

DESIGN & SAFETY CONSIDERATIONS FOR BATTERY OPERATED DEVICES

Testing, Storage, Handling and Disposal of Primary Batteries (non-rechargeable)

- Normally, testing procedures for batteries should follow the American National Standards Institute's procedures as described in their Standard C18.1 entitled "American National Standard for Dry Cells and Batteries-Specifications."
- Batteries can be stored satisfactorily at room temperatures. Although storage at lower temperatures reduces the amount of ampere-hours capacity lost on the shelf, the percentage saved makes it uneconomical under most circumstances.
- In unpacking shipments of batteries, care should be exercised to avoid physical damage or possible short circuiting.
- Energizer alkaline and carbon zinc batteries are RCRA non hazardous waste. Federal hazardous waste regulations are specific about relating waste determination to waste as generated. Scrap, alkaline and carbon zinc batteries are not hazardous waste and are not regulated by DOT as hazardous material.

Tips/Hints

- **Select optimal service, life, and size balance for best operation and user satisfaction.** Energizer batteries are engineered to give the maximum customer satisfaction through optimized designs. They are designed to yield the best balance of service, shelf life and safe, reliable performance. However, users seldom evaluate performance of a battery through any parameter other than service hours. When service life is perceived to be too short, the consumer becomes dissatisfied with the device. Don't let this happen in your design. Always choose a battery that can support the energy needs of your device.
- **Help users correctly insert the fresh batteries into your device.** The best assistance is to design the battery contact so that a battery installed backwards cannot supply power. If this is not feasible, then provide clear instructions. A sticker or easily readable instructions molded in the battery compartment are suggested. These instructions should include the type of battery to be used and polarity symbols.
- **Design around battery sizes that have distribution at least equal to that which you expect for your product.** Batteries made by the Eveready Battery Company have wide distribution throughout the world. While industrial customers have access to all types, consumer outlets tend to stock the most popular sizes. Unless your device will require unique operation characteristics available only in new battery sizes, packs, or systems, make battery replacement easy for consumers by using only the most popular batteries.

- **Water-tight aquatic devices must be designed to deal with battery generated hydrogen.** The tremendous growth of aquatic activities has increased interest in waterproof cordless devices. Lighting devices, photographic gear, and various types of instrumentation have become usable underwater. Designers of any water or air-tight device should be aware of the normal evolution of hydrogen gas from batteries. This gas must be either absorbed or allowed to escape. Otherwise, high temperature or a static spark could trigger the ignition of the entrapped hydrogen/air mixture. If your device is used under these conditions, please contact your Energizer representative for design assistance.
- **Allow batteries to breathe (vent) and expand or contract.** Avoid encapsulation or potting.
- **Locate batteries as far away as possible from any heat source to prevent service degradation.** A provision for ventilation or insulation can help.
- **Devices with alternate power supply options should be designed to assure the batteries are isolated from the alternate power supply circuit.** Use of external switches, activated by the alternate power supply cord should be avoided. Commercially available "generic" replacement cords may not activate the protection switch. Consider the redundant diode protection against unintended battery charging. Maximum leakage current should never exceed 50 micro amps.
- **Use series battery connection, if practical.** If a battery is inserted backwards in parallel or series/parallel wiring or in some series connections, leakage and/or battery rupture may occur.
- **Use of good battery contacts are an important part of the device.** Fabricate them of nickel or nickel plated steel. Contact forces should be at least one half pound force for light handling and smaller battery sizes up to two pounds force for rough handling and larger battery sizes.
- **If metal-jacketed batteries are used, additional protection is recommended to isolate the metal jacket from any material that can conduct electricity and prevent any potential short circuit.** Metal jackets used on Energizer batteries are designed to electronically isolate the jacket from the battery.
- **If plastic film labeled batteries are to be used in any device,** additional care should be taken to avoid sharp edged conductive material in the battery compartment. These sharp edges could cut through the plastic label to the metal can and short circuit the battery. Battery leakage or rupture could occur.
- **Design the battery compartment to have a high resistance to leakage.** In the rare case of battery electrolyte leakage, the device can still serve the customer if the electrolyte is isolated from the functional areas of the device.
- **Battery compartments should be accessible,** yet tamperproof, to protect children who might have access to your products.
- **Battery compartment size and contact location should be based on the American National Standards Institute's and IEC standard dimensions,** not upon measurement of physical samples. Refer to ANSI Standard C18 and International Electrotechnical Commission IEC86.

- **Design equipment to switch off after the battery voltage has dropped below the functional limit of the device.** This is especially true of devices which leave the battery on a virtual short circuit when the voltage level has dropped. Electrolyte leakage can occur under these conditions.
- **Operating instructions** for the device should include the following useful points which will increase the product's utility and user satisfaction:
 - A. If consumers should use a particular type of battery (Energizer, Super Heavy Duty, etc.) recommended it Include the following statement: Please use recommended batteries. Carefully follow all instructions and warnings on the battery label and package.
 - B. Instruct the consumer to replace all batteries at one time. The replacement of a partial set or mixing batteries from the different chemical systems exposes the device to the possibility of electrolyte leakage and damage through over-discharge of the lower capacity batteries.
 - C. Advise the consumer that batteries that are not specifically designed to be recharged can leak and in, some cases, rupture if recharged.
 - D. Tell the consumer not to heat or open batteries. This will expose the user to chemical burns, or, in rare cases battery ruptures.
 - E. Suggest to customers that they check the batteries' effectiveness frequently, particularly in devices that are depended upon for personal safety. Batteries should be replaced as soon as their performance becomes unsatisfactory.
 - F. Recommend that the user makes sure that the contact surfaces are visually clean and bright when installing new batteries.
 - G. Suggest that the user remove the batteries if the device will not be used for several months.