INFORMATION SHEET 3: Sources of Electromotive Force

The word "battery" is often used incorrectly. We speak of A, AA and AAA units as batteries when in fact they are "cells". The definition of a battery is: A unit containing one or more cells.

Release of free electrons by chemical action:

A cell, as a general rule, contains two dissimilar metals, an electrolyte and a separator. The word dissimilar is the key word here. This can be tested in your own kitchen with a lemon. Poke two copper wires into a lemon and measure the voltage across them. Should be zero. Change one of the wires to iron, or even **silver** plated wire and you'll be able to measure a small voltage.

Cell Voltage is determined by the types of metals used. Carbon also acts as a metal in small cells. The current output of a cell is determined by both the metals and their surface area. The energy storage is rated in Ampere-Hours. An Ampere-Hour is a current flow of 1 Ampere for a period of 1 hour.

Lead Acid (Automobile): Uses Lead Dioxide/Sponge Lead and Sulfuric Acid with 2.15V per cell
Flashlight Cells: Zink/Carbon/Manganese oxide and Potassium Hydroxide with 1.4- 1.5V per cell
Lithium Ion: Carbon/Metal Oxide and Lithium Salts with 3.6-3.85V per cell

Release of free electrons by photon action:

Silicon Solar: Is a PN silicon junction. Photons (light) striking the thin junction raises its energy level. This frees electrons to cross the junction to pass as a current through a load and return to the junction. Silicon PN junctions typically exhibit .5 to .7 volts across the junction. Solar panels, therefore, use about 36 solar cells to produce an 18 volt panel. Nominally 12V under load.

Release of free electrons by thermal action:

Two dissimilar metals are bonded together to form a junction. Each of these metals reacts differently to temperature. Each releases free electrons due to heat, but one more so than the other. One having many free electrons, the other having fewer electrons. Therefore a potential difference, an EMF, exists between the two. Metals such as nickel, copper, chromium, and alloys are used. The output from the device is small, in the order of thousandths of a Volt. Useful in furnaces to control gas valve relays.

Release of free electrons by magnetic action:

Moving electric charges, such as electrons, have a magnetic field around them. Free electrons in a wire are in constant motion. Moving a magnet next to a wire tends to align those moving magnetic fields with that of the magnet. The faster the magnet is passed by the wire the faster the associated electrons in the wire move. With many turns of wire, and a fast moving outside magnetic field, a substantial EMF is produced at the two ends of that wire. This is the principle of a generator and alternator.

Release of free electrons by mechanical action:

Crystals, such as Quartz, twist slightly when an EMF is applied across their structure. The opposite is also true. Bend, twist or apply physical pressure to a crystal and it produces a small EMF at its surface. This characteristic has been used in phonograph pickups, microphones and frequency control in radios.

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