

MSIU SAFETY ALERT 01/2022

Lithium-ion battery fires on board



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MARINE SAFETY INVESTIGATION UNIT

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This Safety Alert is being brought to the attention of Maltese registered vessels, local yacht marinas and terminal facilities. It is being published for information purposes only and is not intended to supersede any requirement issued by the Authority for Transport in Malta and / or manufacturers of Lithium ion (Li-ion) cells and batteries. Rather, it should be read in conjunction with the relevant requirements and communication issued by the Authority and manufacturers, to enhance maritime safety.

The Merchant Shipping (Accident and Incident Safety Investigation) Regulations 2011 provide for the Head of Marine Safety Investigation to make recommendations at any time, resulting from one or more marine safety investigations, either in progress or in finalised version if, in his opinion, it is necessary or desirable to do so.

This Safety Alert is not written, in terms of content and style, with litigation in mind and pursuant to Regulation 14(2) of the Merchant Shipping (Accident and Incident Safety Investigation) Regulations 2011, shall in no case create a presumption of blame or liability. To this effect, this Safety Alert shall be inadmissible in any judicial proceedings whose purpose or one of whose purposes is to attribute or apportion liability or blame.

The sole purpose of this Safety Alert is confined to the promulgation of safety information and therefore may be misleading if used for other purposes.



Dr. Kevin Ghirxi
Head of Marine Safety Investigation

BACKGROUND

Li-ion batteries (and cells) have become widespread energy sources. Significant advances in research and technology have contributed to an increase in energy density, longer life cycles, and one of the best specific energy to weight ratios.

The Marine Safety Investigation Unit (MSIU) has been notified of several fires on board yachts and cargo vessels, some of which involved Li-ion batteries. A number of these occurrences warranted safety investigations by the MSIU and safety investigation reports have been published, as required by National legislation. In particular, the following safety investigation reports are being singled out:

[16/2019](#) – Fire in the garage space of a commercial yacht on 07 September 2018;

[21/2021](#) – Fire on board a container vessel on 28 September 2020;

[13/2022](#) – Fire on board a commercial yacht on 06 September 2021.

There are several other reported occurrences, with an ‘active’ safety investigation status.

Li-ion batteries may also be a safety issue on container vessels, should cargo be undeclared, mis-declared and / or unmarked and consequently, not stowed in line with IMDG Code Class 9, UN 3480, and UN 3481.

The IMO’s Global Integrated Shipping Information System and EMSA’s European Maritime Casualty Information Platform contain information on other occurrences featuring Li-ion batteries, as well as small Li-ion battery-powered personal devices.

FINDINGS

The fires referred to in this Safety Alert, had Li-ion batteries either as a primary cause, or a likely cause. A review of available technical literature and data generated by safety investigations, revealed the fierce intensity of Li-ion battery fires, but also the potential serious challenges to control and extinguish them with the use of conventional fire-extinguishing systems.

The identified issues may be classified into three main themes:

- Physical / chemical;
- Crew awareness; and
- Fire solutions.

Physical / chemical

- *internal latent defects* during the manufacturing process, caused by flaws in the materials, foreign object debris and perturbations in the cells, potentially leading to short circuits within the battery;
- *physical damage* to the battery during its life cycle, which can lead to internal short circuits, an increase in battery temperature, heat release and the discharge of the flammable, toxic electrolyte;
- *overcharging, overdischarging and short-circuiting* of the Li-ion battery are hazardous processes. Whilst overcharging may cause an increase in battery internal pressure and thermal runaway¹, overdischarging (in Li-ion batteries connected in series) may cause capacity degradation and internal short circuiting;
- *thermal abuse* occurs when the battery is exposed to high temperatures. Exposure to high temperatures can cause localised internal heat, potentially leading to internal short circuiting and thermal runaway.

Crew awareness

- *insufficient technical information* to crew members. Crew members do not necessarily have the required technical information to appreciate the risks associated with internal short circuits, the consequent cascading effects of battery thermal runaway, and the related tell-tale signs.

Fire solutions

- *insufficient and / or inadequate means for mitigation and suppression* to control the propagation of a fire which, very often, is extremely rapid, potentially escalating to a fire scenario that becomes beyond control, within a short period of time. Then, even if no fire develops, on board resources for the storage of a damaged Li-ion battery in a safe manner until landed in a dedicated shore facility, may be lacking.

¹ Thermal runaway is an extremely hazardous exothermic process, starting in a single cell and propagating thermally through adjacent cells in a domino effect. Thermal runaway is manifested by an increase in battery temperature and the release of gaseous electrolyte, leading to cell failure, fire, and a potential explosion.

RECOMMENDATIONS

Whilst referring to '[Commercial Yachting Notice No. 4](#)', issued on 22 June 2022 by the Merchant Shipping Directorate of the Authority for Transport in Malta, the MSIU strongly urges owners and managers of Maltese registered vessels, as defined in the [Merchant Shipping Act](#), to require that procurement of Li-ion batteries intended for vessel's use, includes safety and technical data on:

- Protection, handling, safe use, safe storage, and safe disposal;
- Fault / failure detection and required actions; and
- Suppressing, extinguishing and post-fire management.

Owners, managers, and operators of vessels that may carry either leisure equipment powered by Li-ion batteries, electric vehicles (EVs), and / or devices falling under the classification of micromobility (e.g., e-kickscooters) on voyages ranging from domestic to international, are also recommended to ensure that there is thorough awareness on the above points, as necessary.

Where applicable, crew members should be provided with regularly updated information and training on identification, on board accessibility to EVs and micromobility class devices, and tackling of related fires.

Moreover, warning signs should be displayed in crew and passenger spaces, to broaden general awareness on the hazards of Li-ion batteries. This should not be limited to Li-ion batteries belonging to the vessel, and / or carried as cargo, but also personal devices powered by Li-ion batteries.

Local yacht marinas and terminal facility operators are encouraged to assess related risks and take necessary pro-active, mitigating measures.

Safety literature on Li-ion batteries, including shipping as cargo, may be accessed at:

Allianz Global Corporate & Specialty. (2022). Lithium-ion batteries: fire risks and loss prevention measures in shipping. Retrieved from <https://www.agcs.allianz.com/news-and-insights/reports/lithium-ion-batteries.html>

Inspections and Compliance Directorate. (2022). *Lithium battery fire*. Washington, DC: United States Coast Guard. Retrieved from https://www.dco.uscg.mil/Portals/9/DCO%20Documents/5p/CG-5PC/INV/Alerts/USCGSA_0122.pdf?ver=rc2OiSMMTKGn-vlDvy4_w%3d%3d

Pipeline and Hazardous Materials Safety Administration. (2021). *Lithium battery guide for shippers. A compliance tool for all modes of transportation*. Retrieved from <https://www.phmsa.dot.gov/sites/phmsa.dot.gov/files/2021-09/Lithium-Battery-Guide.pdf>

Pipeline and Hazardous Materials Safety Administration. (2022). *Lithium battery test summaries (TS)*. Retrieved from <https://www.phmsa.dot.gov/sites/phmsa.dot.gov/files/2022-01/Test%20Summary%20Brochure%20web.pdf>

United States Environmental Protection Agency. (2022). *Used Lithium-ion batteries*. Retrieved from <https://www.epa.gov/recycle/used-lithium-ion-batteries>