



## Battery Storage Recommendations



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### Storage recommendation for various battery types in the manufacturer's words.

It makes a lot of sense to read what the battery manufacturers say about long term battery storage. The following is a selection of several manufacturers who have put information in their catalogs. Please read the disclaimer below:

#### Sealed Lead Acid Battery Storage

**Power-Sonic** Batteries should *not* be stored in a discharged state or at elevated temperatures. If a battery has been discharged for some time or the load was left on indefinitely, it may not readily take a charge. To overcome this, leave the charger connected and the battery should eventually begin to accept charge. Although Power-Sonic batteries have a low self-discharge rate which permits storage of a fully charged



battery for up to a year, it is recommended that a battery be charged 6-9 months after receipt to account for storage from the date of manufacture to the date of purchase. Otherwise, permanent loss of capacity might occur as a result of sulfation. To prolong shelf life without charging, store batteries at 10 degrees Celsius or less.

**Gaston:** Lead-acid batteries previously were affected by long term storage after charging. But Gaston SLA batteries are not so affected. This battery offers longer extended storage than conventional batteries (referenced curve shows 3% per month self discharge rate at 20 degrees C.) During storage, carry out supplementary charging according to Table 3 (below 20 degrees charge every 6 months, 20 to 30 degrees C charge every 3 months, over 30 don't store). Although the self-discharge rate is low, specific precautions must be taken against the battery over discharging itself by self-discharge when in storage or not operating. In general, to optimize performance and service life, it is recommended that Gaston batteries which are to be stored for extended periods of time be given a supplementary charge, commonly referred to "top charging" periodically. The top charge referred to is a charge of 20-24 hours at a constant voltage of 2.4 volts per cell.

## **Spiral Wrapped Lead Acid Battery Storage**

### **Hawker Energy Products**

When a Cyclon battery is kept in storage, i.e. on open circuit, the ambient temperature should be controlled to prolong storage time and maintain maximum capacity over time. To get the best storage results, batteries should be charged at room temperature or below, and charged prior to being put back in service.

The OCV (open circuit voltage) of each battery must be monitored on an individual basis. If the OCV measures 1.93 Vpc, it has zero effective capacity and should be boost charged immediately. Even if the OCV reads higher than 2.00 Vpc at the end of 12 month's storage, the battery should be recharged before use. Thus, to maintain maximum reliability, batteries should be boost charged once every 12 months, or when the OCV reads 2.00 Vpc, whichever occurs earlier.

If the OCV is allowed to drop between 1.93 and 1.80 Vpc, some permanent damage may occur to the battery. However, if it drops to less than 1.80 Vpc, the battery will most likely be unchargeable by conventional methods. Therefore, under no circumstances must the OCV be allowed to drop below 1.80 Vpc.

Just as high temperature accelerates the aging of a battery, so does it accelerate the self-discharge rate. Thus, when the storage temperature exceeds 25°C, one must monitor the open circuit voltage more frequently. . .

## **Flooded Lead Acid Battery Storage**

**Trojan:** Periods of inactivity can be extremely harmful to lead acid batteries. When placing a battery into storage, follow the recommendations below to insure that the battery remains healthy and ready for use.

NOTE: Storing, charging or operating batteries on concrete is perfectly OK. The most important things to

avoid:

1. Freezing. Avoid locations where freezing temperature is expected. Keeping battery at a high state of charge will also prevent freezing. Freezing results in irreparable damage to battery's plates and container. [Freezing can happen between -19 F (40% charge) and -98 F (fully charged)]
2. Heat. Avoid direct exposure to heat sources, such as radiators or space heaters. Temperatures above 80° F accelerate the battery's self-discharge characteristics.
3. Step by step storage procedure: 1. Completely charge the battery before storing. 2. Store the battery in a cool, dry location, protected from the elements. 3. During storage, monitor the specific gravity (flooded) or voltage. Batteries in storage should be given a boost charge when they show a 70% charge or less. Completely charge the battery before re-activating.

For optimum performance, equalize the batteries (flooded) before putting them back into service. Refer to the Equalizing section for this procedure.

#### **Continental Battery Storage:**

Q: Will a battery rapidly self discharge if placed on concrete?

A: No, placing a battery on concrete will not cause it to discharge any faster than any other surface.

Q: Can I store a battery indefinitely?

A: No, a battery will self-discharge slowly over time. Allowing a battery to sit in a discharged state will ultimately lead to severe positive grid corrosion and battery failure. An unused battery should never be allowed to sit over 6 months without a recharge.

### **NiMH (Nickel Metal Hydride) Battery Storage**

#### **Duracell NiMH Battery Storage**

Ni-MH batteries can give years of safe and reliable service if they are used in accordance with recommended procedures and are not abused. Batteries should be kept clean and dry both during use and storage. They can be stored for many months in a charged or discharged state without any detrimental effects as long as they are not exposed to extreme temperatures for any long period of time. After periods during which the battery has not been used, the battery should be charged before being placed in service. Extended overcharging or overheating of the battery should always be avoided.

**Varta NiMH:** Battery storage in any state of charge is possible. Storage temperatures between -20 and +35 are recommended, relative humidity approximately 50%. In case of long term storage cells must be recharged once a year.

**Sanyo NiMH:** Under the recommended storage conditions (-20 C to +35 C) the Twicel can be stored indefinitely in either a charged or uncharged state. Recovery may take several cycles. If a battery is stored for a prolonged time connected to a load, electrolyte fluid will leak, the battery will begin to deteriorate, and

capacity will be impaired after storage. During long time storage battery deactivation may tend to occur, and for this reason charging may stop early during recharging after storage. This problem can be solved by charging and discharging the battery several times.

**Sanyo NiMh Battery Storage:** Generally speaking, a loss of voltage and capacity of batteries due to self-discharge during storage is unavoidable. The factors inducing this self-discharge of Nickel-Metal Hydride batteries is listed below:

1. The inside of the cell is a hydrogen atmosphere at low pressure, which gradually reduces the active materials at the positive electrode, resulting in a drop of cell capacity. Accompanied by this, the negative electrode which is thermodynamically unstable in its charged state gradually gives off hydrogen gas, thus reducing cell capacity.
2. The active materials at the positive electrode in its charged state self-decompose, causing the cell capacity to decrease.
3. Impurities within the cell, especially nitric ions, are reduced at the negative electrode and diffuse to the positive electrode where they are oxidized. This results in a lowered cell capacity.

The factors (2) and (3) also apply to Nickel-Cadmium Batteries. As discussed above, the self-discharge of Nickel-Metal-Hydride Batteries during battery storage causes a loss in stored energy. However, once recharged, this lost portion of the capacity will be almost completely restored. The self-discharge characteristics of Nickel Metal Hydride batteries is affected by storage temperature. . . If the battery is stored at high temperatures, the self-discharge will be accelerated. Also, the longer the storage period, the more the cell capacity decreases. As mentioned above, since the capacity of Nickel Metal Hydride batteries lost by self-discharge can be restored by recharging, there are virtually no noticeable adverse effects of battery storage. However, prolonged storage at high temperatures may deteriorate or deform the gasket or the separator, and should be avoided. Either fully charged or discharged, Nickel Metal Hydride ( NiMH ) batteries may be stored indefinitely. . . In either cased (charged or discharged) the capacity is recovered within two or three charge / discharge cycles.

### **Panasonic NiMH Battery Storage**

Because long term storage can accelerate battery self-discharge, and lead to the deactivation of reactants, locations where the temperature ranges between +10°C and +30°C are suitable for long term storage.

When charging for the first time after long term storage, the deactivation of reactants may lead to increased battery voltage, and decreased battery capacity. Restore such batteries to original performance by repeating several cycles of charging and discharging.

When storing batteries for more than one year, charge at least once a year to prevent leakage and deterioration of performance due to self-discharging.

## Nickel Cadmium

### Linden: Handbook of Batteries and Fuel Cells

The sealed nickel-cadmium cell can be stored in the charged or discharged state without damage. It can be restored for service by recharging (one or two charge/discharge cycles). [Ed. note: or three charge/discharge cycles].

### Panasonic NiCad Battery Storage

Store NiCad batteries in a dry location with low humidity, no corrosive gasses, and at temperature range of -20°C to +45°C. Storing batteries where humidity is extremely high, or where temperatures fall below -20°C or above +45°C

Because long term storage can accelerate battery self-discharge, and lead to the deactivation of reactants, locations where the temperature ranges between +10°C and +30°C are suitable for long term storage.

When storing batteries for more than one year, charge at least once a year to prevent leakage and deterioration of performance due to self-discharging. When using a rapid voltage detection charger carry out charge and discharge at least once every 6 months.

## Lithium Ion

**Moli Energy Lithium Ion Battery Storage:** Storage temperature range is -20 to 60° C. Recommended storage voltage range is 4.1 to 2.0 volts per cell. For prolonged storage periods, store discharged [i.e. 2.0 to 3.0 volts per cell] and at -20° to 25° C.

### Panasonic Lithium Ion Battery Storage:

The batteries should be stored at room temperature, charged to about 30 to 50% of capacity. We recommend that the batteries be charged about once per year to prevent overdischarge.

**PowerStream Note:** Test data confirms that storage of lithium-ion batteries is best if the cell is partially discharged. In one test by Cadex Electronics ( <http://www.buchmann.ca> ) after 1 year storage at 25°C the non-recoverable capacity remaining is 96% when stored at 40% initial charge level, but only 80% if stored with 100% initial charge level. This effect is reduced at lower temperature and is a non-issue at 0°C. At higher temperatures the effect is much worse. Cadex's recommendations are to store below 15° C at 40% of full charge (2.5 volts per cell).

## Storing Primary Batteries

### Varta Alkaline Battery Storage

A refrigerator, with a temperature range from 0°C to 10°C [32°F to 50°F], is a good place for storing batteries, especially primary batteries. The refrigerator may, of course, also be used to store secondary batteries, but since they are rechargeable, their loss of capacity during storage may be better compensated by recharging, particularly as they can take up substantial space in the refrigerator (e.g. automotive batteries).

What impact may a "special" environment have on primary batteries? When storing primary batteries over several years in a refrigerator, it is important to remember that a refrigerator exhibits a rather low relative humidity. This phenomenon is familiar from uncovered food which is stored for a couple of days or longer: The food (e.g. cheese, meat) will loose moisture and dry out. This also happens - even if only slowly - to unpacked batteries if stored over an extended period of time (years). The water-vapor permeability of the batteries' plastic seal determines how quickly they dry out. The rate at which the water vapor permeates the plastic seal depends on its cross-section and surface and on the relative humidity of the battery's hydrous electrolyte.

Generally this rate is very, very low. Nevertheless it cannot be ignored over extended periods of time, leading finally to a noticeable increase in the battery's internal resistance, while reducing its load capability. Thus, if anyone has to store primary batteries for a longer period of time in a refrigerator, they should be stored in a vapor-proof packaging, such as plastic-laminated aluminum foil. This precautionary measure is only necessary where batteries are stored for several years in a refrigerator or an extremely dry environment. Before use, primary batteries should be removed from the refrigerator soon enough to allow them to adapt to the ambient temperature.

Another tip: During the summer months, the glove compartment of an automobile is a quite unsuitable place to keep a flashlight. If the sun shines down on the car, temperatures may rise up to and even exceed 60°C. Consequence No. 1: The internal resistance of the batteries increases and the batteries dry out. Consequence No. 2 : When it is needed the flashlight may provide only a dim flicker. The same applies to a battery-operated emergency light in the car's trunk. This too should be checked regularly to ensure that it is functioning properly, and if necessary, the batteries should be replaced in good time.

**PowerStream Disclaimer:** This battery storage information is provided for the pleasure of our readers only. The information was taken directly from the manufacturers public information. PowerStream doesn't know if it is accurate or not. Batteries made by other manufacturers may require different storage conditions than those listed. The typist is not a professional, and so transcription errors may have occurred. For the most accurate information contact the manufacturer of the battery you are interested in.

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Storing batteries in refrigerator. Automobile battery storage.

Storing batteries on concrete. Lithium Ion Battery Storage.

Storing batteries. Rechargeable battery storage.

Deep cycle battery storage. Lead Acid battery storage.