Unicad® Rechargeable Nickel Cadmium Batteries
UNICAD offers a broad spectrum of high performance Nickel-Cadmium, Nickel-Metal Hydride and Lithium-ion batteries to meet your requirements.

U&C Batteries Private Limited was founded in 1992 with the mission of providing leading rechargeable battery solutions to meet the ever-increasing demand for portable energy storage. Originally starting out as a pioneer in the indigenous development and manufacturing of vented and sealed cylindrical Nickel Cadmium batteries, we now offer leading technologies in rechargeable alkaline and lithium batteries. With a decade of experience, U&C Batteries designs, develops, manufactures and markets rechargeable batteries for the OEM and consumer markets.

The cornerstone of our success is our commitment to technology innovation and customer satisfaction. Whatever be your application and your requirement, we will help develop the right battery for you.
Nickel Cadmium Batteries

GENERAL OVERVIEW
Unicad Nickel Cadmium batteries feature advanced technologies that yield high-performance, superior quality and safety. Due to their reliability and ease of use, they are among the most popular rechargeable batteries in our product line. They find their use in a wide variety of applications.

Unicad batteries conform to the mandatory and voluntary guidelines specified by IEC 1429 and the EU directive on environmental battery marking. Refer to the Rechargeable Battery Recycling Corporation’s website (www.rbrc.org) for details on their recycling program.

CONSTRUCTION AND CHEMISTRY
Unicad batteries feature a robust cell design, construction and manufacturing process that optimize the battery performance. The electrodes are made using several state-of-the-art processes like sintering technology, reprocess and foam technology depending on the battery type and application.

The basic components of a rechargeable Nickel Cadmium cell are illustrated in the cell construction figure in Fig 2. Ni-Cd batteries use positive electrodes that use Nickel Hydroxide as the main active material and negative electrodes that use a Cadmium compound as the main active material. Among other components of the cell are the separator, positive and negative current collector tabs, alkaline electrolyte, safety gas-vent system, insulation gasket, sealing plate, positive cap and a nickel-plated steel casing.

The manufacturing process of a cell starts with a stack of positive and negative electrode pre-cut and balanced for the capacity of the cell. The electrodes are isolated from each other by a non-woven fabric separator. The stack is coiled and inserted in the cylindrical cell casing and sealed with the positive cap assembly, with the gas-vent system and sealing plate, and the insulation gasket.

The superior cell design, materials, electrode process, high-density electrode stack, the design of the gas-release vent and the manufacturing process make Unicad batteries the choice of battery for all your applications.

The following electro-chemical reactions define the chemistry of Nickel Cadmium batteries:

(Positive)
\[
\text{NiOOH} + \text{H}_2\text{O} + e^- \xleftrightarrow{\text{Discharge}} \text{Ni(OH)}_2 + \text{OH}^- \ldots 0.52\text{V} \quad (1)
\]

(Negative)
\[
\text{Cd} + 2\text{OH}^- \xleftrightarrow{\text{Discharge}} \text{Cd(OH)}_2 + 2e^- \ldots -0.80\text{V} \quad (2)
\]

(Overall Equation)
\[
2\text{NiOOH} + 2\text{Cd} + 2\text{H}_2\text{O} \xleftrightarrow{\text{Discharge}} 2\text{Ni(OH)}_2 + \text{Cd(OH)}_2 \ldots 1.32\text{V} \quad (3)
\]

In general, the charge reaction stores up electrical energy in the electrodes and the discharge reaction supplies the stored energy (emf) to the electrical load. As seen from the overall equation, the alkaline electrolyte apparently does not contribute to the reactions. In addition, the following additional reactions take place at the electrodes during over-charging.

(Gas Generation at Positive - Overcharge)
\[
2\text{OH}^- \xrightarrow{\text{Discharge}} \frac{1}{2} \text{O}_2 + \text{H}_2\text{O} + 2e^- \quad (4)
\]

(Gas Recombination at Negative - Overcharge)
\[
\text{Cd} + \frac{1}{2} \text{O}_2 + \text{H}_2\text{O} \xrightarrow{\text{Discharge}} \text{Cd(OH)}_2 \quad (5)
\]

Oxygen gas generation takes place due to the electrolysis of water at the positive electrode after complete charge and gas recombination takes place at the negative electrode. Due to the difference in the reaction rates of equations (4) and (5), Unicad batteries are designed such that the capacity of the negative electrode is higher than that of the positive electrode. This enables all the oxygen gas generated by the overcharged positive electrode to be completely recombined by the uncharged portion of the negative electrode, thus, making the sealed battery design possible. This design prevents internal gas pressure build-up that could cause the cell to explode. As an additional safety, all Unicad batteries are designed with a gas-release safety vent to discharge built-up internal gas pressure.
Nickel Cadmium Batteries

Features

High-performance and reliability
The coiled cylindrical electrode design offers very high energy density and output power higher than that of conventional primary cells. The over-pressure valve design controls cell pressure for increased safety. Unicad batteries are designed to withstand continuous overcharge and overdischarge to ensure extended reliable performance.

Excellent high-rate discharge characteristics
UNICAD batteries feature an advanced electrode design and current collectors with low cell impedance that can deliver a stable discharge voltage under very high rate discharge current loads many times their capacity.

Extended life and superior economy
Unicad batteries can be recharged for up to 500-1000 charge-discharge cycles\(^1\). This offers great economy over conventional dry and alkaline batteries over the entire life. Unicad batteries have a very low self-discharge rate and extended shelf-life.

No memory effect with foam technology\(^2\)
The advanced electrode fabrication and processing using foam technology effectively eliminates the disadvantage of memory effect associated with Nickel Cadmium batteries.

Wide range of operating temperature from -20ºC to 50ºC\(^3\)
The totally sealed cylindrical cell design and construction with resealable gas release vent yields optimal performance with minimal variation due to temperature and humidity changes.

Wide range of batteries to suit every need and application
Unicad batteries are available in sealed cylindrical and vented construction. The batteries are available in a wide range of dimensions and capacities ranging from 100 mAh to 10 Ah with a host of standard battery packs to choose from. We also offer custom-built battery packs and packaging along with circuit and battery protection electronics. Whatever your need and application may be, we will help develop the right battery for you.

Special purpose performance batteries
Unicad batteries are also offered in non-standard types designed specifically for one or more special purpose application. The entire line-up of the series of the batteries is as follows:
- Standard Capacity S Series
- High Capacity HC Series
- Rapid Charge RC Series
- High Temperature Trickle Charge HT Series
- High-rate Discharge HD Series

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\(^1\) Based on IEC charge/discharge specifications.
\(^2\) Foam electrodes offered in the HC series
\(^3\) Charging temperature range varies. Refer to Temperature characteristics.
Nickel Cadmium Batteries

Applications

<table>
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<tr>
<th>Application*</th>
<th>Standard capacity Series</th>
<th>High capacity Series</th>
<th>Rapid charge Series</th>
<th>High temperature Series</th>
<th>High-rate discharge Series</th>
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*The above table lists typical applications only. Contact U&C for the recommended battery type if your application is not listed here.
## Nickel Cadmium Batteries

### Specifications

**Series Code**
- **S** Standard Capacity
- **HC** High Capacity
- **RC** Rapid Charge
- **HT** High Temperature
- **HD** High Rate Discharge

#### Standard capacity batteries – S Series

<table>
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<tr>
<th>Model</th>
<th>Size</th>
<th>Nominal Voltage (V)</th>
<th>Capacity at 0.2It Rate (mAh)</th>
<th>Standard Charge</th>
<th>Fast Charge</th>
<th>External Dimensions</th>
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Operating temperature range: Standard charge: 0°C~45°C, Fast charge: 10°C~45°C; Discharge: -20°C~50°C; Storage: -20°C~35°C

#### High capacity batteries – HC Series

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Operating temperature range: Standard charge: 0°C~45°C; Discharge: -20°C~50°C; Storage: -20°C~35°C
# Nickel Cadmium Batteries

## Rapid charge batteries – RC Series

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<th>Fast Charge</th>
<th>1-hr Rate Charge Current (mA)</th>
<th>External Dimensions</th>
<th>Approximate Weight (g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>UC-AAA25</td>
<td>AAA</td>
<td>1.2</td>
<td>250</td>
<td>25</td>
<td>14-16</td>
<td>75</td>
<td>4-6</td>
<td>375</td>
</tr>
<tr>
<td>UC-2/3AA27</td>
<td>2/3AA</td>
<td>1.2</td>
<td>270</td>
<td>27</td>
<td>14-16</td>
<td>81</td>
<td>4-6</td>
<td>400</td>
</tr>
<tr>
<td>UC-AA60</td>
<td>AA</td>
<td>1.2</td>
<td>600</td>
<td>60</td>
<td>14-16</td>
<td>180</td>
<td>4-6</td>
<td>900</td>
</tr>
<tr>
<td>UC-AA70</td>
<td>AA</td>
<td>1.2</td>
<td>700</td>
<td>70</td>
<td>14-16</td>
<td>210</td>
<td>4-6</td>
<td>1100</td>
</tr>
<tr>
<td>UC-4/5SC120</td>
<td>4/5SUB C</td>
<td>1.2</td>
<td>1200</td>
<td>120</td>
<td>14-16</td>
<td>360</td>
<td>4-6</td>
<td>1800</td>
</tr>
<tr>
<td>UC-SC120</td>
<td>SUB C</td>
<td>1.2</td>
<td>1200</td>
<td>120</td>
<td>14-16</td>
<td>360</td>
<td>4-6</td>
<td>1800</td>
</tr>
<tr>
<td>UC-C280</td>
<td>C</td>
<td>1.2</td>
<td>2800</td>
<td>280</td>
<td>14-16</td>
<td>-</td>
<td>-</td>
<td>4200</td>
</tr>
</tbody>
</table>

Operating temperature range: Standard charge: 0°C~45°C, Fast charge: 10°C~45°C, Rapid charge: 15°C~40°C Discharge: -20°C~50°C; Storage: -20°C~35°C

\(^1\) 0.2It discharge capacity after standard charge at 0.1It for 16 hours.

[It] is the IEC standard expression for charge/discharge current and what was previously expressed as \([C]\).  
\[It(A) = \frac{(Ah)}{1h}\]
Nickel Cadmium Batteries

Typical Performance Characteristics – Standard ‘S’ Series

- **Charge Characteristics**
The charging characteristics depend on the charging current, temperature and charge duration. The cell voltage increases as the charge duration proceeds. In the final stage, the voltage decreases slightly due to the heat generation in the cell and finally reaches equilibrium. The charging voltage and efficiency also depends on the ambient temperature. Increasing the charging current and lowering the charging temperature causes the cell voltage to increase.

- **Discharge Characteristics**
The discharge characteristics depend on initial charge, discharge current, temperature and other factors. The operating voltage of the cell varies depending on the discharge current of the load. Compared to the cell voltage of primary cells, the operating voltage of Ni-Cd batteries remains fairly constant at 1.2V for 90% of the discharge duration.

- **Temperature Characteristics**
The cell characteristics of Ni-Cd batteries vary with ambient temperature, discharge current and other factors. Unicad batteries can be operated in a wide range of temperatures. The operating temperature range for standard cells is 0°C~45°C for standard charge, 10°C~45°C for fast charge and -20°C~50°C for discharge. The operating temperature range is wider for high-temperature cells as indicated in the next section.
Nickel Cadmium Batteries

- **Cycle Characteristics**
The life of Ni-Cd batteries depends on various factors such as the charge and discharge conditions, temperatures and other factors. The actual cycle life cannot be easily measured because it depends on the conditions of use, the discharge duty cycle and the particular application or device the batteries are used for. However, when used according to the IEC charge-discharge specifications, the average life of Unicad batteries is well over 800 charge/discharge cycles.

![Cycle Characteristics](image)

- **Storage Characteristics**
The capacity and cell voltage of charged Ni-Cd batteries gradually decrease upon long-term storage, also known as self-discharge. This tendency is greater at higher ambient temperatures. However, the drop in capacity upon self-discharge is temporary and the original capacity of the batteries can be completely restored by subsequent charging.

![Storage Characteristics](image)
Nickel Cadmium Batteries

Rechargeable Battery Packs

Unicad Ni-Cd batteries are primarily used in rechargeable battery packs and assemblies for a wide variety of applications. The following parameters should be kept in mind for the design of the right battery pack and assembly for your application.

- Ratings (voltage and load current characteristics) of the device or application.
- Total average discharge duration per charge
- Charging specifications
- Size and type of each cell
- Total voltage and capacity of the battery pack
- Number of cells, configuration and dimensions
- Packaging method and the terminal connection type

The design consideration for a battery configuration is driven by the available equipment space and battery mounting method for the particular application. Unicad battery packs provide a range of standard battery packs with a choice of external packaging and terminal connections.

Please refer to the following schematics of battery types for some standard linear and tubular configurations along with the terminal connection types. We also provide consultation for custom battery packs in any configuration to meet your requirements.

<table>
<thead>
<tr>
<th>Type A</th>
<th>Type B</th>
<th>Type G</th>
<th>Type S</th>
<th>Type T</th>
<th>Type W</th>
<th>Type Y</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cells stacked in vertical column</td>
<td>Cells arranged in a row</td>
<td>Cells stacked in 2 columns</td>
<td>Cells stacked in multiple columns</td>
<td>Cells arranged in a triangle</td>
<td>Cells arranged in staggered layers</td>
<td>Cells arranged in parallel layers</td>
</tr>
</tbody>
</table>

The standard configurations shown above are available in external heat-shrink PVC tube in a range of colors.

Standard Connector Types

- GP Universal Plug (UP)
- JST (JT)
- Molex (MX)
- Mitsumi (MI)

Nomenclature for Battery Packs

An example:

UC-2/3AA27-3B-MI

Cell Model #  Configuration Type

Number of Cells  Connector Type

Standard connectors shown. Contact us for other connector types. (Connector illustration taken from GP® specifications.)
Nickel Cadmium Batteries

UNICAD Battery Pack Construction
The basic construction of a UNICAD battery pack is shown below.

Parts for Battery Packs:
1. **Terminal Plates.** The terminal plates are made of high-quality nickel for excellent solderability. The plates are electrically spot-welded to the cells and are highly conductive and alkaline-resistant. The terminal plates are available in a range of widths and thickness for your needs.

2. **Lead wires.** To connect the batteries to the device or a connector, vinyl-clad heat-resistant electrical wire of standard width and gauge (AWG18-24) is used. The standard colors used are red for positive and black for negative. The ends of the lead wires can be provided with customized connectors or can be provided with bare cut ends.

3. **Heat-shrink PVC Sleeve.** Heat-shrinkable PVC sleeves and tubes are used for individual cells and battery packs as external cover. Sleeves are available in a wide range of colors and tube thickness ranging from 0.1mm to 0.2mm depending on the battery type and configuration. OEM batteries are generally provided with the battery type and batch printed on the sleeve. Custom labels and prints can be provided with screen, pad or flexographic printing.

4. **Protective Components.** Thermal protectors, PPTC resettable devices, current and temperature fuses etc. can be provided upon request with the battery pack to prevent overcharging, current over-drain, short-circuits and other electrical hazards. These devices protect the expensive rechargeable battery pack, device circuitry and the device itself. Please consult with us for your specific needs and ratings for the protective devices.

5. **Others.** Other battery pack parts can be provided according to custom specifications. Depending on your needs, we can provide custom-built plastic or polycarbonate hard casing, packaging and adhesive materials, terminal connections, connectors, charge-control and temperature sensors etc. for the battery packs.

Precautions for Use of Battery Packs:
1. The battery pack needs to be placed as far away from heat generating mechanical or electronics parts such as engines, transformers, radiators etc. If necessary, air ventilation or cooling of batteries may be required if the ambient battery temperatures are beyond the range of recommended operating temperatures as specified in the temperature characteristics.

2. Mechanical abuse of battery packs or improper charging methods may cause cells to explode or leakage of electrolyte. Proper precaution must be taken to ensure battery packs are kept in alkaline-resistant and fire-proof materials.

3. Use one of the recommended standard configuration battery assembly and terminal connection type. If possible, seal the terminals with heat-shrink sleeve as an oxidized coating may form on the exposed terminals after prolonged periods of use, leading to poor conductivity. Thus, improper terminal connection and loose mechanical contact with battery (such as springs) should be avoided.
Charging Methods

- **Standard Charging**
  Quasi-constant or constant current charging at 0.1It mA for 14-16 hours is recommended as standard charge for Unicad Ni-Cd batteries. Overcharging at 0.1It mA for up to 48 hours can be done at room temperature without causing damage for standard series batteries.

- **Constant Current Charging**
  Quasi-Constant current charging is widely used for charging Unicad Ni-Cd batteries because it is best suited for the charging characteristics and the charging circuit configuration is simple and inexpensive. By using a resistor between the DC power supply and the Ni-Cd cell in series, the impedance of the charging circuit is increased and a nearly constant charging current is maintained. The value of the resistance is adjusted such that the charge current at the end of charging does not exceed the specified current value.

- **Fast Charge**
  Fast charging methods usually require a controlled end-of-charge detection circuit to help prevent internal gas pressure and cell temperature build-up due to overcharging. For fast charge, 4-6 hours charging at 0.3It mA is recommended for Unicad Ni-Cd batteries that are specifically rated for fast or rapid charge.

- **–ΔV Sensor Fast-charging**
  The voltage of Ni-Cd cells increases up to the peak level during charge and starts to decrease slightly at the end of charge (refer to charging characteristics). Taking advantage of this drop in charge characteristics, a −ΔV charging circuit can be employed by monitoring the cell voltage by means of a microprocessor and a switching circuit to terminate charging. A −ΔV value of 0-20 mV/cell is recommended. This charging method ensures safe and nearly 100% charge capacity of the cell.

- **Temperature Sensor Fast-charging**
  By monitoring the temperature of the cell using a temperature sensor, a switching circuit can be employed to switch the standard DC power rectifier circuit off when it detects the cell temperature increase at full charging. The charging current can be specified to be at the recommended levels for fast charging.

- **Trickle Charging for Stand-by Use**
  A trickle charge between 0.02It and 0.05It is sufficient to keep a battery fully charged. When the battery is kept within the recommended operating temperature range (0 °C -45 °C for standard series), heating effects during overcharge is minimized and thus yields maximum battery life.

- **Other Charging Methods**
  Constant-voltage charging methods like constant-current controlled, voltage-controlled, V-taper controlled charging are sometimes used as other fast-charging methods. These methods are strongly not recommended for Unicad Ni-Cd batteries because of thermal runaway phenomenon, which can lead to excessive end-of-charge current and thus damage the cell if the charging is not terminated. Timer-controlled charging is in general not recommended unless used in combination with the above-recommended controlled-charging methods.

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1 Please consult with U&C for charging circuits for any of the methods described here.
2 \( V_{cell} \) = Cell Voltage; \( I_{ch} \) = Charging Current; \( T_{cell} \) = Cell Temperature
Nickel Cadmium Batteries

Battery Usage Precautions, Safety, Handling, Maintenance, Recycling

⚠️ CAUTION!

1. Charging:
   1.1 **Rapid Charging:** Follow recommended charge rate and charging methods for rapid charging. Only use batteries specifically recommended for fast charging.
   1.2 **Trickle charging:** Use recommended trickle charge rate of 0.02-0.05 It mA. The correct current value depends on the particular device and application.
   1.3 **Charge Temperature:**
      a. Charge batteries within recommended ambient temperatures specified for the battery type and charge method.
      b. Ambient temperature affects charging efficiency. 10 °C – 30 °C is the best temperature range.
      c. At temperatures below 0 °C, the gas absorption reaction rate is not fast enough causing gas pressure inside the battery to rise. This may cause the gases to escape through the safety vent thus leading to leakage of alkaline gas and deterioration in battery performance.
      d. Charging efficiency drops at temperatures above 40 °C. This can disrupt full charging and lead to deterioration in performance and battery leakage.
   1.4 **Parallel charging:** Parallel charging of Unicad batteries is not recommended and sufficient care must be taken during the design of the charger when charging batteries connected in parallel. Contact U&C for further information on batteries that can be used for this purpose.
   1.5 **Reverse Charging:** Never attempt to charge with the polarity reversed. This can cause increase in gas pressure, which can activate the safety vent and lead to alkaline electrolyte leakage, rapid deterioration in battery performance, battery swelling or rupture.
   1.6 **Overcharging:** Avoid overcharging. Repeated overcharging can lead to deterioration in battery performance. The excessive heat accumulated per each charging cycle during overcharge can significantly shorten the battery life. A choice of −ΔV or Temperature control charging cut-off circuit is critical for avoiding overcharging and ensuring a long battery life.

2. Discharging
   2.1 **Discharge end voltage:** Overdischarge and reverse charge of battery can deteriorate battery characteristics. Install an over-discharge cut-off circuit to avoid this and to optimize battery performance. The recommended discharge cut-off voltage is 1V/cell. However, for batteries with large number of cells in series a higher end-voltage per cell is recommended to avoid over-discharge. The recommended discharge cut-off voltage for a battery with n cells in series is given by:
   - 1-6 cells in series: n V
   - 7-20 cells in series: (n-1)*1.2 V

   For very high-discharge rate applications, an end-voltage lower than 1V/cell should be considered.

   2.2 **Discharge temperature**
      a. Discharge temperature within the recommended ambient temperature range.
      b. Discharge current affects battery performance. Discharge efficiency is best within current range of 0.1 It-0.5 It mA.
      v. Discharge capacity drops at temperatures below -10 °C and above 50 °C. Operating outside the range can lead to rapid deterioration in battery performance.

2.3 **Over-discharge:**
   a. Discharge temperature within the recommended ambient temperature range.
   b. Discharge current affects battery performance. Discharge efficiency is best within current range of 0.1 It-0.5 It mA.
   v. Discharge capacity drops at temperatures below -10 °C and above 50 °C. Operating outside the range can lead to rapid deterioration in battery performance.

2.4 **High-current discharging**
   High-current discharge can lead to heat generation and decreased discharging efficiency. Use high-drain series batteries for continuous and pulse high-current discharging. Consult U&C for your particular application.

3. Storage
   3.1 **Short-term Storage**
      a. Store batteries in a dry location with low humidity, no corrosive gases and at a temperature range of -20 °C to 45 °C.
      b. Storing batteries in very humid locations or at other than recommended temperature range can cause batteries to rust or leak.

3.2 **Long-term storage**
   a. Long-term storage can accelerate battery self-discharge and lead to deactivation of reactants. Store in recommended range of 10 °C to 30 °C.
   b. Long-term storage can cause temporary loss of battery capacity. The original capacity can be restored by repeated charge-discharge cycles.
   c. Charge batteries at least once a year to prevent leakage and deterioration in performance due to self-discharge.

4. Service life
   4.1 **Cycle life**
   Batteries used under proper conditions of charging and discharging can be used over 800 cycles. Significantly reduced service time after complete charging means that the life of the battery has been exceeded. At the end of service life, an unusual increase in internal resistance or an internal short-circuit failure may occur. Chargers should therefore be designed to ensure safety in the event of heat generated upon battery failure at the end of service life.
4.2 Service life with long-term use. Battery performance deteriorates with use and with prolonged storage because of the deterioration in chemical products involving internal chemical reactions. Under proper usage and charge conditions, a battery will last 3 to 5 years. However, when used in other than recommended conditions, significant shortening of service life, damage to product and deterioration in performance can occur.

5. Design of products that use Unicad batteries

5.1 Connecting batteries and products. Never solder a lead wire and other connecting materials directly to the battery. Doing so will permanently damage the battery’s internal safety-vent, separator and other parts made of organic materials.

To connect a battery to a product, spot-weld a tab made of nickel or nickel-plated steel to the battery’s terminal strip, and then solder a lead-wire to the tab in as short a time as possible.

Use caution in applying pressure to the terminals in cases where the battery pack can be separated from the equipment.

Avoid mechanical or loose connection methods such as springs as this can cause oxidation of the terminals, which will cause poor conductivity. The terminals need to be periodically cleaned with a dry cloth once every month to remove any oxidation deposits on the terminals.

5.2 Correct Polarity. Care must be taken during the design of the battery pack to ensure batteries and the connector cannot be inserted in reverse. Also, caution must be given to certain structures or product terminals, which can cause short-circuiting more likely.

5.3 Materials for terminals in products using the batteries. Use alkaline-resistant material for the products contact terminals and surroundings in order to avoid problems and damage due to corrosion in case of alkaline electrolyte leakage when the safety vent is activated, due to improper use. Nickel, Nickel-plated steel are high alkaline-resistant metals. Copper, aluminium, tin, zinc and brass are low alkaline-resistant metals.

5.4 Ambient Temperatures in use. Install batteries far from heat-generating parts or products such that the recommended ambient temperatures for use, charging, discharging and storage are maintained. The best battery position is a battery compartment that is composed of an alkaline-resistant material, which isolates the batteries from the products’ circuitry.

5.5 Installation in equipment. Never design an airtight battery compartment. If the batteries are abused, internal gassing may occur which may be released by the cell safety-vent. The vented gases are potentially flammable and may cause a fire or an explosion in the presence of a source of ignition (sparks generated by a motor switch, etc.). Care should be taken during the design of the battery compartment to ensure proper air-ventilation.

6. Other precautions. Batteries should always be charged completely prior to use. Be sure to charge correctly.

7. In order to ensure safe battery use and optimize battery performance, please consult with U&C for the specific application regarding voltage and current ratings for use and product design prior to final-use of battery-operated product.
Nickel Cadmium Batteries

⚠️ WARNING!

Prohibited items regarding battery handling.
U&C assumes no responsibility for problems resulting from batteries handled in the following manner:

- Never disassemble a battery, as the electrolyte inside is strongly alkaline and can damage skin and clothes.
- Never attempt to short-circuit the terminals of a battery. Doing so can damage the product and generate heat that can cause burns.
- Never dispose off a battery in fire as this can cause the battery to rupture. Never place batteries in water, as this causes batteries to cease to function.
- Never solder anything directly to a battery. This can permanently damage the safety-vent, the separator and other organic materials in the battery.
- Never insert the battery with the negative and positive terminals reversed, as this can cause the battery to swell or rupture at the same time may cause permanent damage to the product or circuitry.
- Never reverse charge or overcharge at higher than rated currents. Doing so causes rapid gas generation and increased gas pressure causing the batteries to swell or rupture. Charging with an unspecified charger or specified charger that has been modified can cause batteries to swell or rupture.
- Do not use a battery in an appliance or device for which it was not intended. Differences in specifications can damage the battery or appliance.
- Never use old and new batteries or batteries with different amount of charges together.
- Never use batteries with dry primary or Ni-MH or Li-ion batteries are with another manufacturer's batteries. Differences in battery characteristics, voltages and capacities can cause electrolyte leakage, degrade battery characteristics or damage to the batteries or the product.
- Never charge/discharge batteries under conditions that are outside the recommended specifications without first consulting with U&C.
- Never alter, modify or tamper with the cell, battery parts or configuration provided in the original condition. Never attempt to service the battery or any of its components by yourself. This will void all warranties provided for the battery product.
- Never leave an uncharged battery connected to a device that constantly drains stand-by current.

⚠️ DANGER!

- Unicad alkaline rechargeable batteries contain a strong colorless alkaline liquid electrolyte (usually KOH). The alkali is extremely corrosive and will cause skin damage upon contact. If exposed, the alkali can damage eyes and lead to permanent loss of eyesight. If any contact occurs with the skin or eye, immediately flush the exposed area with lots of clean water and consult a doctor.
- To avoid serious personal injury due to heat generation, battery leakage or rupture, carefully observe the warnings and precautions outlined in this section.

Battery Maintenance

- Periodic visual inspection of the battery is recommended. Ensure that there is no electrolyte leakage or swelling of the cell case as these indications develop if the battery is mechanically abused or not used according to recommended conditions.
- Periodically clean any exposed parts of terminals with a dry cloth once every month to remove any oxidation deposits on the terminals or other exposed battery parts.
- To avoid accelerated self-discharge and loss of performance of batteries upon storage, periodically cycle the battery with a charge-discharge cycle. For long-term storage, recommended period is once every 6 months.

Battery Shipping and Transportation

Unicad sealed cylindrical batteries can be shipped in normal packaging conditions without special handling. However, proper care should be taken to ensure that the batteries are properly packaged with alkaline-resistant cushioning material according to specifications to avoid mechanical damage and excessive vibrations during transportation.

Battery Disposal & Recycling

When the battery has reached the end of its life, the battery should be recycled or disposed of properly. Do not dispose of in fire or water as this may cause the battery to explode causing personal injury. Properly isolate the battery terminals prior to disposal. Unicad rechargeable batteries contain harmful elements like Cadmium. Recycling Nickel Cadmium batteries is highly recommended to keep these batteries out of landfills and solid waste stream and thus preserving the environment. In some countries or regions, recycling of batteries is the law. Contact your state or local authority for information on battery disposal regulations or for locations of battery recycling sites. Contact RBRC (1-800-8-BATTERY) or visit their website www.rbrc.org for information on recycling regulations and their battery-recycling program in the United States.
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