



## LITHIUM-ION BATTERIES IN INLAND NAVIGATION

### SAFE USE, RISKS AND PREVENTION

The use of lithium-ion (Li-ion) batteries - also called accumulators - in inland navigation is increasing rapidly, to reduce the impact of inland navigation emissions. These batteries require specific installation and can also pose significant hazards regarding fire and safety risks. In this leaflet we would like to inform you about possible risks and how to prevent any issues when using li-ion batteries on board.



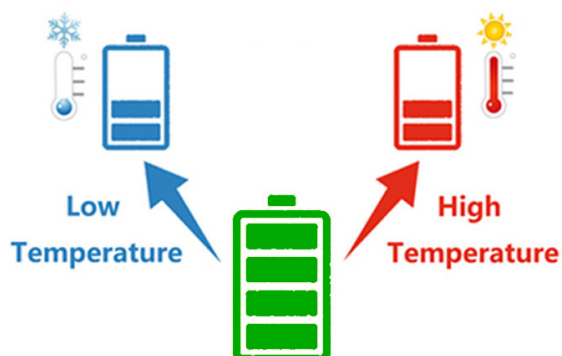
### ABOUT LITHIUM-ION

A lithium-ion battery (Li-ion) is a rechargeable battery with twice the energy capacity of the more commonly known Nickel-Cadmium battery. On a Lithium-ion battery, the anode is made from carbon and the cathode out of lithium metal oxide. The electrolyte between the electrodes consists of organic carbonate compounds, such as ethylene carbonate, to which lithium complexes are attached.

### RISKS

#### Fire / explosion

Lithium, like all alkali metals, is highly reactive and flammable. A lithium fire can be recognised by its brilliant silver flame. Furthermore, lithium can ignite and is potentially explosive when exposed to air and water. The core of a lithium-ion fire is the cell itself which is very difficult to access and even harder to extinguish due to having multiple elements of fire types (metallic, chemical, etc.). It also releases energy to its surroundings and can potentially produce its own oxygen. A battery fire will emit toxic gases. This means all protocols for entering enclosed spaces must be strictly followed.



#### Thermal runaway

Lithium-ion batteries can blow-up or melt when internal electrical components short-circuit. This can occur due to mechanical problems after an accident, or when the batteries are not installed correctly. Often the cause of these failures is when one portion of the battery gets too hot and cannot cool down quickly enough. This creates a chain reaction generating more heat. During thermal runaway, the separate battery modules melt, creating heat and the electrolyte material between the anode and the cathode may start to boil. The thermal runaway will eventually cause the battery to self-ignite or even explode.

### LEGISLATION

Lithium-ion accumulators are subject to the requirements of European standards EN 62619: 2017 and EN 62620: 2015. For the use on board inland vessels, installations for Lithium-ion accumulators need to comply with ESTRIN's Article 10.11 Batteries, accumulators and charging equipment. As of 1-1-2020, ES-TRIN 2019 is in force in which the new Chapter 11 includes 'Special provisions for electric drives'. Ships where the electric drive is installed before 1-1-2020 do not have to meet these requirements, as described above. However, it is important to abide to the requirements as much as possible to avoid forementioned risks.



## PREVENTION

### Location

To prevent incidents, battery systems should be installed according to ESTRIN's requirements (Article 10.11), and should not to be installed in wheelhouse, cargo hold and accommodation, or passenger compartments, cabins and kitchens and must be well secured and ventilated.



### Cooling

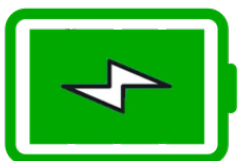
Liquid and air cooling are the only safety systems currently tested and proven to prevent thermal runaway. These active cooling systems prevent batteries from entering thermal runaway by simply extracting more heat than the cells can produce.

### Fire protection

For accumulators with a total power of more than 20 kWh, the spaces in which they are installed need to be protected against fire with one or more lithium-ion accumulators being protected by A60-type partition walls. Fire protection needs to be approved by an expert of the flag state. Accumulators with a payload of up to 2.0 kW may also be installed below deck in a cabinet or box. These requirements are not for accumulators with a payload of less than 0,2 kW.



Accumulator fires are very hard to extinguish. Early detection is key. Direct injection of foam shows the best heat mitigating results. High pressure water mist protection also provides good heat mitigation at module level.



### Battery Management System

The installation needs to be provided with a battery management system (BMS), which protects a cell by cutting the power in case of external and internal short circuit, surge, complete discharge, power- and thermal management, and regulating the charging of the cells.

### Alarm system

Compartments where accumulators are installed need to be protected against fire from one or more lithium-ion accumulators based on a fire protection concept drawn up by an approved expert.



## OTHER ISSUES

- ▶ In the market refurbished accumulators are available. However often these do not comply to the EN 62619: 2017 and EN 62620: 2015 standards and the use of refurbished accumulators, although cheaper, should be avoided.
- ▶ As of 1-1-2020, ES-TRIN 2019 is in force in which the new Chapter 11 includes 'Special provisions for electric drives'. Ships where the electric drive is installed before 1-1-2020 does not have to meet these requirements, as described above. For existing vessels with installed accumulators not all forementioned requirements are legally required. These vessels need to comply with the regulation with newly built craft and/or to the Replacement or Conversion of the parts or areas concerned, at the latest by renewal of the barge certificate after 1.1.2025. However, although when not legally required yet, it is important to abide to forementioned as much as possible to avoid serious incidents.
- ▶ These exemptions on can be found in ESTRIN Article 10.11 for existing vessels can be found in ESTRIN's article 32.01, 32.02, 32.03, 32.04 and 32.05 for vessels sailing on the Rhine river and in article 33.01, 33.02 and 33.03 for vessels not sailing on the River Rhine.

## DISCLAIMER

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