WAMTECHNIK
ENERGY FOR IDEAS

# Operating rules for cells and batteries in nickel-cadmium (Ni-Cd) and nickel-metal hydride (Ni-MH) technology

Ni-Cd and Ni-MH batteries are high-energy products. Incorrect handling may result in energy release in a short time by short-circuit and explosive unsealing of the battery!

These batteries are industrial products designed for professional use with appropriate proccesing and electrical connection technology. Under no circumstances should they be sold to users who do not know the basic principles of their use and are therefore exposed to **potential personal injury** and **damage to the property** (e.g. short circuit, cell leakage, caustic substances release).

It is absolutely necessary to comply with these Operating Rules and to use the cells only in accordance with the parameters contained in the cell's Data Sheets issued by cell's Manufacturers. The information contained therein defines permissible electrical and temperature parameters and has direct impact on the SAFETY of batteries usage.

## SAFETY RECOMMENDATIONS

Batteries should be used only in accordance with the manufacturer's cell Data Sheet.

**In particular:**

- It is forbidden to short-circuit the battery +/- poles due to the risk of short-circuit, cells damaged, personal injury to the user and fire threat to the property.

**ATTENTION:** Inserting the battery into a pocket with keys or other metal parts can cause short circuit or person's burn.

- Do not subject the cells to excessive electrical stress (excessive discharge current) or overcharging. Direct risk of overheating or cell unsealing with caustic substances release!
- It is forbidden to charge the battery without control of the charging conditions: voltage, current and temperature of the battery.
- Use only checked and functional chargers. Risk of overheating or cell leakage.
- Do not charge the batteries in sub-zero temperatures and above the maximum temperature (usually +45°C). Risk of overheating or cell leakage.
- Under no circumstances should the battery be used in reverse polarity.



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- It is not allowed to repair, disassemble and deform the cells or battery packs.
- Never allow cells to be heated up above +65°C.
- Batteries must not be thrown into fire or water.
- Do not subject the batteries to mechanical shocks, drop or fall, vibrations or mechanical pressure.
- Do not use damaged or deeply discharged batteries.
- Always store batteries out of the reach of unauthorized persons, especially children.
- Soldering cables to the surface of batteries is prohibited. Risk of overheating, parameters loss or cell leakage.
- Unused battery should not be stored or left in charger unattended.
- Do not touch any liquid or substance which leaks from the battery. A leaking battery must be disposed of (see section of this document entitled „Disposal and recycling"). In the event of contact of liquid with the eyes, do not rub the eyes. Immediately start rinsing the eyes with water and continue for at least 15 minutes, lifting the upper and lower eyelids until all traces of liquid have disappeared. Then get medical attention.

## INSTALLING AND USAGE OF BATTERIES

Besides the explicitly labelled consumer products, industrial Ni-Cd and Ni-MH batteries may be installed by qualified persons with technical knowledge in the field of safe usage of cells and batteries.

Appropriate tools must be used to assure safe and secure connection of battery cells and their connection to the device or secure connection leads (e.g. correctly selected connectors, wire-sets, etc.).

**ATTENTION:** Failure to comply with these rules, attempting to install, repair or run NI-Cd or Ni-MH cells and batteries, making changes in product design by unauthorised and unqualified individuals can jeopardize the user and result in loss of warranty.

## GENERAL INFORMATION

Ni-Cd and Ni-MH batteries provide good performance when used in accordance with the cell manufacturer's guidelines.

Do not leave batteries unattended for a long time, both in the product being powered and during storage. If the battery is not used for a long time, check the battery state of charge and charge or properly dispose of the battery, as appropriate.

Batteries naturally lose their performance during use, in particular electrical capacity. A typical estimated lifetime of a battery is two to four years or 300-600 cycles, whichever occurs faster. One work cycle is the process of full charge and then full discharge.

During usage and storage, batteries are slowly self-discharging (natural self-discharge). It is required to charge the battery during storage.



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Check the battery's state of charge regularly. The instructions for using the batteries-powered device usually contain information on how to check the battery status as well as instructions on how to charge the battery. Always follow the instructions supplied with the product.

The battery might be heated up during charging and usage, especially with higher charging and discharging currents.

If the operating time of the battery or battery pack has been shortened, or the charging time has been extended, the battery or battery pack may need to be replaced with a new one.

## USAGE AND MAINTENANCE OF BATTERIES

### CHARGING

Charge the battery before usage.

Charging should be performed with a dedicated charger for batteries or battery packs with appropriate operating parameters, or in a device in which the batteries or battery pack are operated. Follow the instruction of charger or documentation of powered device.

Charging parameters are specified in the Data Sheet for each cell: charging voltage and current as well as permissible charging temperature and time range (depending on project). These parameters must be strictly observed, exceeding them may cause fast deterioration of parameters, cells damage, explosive cells unsealing with caustic substances release.

It is recommended to charge the battery after full discharging due to possible phenomenon of memory effect or cells' aging.

**Electrical charging parameters:**

- Always make sure that the charging systems used sets appropriate voltage and current values to the batteries and have protections against exceeding these parameters.

**Temperature and time of charging process:**

- Do not charge the battery at temperatures below +10°C. Risk of cell leakage, caustic substances release or user's burn.
- Do not charge the battery at temperatures above the permissible limit, usually +45°C. Risk of cell leakage, explosion or fire.
- The battery might be heated up during charging and usage, especially with higher charging current.



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- Observe the temperature of the cells themselves, regardless ot the ambient temperature. If the cells are clearly hot (above +45°C), the charging should be stopped. Risk of cell leakage, caustic substances release or burn.
- Depending on project or device, the charging system must ensure control of time and temperature of charge as well as must provide reaction (e.g. switching off the device) in case of exceeding the parameters.
- Do not charge deeply discharged batteries. There is a danger of using them again. Deep discharged batteries must be disposed of properly.
- Unsued battery pack should not be stored in charger.

**DISCHARGING**

The range of parameters specified by the Manufacturer for discharging the batteries must not be exceeded (Cell Data Sheets). Exceeding the maximum operating parameters may result in overheating, cells unsealing and possible burns of the user. The battery might be heated up during charging and usage, especially with higher operating current.

- Do not exceed allowed range of discharge (operational) current and end-discharge voltages (cut-off voltage) specified in the battery Data Sheet.
- Do not exceed discharge temperature ranges, in particular upper limit (usually +50°C).
- Observe battery life. Battery life varies depending on the product configuration and how it is used, and most often it is given in the User Manual of the final device.

If you notice any of the following situations, consider replacing the battery with a new one: **[A]** the battery life has been significantly shortened; **[B]** the battery charging time has been significantly increased; **[C]** the battery heats up excessively (>+45°C) during operation or charging.

If the battery life has been shortened, the battery may need to be replaced with a new one. You can try to remove the effects of cells' aging by performing 3 full cycles (full discharge to end-of-discharge voltage and then fully charge again), the battery may return to proper operation and have approx. 85-90% of initial capacity.

## CELL LIFE

Batteries are subject to aging process and naturally lose their parameters during use. A typical estimated lifetime of nickel-cadmium (Ni-Cd) and nickel-metal hydride (Ni-MH) battery is two to four years or 300-600 full cycles.

Significant reduction of working time, extension of charging time or heating of the batteries indicates battery's intensive usage. Batteries or battery packs may need to be replaced with a new one.



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## STORAGE

1. Batteries and battery packs should be stored in manufacturer's packaging or other packaging ensuring electrical insulation and tightness not less than that of the cell manufacturer.
2. Do not store the battery packs under the direct sun exposure.
3. Battery packs must be stored not connected to any electrical circuit.
4. Unused cell or battery pack self-discharges slowly, therefore it is recommended to periodically charge the cell or battery during long-term storage.

### Ni-Cd

5. A brand new Ni-Cd (nickel-cadmium) accumulator or battery pack can be stored for a maximum 1 year without losing performance under the recommended optimal temperature and humidity conditions. Maintenance activities are not required in the first cycle of storage.
6. Long-term storage of Ni-Cd batteries is possible provided that the parameters of the cells are regularly checked and possible maintenance activities are performed. After 12 months, and cyclically every 12 month, the battery needs to be charged up to optimal level of 100% of nominal capacity. When stored in higher temperatures, maintenance activities must be performed after a shorter period of storage.

### Ni-MH

7. A brand new Ni-MH (nickel-metal hydride) accumulator or battery pack can be stored for a maximum 6 months without losing performance under the recommended optimal temperature and humidity conditions. Maintenance activities are not required in the first 6 months of storage.
8. Long-term storage is possible provided that the parameters of the cells are regularly inspected and possible maintenance activities are performed. After 6 months, and cyclically every 6 month, the battery needs to be charged up to optimal level of 100% of nominal capacity. When stored in higher temperatures, maintenance activities must be performed after a shorter period of storage.

Before charging the batteries, it is necessary to first discharge it fully and then charge by the stabilized direct current. It is advisable to use charging current C/10 for 16 hours (C = Capacity of the battery). Other ways must be consulted with the supplier and must be verified with the cell's Data Sheet.

It is necessary to keep the records of temperatures and periodic activities during storage and make them available to the supplier in the event of complaint.

**Recommended storage conditions:**



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|---|---|
| **Storage temperature:** | +5°C - +25°C (recommended) |
| **Allowed temperature ranges:** | -10°C - +30°C up to 6 months of storage; |
| **Relative humidity:** | < 70% , no condensations on cells and/or packaging |
| **State of charge**: | approx. 100% of electrical capacity |
| **General coditions:** | Dry, cool and clean room, in particular free from corrosive agents. Cells in the manufacturer's factory packaging (or similar), ensuring good insulation and protection. |

At temperature higher than +25°C, chemical self-discharge and aging processes occur faster. Avoid storage at higher temperatures.

Do not store or use deeply discharged batteries. Serious danger of using them again.

## TRANSPORT

Transport of accumulators and batteries is regulated by safety rules.

Ni-Cd and Ni-MH cells and battery packs can be dangerous goods in some types of transport and are subject to special regulations according to ADR / IATA / IMO shipping contracts (transport of dangerous goods by road / air / sea).

Before transporting the accumulators, check the local, national and international regulations in force. The easiest way is to order transport to a professional transport company with documented authorization for dangerous goods transport.

Transport of used battery product (withdrawn from usage), defective or withdrawn from the market, may in some circumstances be clearly restricted or prohibited.

## WASTE PREVENTION AND BATTERY WASTE MANAGEMENT

Ni-Cd and Ni-MH batteries and battery packs are subject to disposal and recycling regulations that vary across countries and regions. After use, batteries and batteries are considered hazardous waste. Before disposing of any Ni-Cd or Ni-MH cell or battery pack, check and comply with applicable regulations. To dispose of cells and batteries, contact your local battery and battery recycling facility. Ni-Cd and Ni-MH cells



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and battery packs can be returned to the supplier (who places the cells on the market in the relevant EU country), who will accept them and forward them to a battery and battery recycling facility.

The most important measure to prevent or reduce waste generation is proper battery design, which ensures maximum battery life and the possibility of reuse in a second-life cycle, allowing for easier recycling. It is also crucial to be aware that following the User Manual affects battery life, allowing the user to maximize its useful life and thereby reduce (slow down) the generation of battery waste.

Under no circumstances should Ni-Cd and Ni-MH cells and packs be disposed of in standard municipal waste. Recycling allows for significant recovery of the cells' raw materials and their further use. To simplify recycling and treatment, Ni-Cd and Ni-MH cells and packs should not be mixed with other used batteries.

Disposing of used electronic equipment, including accumulators and batteries, in standard municipal waste bins is prohibited. Discharged cells should only be placed in collection containers. To prevent short circuits, protect the leads/contacts/connection points of power cables, e.g., with insulating electrical tape or other approved protective material. A short circuit can cause ignition, damage to the housing, or leakage of harmful chemicals. Always handle used Ni-Cd and Ni-MH cells and packs with caution. Ni-Cd and Ni-MH cells and packs are high-energy hazardous waste containing potentially flammable compounds and other chemicals harmful to health and the environment. In the worst-case scenario, the battery may ignite.

Improper disposal of used Ni-Cd and Ni-MH cells and packs can have serious consequences, including:

- contamination of soil and groundwater by heavy metals and electrolytes,
- hazard to humans and animals – toxic substances can cause illness. Heavy metals present in cells can cause a number of health problems, including damage to the nervous system, kidneys, and liver, and increase the risk of cancer.
- environmental pollution and loss of the possibility of recovering valuable raw materials such as nickel, manganese, and cobalt.

**Critical conditions:**

1. Under no circumstances should the battery terminals be short-circuited (shorting [+] to [-]); all contacts and connection points must be effectively insulated. Cells can contain a significant amount of energy, which can be a source of strong electric current and, in the event of a short circuit, cause electric shock, burns, or the release of harmful chemicals. A short circuit can cause ignition, damage to the casing, or leakage of harmful chemicals.



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2. Do not mechanically damage the battery (e.g., puncture); this can cause the release of harmful/corrosive/toxic chemicals; in the worst case, it can lead to ignition. Used batteries must be effectively packaged to avoid this type of damage.

3. Under no circumstances should cells be disposed of in standard waste. This poses a critical environmental hazard and a potential hazard to people and animals, and in the worst case, a fire hazard. The collection of cells is only possible in special containers, further processing is only permitted by the relevant institutions/companies dealing with chemical processing and having the appropriate environmental permits.

**SAFE HANDLING AND STORAGE OF USED Ni-Cd AND Ni-MH CELLS AND PACKS**

The storage and collection of used Ni-Cd and Ni-MH cells and packs requires adherence to specific safety and protection measures, including occupational health and safety regulations. Appropriate storage conditions must be ensured, and mechanical damage to cells/packs and contact with hazardous substances must be prevented. Handling used cells/packs should be performed by trained employees who always wear appropriate personal protective equipment, such as protective clothing, gloves, goggles, and a hard hat. Training should identify potential hazards, such as electric shock from high current or voltage, burns, ignition (most often resulting from a short circuit), release of harmful/corrosive/toxic chemicals, and procedures for managing identified hazards.

**Conditions for the safe storage of used cells/battery packs:**

▪ Used cells/battery packs should be stored selectively in non-conductive containers, resistant to the substances contained in the cells/battery packs, closed and labeled, and compliant with ADR regulations. Limit contact with other waste and flammable substances.

▪ Used cells/battery packs should be stored in a separate, weather-resistant area, away from sources of heat, fire, and moisture.

▪ Ensure adequate ventilation in rooms where used batteries/rechargeable batteries/cells are stored.

▪ The container containing used cells/battery packs should be free of any metal elements that could cause a short circuit.

▪ Do not mix damaged and undamaged batteries/rechargeable batteries/cells – separate storage is required.
▪ Power cable terminals/contacts/connection points in cells/packages must be effectively protected, e.g., with electrical tape or other approved protective material, to prevent short circuits. Ensure access by unauthorized persons is restricted.



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## COUNTERPARTY'S STATEMENT

Wamtechnik Limited Liability Company (hereinafter referred to as the „Company") shall not be liable for damages that may result from the use of the offered Ni-Cd and Ni-MH batteries contrary to their intended use and these Operating Rules (hereinafter referred to as the "Manual").

The purchase of Ni-Cd and Ni-MH batteries offered by the Company is connected with getting acquainted with and accepting the above mentioned Manual. The Company's Counterparty, purchasing the batteries in question from the Company, declares that he has familiarized himself with this Manual and is aware of the risks and threats that may result from using, storing and transporting the batteries in a manner inconsistent with this Manual.



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