

Battery Service, Maintenance and Replacement

Testing, Usage, Safety and Disposal

Battery Testing

The best way to test a battery is to measure its output voltage while it is connected to equipment under typical operating conditions. Measure the voltage with a digital multimeter. The voltage should be above the cut-off value for that type of battery.

An alternative method is to connect a resistive load to the battery and measure the output voltage. An open circuit (no load) voltage measurement is of no value.

The size of the test load is dependent upon the Ah capacity of the battery and may vary over a wide range. Check with the battery manufacturer for recommendations for each battery type. A typical useful test load or discharge current is at the C/10 rate or more to get an accurate indication.

Typical Load Voltage

A battery with a 1.5 Ah rating would have a load current of $C/10$ or $1.5/10 = .15$ A or 150 mA. If the cell voltage is 1.5 volt, a load resistor of $1.5/.15 = 10$ ohms.

For a typical test load for alkaline cells, use a 10 ohm resistor. The load voltage should be 1.1 volt or higher.

For a 9 volt battery, use a 250 ohm resistor and the load voltage should be 6.6 volts or more.

When testing a Li/MnO₂ lithium, use a 600 ohm resistor. The load voltage should be 2 volts or more.

Test load resistors must have an appropriate wattage rating.

Replacing Batteries

Always replace any battery with the exact equivalent.

The only exception to this is that primary batteries may be replaced with secondary batteries of the same size and Ah rating if available. For example, AAA, AA, C, and D alkaline cells can be replaced with NiCd, NiMH, or lithium cells of the same size and capacity. These cells will have to be recharged by taking them out of the equipment and inserted into an external charger while not connected to the device being powered.

Do not mix different types of cells. Do not use an alkaline in series with a NiCd, for example, or any other combination.

Be careful to install cells and batteries with the correct polarity. Double check your installation; the reversal of polarity can cause battery or equipment damage. Reversing one cell in a multicell connection will also lead to a lower operating voltage.

Battery Storage

If equipment is to be stored or not used for several months or more, take the batteries out to prevent leakage of chemicals, rust, or corrosion that can damage the equipment.

When storing batteries, be sure they are in an environment where the temperature is between 50° and 77° Fahrenheit. Lower or higher temperatures will shorten the shelf life.

Humidity level should be less than 65%.

Battery Safety

While batteries are reasonably safe, they can be very dangerous if used improperly. The greater the battery size, the more dangerous they are to humans. And certain types of batteries can cause harm because of their chemical nature. All batteries should be kept away from children.

Improper charging can also result in hazards.

Always use the charger provided with the device to charge a secondary battery. Never use a charger for a battery for which it was not intended. It could lead to a fire or explosion. It can also destroy the battery or the charger.

Shorting a Battery

Prevent shorting the battery. Be sure that the battery terminals are insulated from surrounding metal structures or tools.

Shorting a battery causes very high current to flow. This can quickly destroy the battery. Shorting the battery will also produce very high temperatures and even an explosion. This is particularly true with lead-acid and any lithium battery.

Remove any jewelry like rings, watches, or bracelets when working with batteries to prevent shorts and personal injury.

Car Battery Safety

Some lead-acid batteries are not sealed and have plugs that allow you to access the individual cells to add water or acid when needed.

During charging, these unsealed batteries give off gases (hydrogen and oxygen) that may be accidentally ignited. When charging these unsealed batteries, be sure they are adequately ventilated and use extra precaution to prevent igniting the gases.

It may be necessary to replace water or sulfuric acid in unsealed lead-acid batteries. This acid is very dangerous so take extra care and use rubber gloves and eye protection. Have access to lots of water to dilute the acid if spilled.

Modern car batteries and gel-type lead-acid batteries are sealed and do not require these precautions.

Battery Disposal

Dispose of batteries safely. Standard primary batteries like alkaline, silver-oxide, and zinc-air may be discarded with your regular garbage. Be sure they are fully discharged. Also, make certain that they will not be accidentally shorted. Do not puncture the batteries or dispose of them in a fire as they may explode and/or give off dangerous fumes.

Rechargeable batteries such as any lead-acid, lithium, NiMH, or NiCd should be taken to local battery recycle/disposal sites. Follow local disposal laws.

To find collection points, go to the Rechargeable Battery Recycling Corporation at www.rbrc.org.

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