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ENERGY FOR IDEAS

Operating Rules for Lithium-Ion cells, batteries and battery packs

Lithium Ion (Li-Ion) cells, batteries and battery packs are high-energy products. Incorrect handling may result in energy release in a short time by **EXPLOSION** or **IGNITION** of the battery!

Li-Ion cells, batteries and battery packs are industrial products designed for professional use, with the necessary safeguards installed. Under no circumstances should they be sold to users who do not know the basic principles of their use and therefore get exposed to **potential personal injury** and **damage to the property** (e.g. ignition in a pocket, fire in a room/apartment).

This document defines general rules for the usage of Li-Ion cells, batteries and battery packs. These rules do not apply to specialized/dedicated systems or battery packs that are subject to specific operating and storage conditions, as defined in the specification of such specific battery pack/battery system project.

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 cells' Manufacturers. The information contained therein has direct impact on the SAFETY of Li-Ion cells, batteries and battery packs.

SAFETY RECOMMENDATIONS

Cells, batteries and battery packs should be used only in accordance with the cell manufacturer's Data Sheet.

In particular:

- It is forbidden to short-circuit the cells', batteries' and battery packs' [+]/[-] poles due to the risk of ignition and explosion, personal injury to the user and fire threat to the property.

ATTENTION: Inserting single cells, batteries and battery packs into a pocket with keys or other metal parts can cause short circuit, ignition or explosion, resulting in serious personal injury.

- It is forbidden to use the cells, batteries and battery packs without installing technically matched safety elements: electronic safety module monitoring parameters and appropriate fuses switching-off discharge and charge operation before the cell starts to overheat and ignite.
- Do not subject the cells, batteries and battery packs to excessive electrical stress (excessive discharge current) or overcharging. Direct risk of ignition or explosion!

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- It is forbidden to charge the cells, batteries and battery packs without precise control of the charging conditions: voltage, current and temperature of the battery.
- Do not charge the cells, batteries and battery packs in sub-zero temperatures and above the maximum temperature (usually + 45°C). Risk of cell explosion or ignition.
- Under no circumstances should the cells, batteries and battery packs be used in reverse polarity and without protective/safety devices.
- It is not allowed to repair, disassemble and deform the cells, batteries and battery packs.
- Never allow the cells or batteries to be heated up above +60°C (+140°F).
- Cells and batteries must not be thrown into fire or water.
- Do not subject the cells and batteries to mechanical shocks, drop or fall, vibrations or mechanical pressure.
- Do not use damaged or deeply discharged cells and batteries.
- Always store cells and batteries out of the reach of unauthorized persons, especially children.
- Soldering cables to the surface of cells and batteries is prohibited. Risk of ignition or explosion!
- Do not use unchecked or damaged chargers. Risk of ignition or explosion!
- Do not leave cells and batteries in chargers unattended.
- Do not touch any liquid or substance which leaks from the cell, battery or battery pack. A leaking cell or 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 will disappear. Then get medical assistance.

INSTALLING AND USAGE OF LI-ION CELLS & BATTERIES

Li-Ion cells, batteries and battery packs may ONLY be installed by qualified persons with technical knowledge in the field of SAFE installation and use of Li-Ion cells.

1. Appropriate tools MUST BE used to assure reliable and safe connection of battery cells to the device or terminals (e.g. correctly selected connectors).

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2. Appropriate safety components MUST BE used to protect the cells' operation (discharging and charging), in particular, dedicated electronic safety modules and properly selected fuses.
3. Safety components MUST BE properly tested before starting usage of power supply based on Li-Ion cells.
4. Assembly of the power supply system must take place under appropriate conditions, taking into account quality issues related to the assembly of electronics in the ESD protected zone, otherwise there is a serious risk of damage of the electronics safety modules protecting the cells. The worst effect of such neglect can be a fire or an explosion of cells operating without proper control.

Failure to comply with these rules, attempting to install and run Li-Ion cell power systems unprofessionally by unskilled individuals, expose the end user to the risk of personal injury due to ignition, fire or explosion of the cells.

GENERAL INFORMATION

Lithium-ion cells, batteries and battery packs provide good performance when used in accordance with the cell manufacturer's guidelines.

Do not leave cells, batteries and battery packs 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 cell or battery charge level and charge it, or properly dispose of the battery, as appropriate.

Cells and batteries naturally lose their performance during use, in particular electrical capacity. A typical estimated lifetime of a lithium-ion cell and battery is 2-4 years or 300-600 cycles, whichever occurs faster. One work cycle is the process of full charging and full discharging of the cell.

In addition, during use and storage, lithium-ion cells and batteries are slowly self-discharging (natural self-discharge).

Check the battery charge level regularly. The instructions for using the battery-powered devices 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.

USAGE AND MAINTENANCE OF CELLS & BATTERIES

CHARGING

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Rechargeable Li-Ion cells, batteries and battery packs should be charged after each discharge. Charging parameters are specified in the Data Sheet for each cell: charging voltage and current as well as the permissible charging temperature range. These parameters must be observed, exceeding them may cause EXPLOSION or IGNITION of the cells.

Electrical parameters:

- always make sure that the charging system sets appropriate voltage and current values to charge the cells and batteries, and have PROTECTIONS against exceeding these parameters.

Charging process temperature:

- Do not charge the cells and batteries at temperatures below +10°C. Risk of cell leakage, explosion or fire.
- Do not charge the cells and batteries at temperatures above the permissible limit, usually +45°C. Risk of cell leakage, fire or explosion.
- Observe the temperature of the cells themselves, regardless of the ambient temperature. If the batteries/cells are clearly hot (above +45°C), the charging process should be COMPLETELY stopped, and the cell must be observed if it is not going into further self-heating. Risk of fire or explosion.
- Do not charge deeply discharged cells and batteries. It is dangerous to use them again. Deeply discharged cells and batteries must be disposed of properly.
  Charging system must ensure adequate control of charge parameters such as current, voltage and temperature, and it MUST provide immediate & fast reaction (e.g. charge switch-off) in case of exceeding any of the process parameters.

DISCHARGING

The range of parameters for discharging cells, batteries and battery packs specified by the Manufacturer must be observed and respected. Exceeding maximum operating parameters may cause cell overheating, unsealing, ignition or explosion.

- Do not exceed allowed ranges of discharge (operational) current and end-discharge voltage specified in the cell, battery or battery pack Data Sheet.
- Do not exceed allowed discharge temperature ranges, in particular the upper limit +60 deg.C.
- Observe battery life. Battery life varies depending on the product configuration and usage, 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 (above +45°C) during operation.

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CELL LIFE

Li-Ion cells and batteries are subject to aging process and naturally lose their parameters during use. A typical estimated lifetime of a lithium-ion cell or battery is 2-4 years, or 300-600 full cycles. The cycle life can be increased by regular use of the batteries in not-full work cycles, agreeing to a slightly shorter working time in each cycle. This means charging to an incomplete level (end of charging at e.g. 90% instead of 100%) and avoiding discharge to 0%.

Significant reduction of working time, extension of charging time or heating of the cells or batteries indicate intensive wear. These batteries should be replaced.

STORAGE

Due to transport safety regulations, lithium-ion cells (single cells) are delivered from factories in a partially discharged state, most often with a charge state in the range of 20% - 30% of the electrical capacity. Brand new cells in this condition can be stored for a maximum of 1.5 years without losing performance, under the recommended optimal temperature and humidity conditions.

Long-term storage is possible if the user ensures that the parameters of the cells are regularly inspected and necessary maintenance activities are performed, in particular charging to about 50% of state of charge, and further control of the condition of the cells at maximum 6-months intervals.

Specialized/dedicated battery systems or battery packs are subject to specific operating and storage conditions, defined in the specification of such specific battery pack/battery system project.

Recommended storage conditions:

Storage temperature:	+10°C - +20°C (recommended)
Allowed temperature ranges:	-20°C - +40°C for 3 months storage -20°C - +20°C for 6 months storage
Relative humidity:	< 70% , no condensation on cells and/or packaging
State of Charge:	< 50% of nominal electrical capacity
General conditions:	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.

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At temperatures higher than +20°C chemical self-discharge and aging processes occur faster. Avoid storage at higher temperatures.

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

TRANSPORT

Transport of all cells, batteries, battery packs and accumulators is regulated by strict safety rules.

All cells and batteries in lithium and lithium-ion technologies are DANGEROUS GOODS in transport and are subject to special regulations according to ADR / IATA / IMO shipping contracts (transport of dangerous goods by road / air / sea). Before transporting a lithium-ion cell or battery, check the local, national, and international regulations in force. The easiest way is to order transport from a professional transport company with documented authorization for dangerous goods transport. The transport of used cells or 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

Li-ion cells, batteries, and battery packs are subject to disposal and recycling regulations that vary by country and region. At the end of their useful life, cells, batteries, and accumulators are considered hazardous waste.

The most important measure to prevent or reduce waste generation is to design the battery correctly, ensuring the maximum possible service life and the possibility of reusing it in a so-called second life cycle and making it easier to recycle later. You can also reduce waste generation by:

- Use only original chargers and follow the manufacturer's instructions.
- Avoid overcharging and over-discharging batteries (see the section: Cell Life).
- Store batteries in a cool, dry place. Avoid extreme temperatures – do not leave batteries in direct sunlight or in frost.
- If possible, recycle or reuse batteries.

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- ➔ It is crucial to be aware that following the User Manual affects the battery life, so the User can extend its lifespan as much as possible and thus limit (slow down) the generation of battery waste.
- ➔ Equally crucial is awareness of the need to recycle lithium-ion cells. Under no circumstances should they be disposed of in standard municipal waste. Recycling allows for significant recovery of raw materials from the cells and their further use. To make recycling and the processing process as easy as possible, avoid mixing used lithium-ion batteries with other types of batteries or non-rechargeable cells.

Before disposing of any battery, check and comply with applicable regulations. To dispose of batteries, contact your local battery recycling facility. You can return batteries to the supplier (who placed the battery on the market in the EU country) who will accept them free of charge and forward them to a battery recycling facility.

It is prohibited to dispose of used electronic equipment, including cells, batteries, battery packs, and accumulators, in standard municipal waste containers. Discharged cells, batteries, battery packs, and accumulators should only be placed in containers designated for their collection. 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 batteries with caution. Batteries are high-energy hazardous waste containing potentially flammable compounds such as lithium and liquid electrolyte, as well as other chemicals harmful to health and the environment. In the worst-case scenario, the battery may ignite.

Improper disposal of used batteries and accumulators 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 batteries can cause a range of health problems, including damage to the nervous system, kidneys, and liver, and increase the risk of cancer. For humans, this can result in a range of illnesses, such as brain damage, pulmonary edema, and skin damage (caused by the corrosive properties of lithium),
- environmental pollution and the loss of the possibility of recovering valuable raw materials such as lithium, nickel, manganese, and cobalt.

Critical Conditions:

1. Under no circumstances should the battery terminals be shorted (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 housing, or leakage of harmful chemicals.**

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2. Batteries must not be mechanically damaged (e.g., punctured), as this may release harmful/corrosive/toxic chemicals; in the worst case, it may cause ignition. Used batteries must be effectively packaged to avoid this type of damage.

SAFE HANDLING AND STORAGE OF USED BATTERIES

Storing and collecting used batteries and accumulators requires compliance with specific safety and protection measures, including occupational health and safety regulations. Appropriate storage conditions must be ensured, and mechanical damage to batteries and contact with hazardous substances must be prevented.

Conditions for safe storage of waste batteries/rechargeable batteries/cells

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

- Store used batteries/rechargeable batteries/cells 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 batteries/rechargeable batteries/cells 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 of batteries/rechargeable batteries/cells 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. Batteries intended for recycling may be stored for no longer than one year, jointly by all subsequent owners of this waste.

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 lithium-ion cells, batteries, battery packs or accumulators offered by the Company in contrary to their intended use and to the above Operating Rules for Lithium-Ion cells, batteries and battery packs (hereinafter referred to as the "Instruction").

Purchasing lithium-ion cells and batteries offered by the Company requires reading and accepting this Instruction. By purchasing the cells and batteries in question from the Company, the Company's Counterparty

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declares that it has read this Instruction and is aware of the risks and threats that may result from the use, storage and transport of cells, batteries and battery packs in a manner inconsistent with this Instruction.

I hereby confirm that I have read the above Operating Rules for the use of Lithium-Ion cells, batteries, battery packs and accumulators.

.....	.....
Date & place	Authorized Signature & contracting party company stamp

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