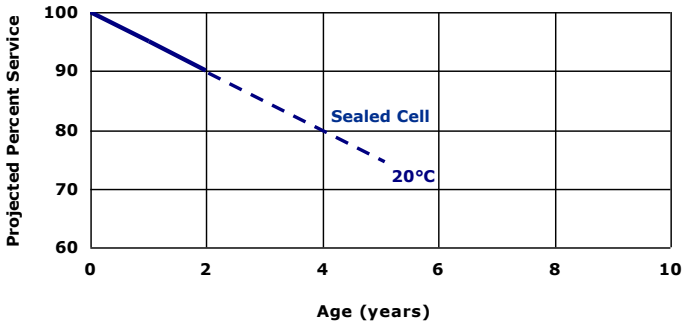
Temperature:

The temperature range in which these batteries can be used in a continuous mode is -10°C to 55°C. Storing batteries overnight in devices designed for drying moisture from hearing aids will have a negligible affect on battery service life.

Typical Percent Service:



Projected Percent Service:



Applications:

"Air Cell" batteries are especially effective in high to medium drain applications that will use the batteries capacity within a few weeks after opening the seal. Applications falling within this usage time will achieve the high energy density advantage: the highest capacity-to-volume ratio for any miniature battery system. Hearing aids are typical devices which fit this usage time parameter.