

Ready for take-off?

Industry must take careful note of the requirements for the safe air transport of lithium batteries



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The world is getting smaller. Nowadays flying is as natural as a taxi or train ride. This new mobility and flexibility not only affects our travel destinations, but also our work environment. Mobile work will replace the classic office work station, placing ever higher demands on the effectiveness and performance of mobile devices.

The limiting factor, in addition to the availability of internet access, will be energy supply. Lithium batteries are nowadays the preferred source of power for a wide variety of consumer goods, from cellular phones to robotic vacuum cleaners. The reason for their popularity lies in their high energy density, which can pose a safety risk if they are not handled properly.

With the increasing use of equipment containing lithium batteries, incidents and accidents have become more frequent. Press headlines about burning mobile phones in passenger aircraft come to mind. Less spectacular cases in cargo planes have clearly shown the danger of improper transportation, knowingly or not, of lithium batteries.

In recent years, at least two plane crashes in which the crew all died could be connected to lithium batteries catching fire

during transportation. Even when batteries do not trigger the fire, they can act as a combustion agent and make it uncontrollable. In addition, the most commonly used extinguishing agent, Halon 1301, is ineffective against fires where lithium is involved.

Multiple types

All lithium batteries are classified as dangerous goods for all modes of transport. The term refers to a family of batteries with different chemistries, comprising many types of cathodes and electrolytes. For the purposes of the International Air Transport Association (IATA) Dangerous Goods Regulations (DGR), the following are separated into the following categories.

'Lithium metal batteries' – including lithium alloy batteries – are generally primary (non-rechargeable) batteries that have lithium metal or lithium compounds as an anode. They are generally used to power devices such as watches, calculators, cameras, temperature data loggers, car key fobs and defibrillators. Their capacity is given in 'gram lithium'.

'Lithium-ion batteries' are secondary (rechargeable) batteries where lithium is only present in ion form in the electrolyte. The category also includes lithium polymer batteries. They are generally used to power devices like mobile phones, laptop computers, tablets, power tools and e-bikes. Their capacity is given in watt-hours (Wh).

Energy content is particularly crucial for the decision as to which dangerous goods regulations have to be taken into account for the transportation of lithium-ion batteries. For those with an energy of up to 100 Wh or 2 gram lithium, simplified requirements apply, due to an exemption from [Iata-DGR, PI 965/966/967, Section II](#). Shipped items must be marked with the label shown in Figure 1a for 'small' batteries.

Lithium-ion batteries with more than 100 Wh or more than 2 grams of lithium in energy, however, must always be treated as Class 9 dangerous goods. Shipped items must be marked with the label shown in Figure 1b for 'large batteries'.

They are separated into the following UN numbers, which are valid for all modes of transport: UN 3090: lithium metal batteries;

- » UN 3480: lithium ion batteries;
- » UN 3091: lithium metal batteries contained in equipment;
- » UN 3091: lithium metal batteries packed with equipment;
- » UN 3481: lithium ion batteries contained in equipment; and
- » UN 3481: lithium ion batteries packed with equipment.

All lithium metal cells and batteries (UN 3090) and all lithium ion batteries (UN 3480) shipped by themselves cannot be transported as cargo on passenger aircraft. Batteries contained in or packed with equipment (UN 3090/UN 3480) are

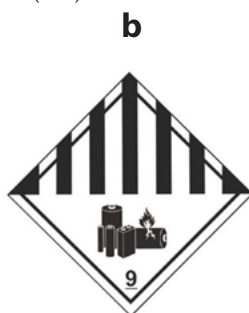


Figure 1 - Labels used in shipment of lithium batteries

allowed, up to a maximum weight of 5 kg/shipped item.

Lithium batteries that have been identified by the manufacturer as being defective for safety reasons, have been damaged or have the potential to produce a dangerous evolution of heat, fire or short circuit are forbidden for transport by air.

All rechargeable lithium ion cells and batteries must be shipped at a state of charge (SoC) not exceeding 30% of their rated design capacity.

Before lithium cells and batteries, including those installed in appliances, can be carried, they must pass the [UN's Manual Tests and Criteria, Part III, Section 38.3](#), which simulate transport conditions such as pressure, temperature, crushing and impact.

The manufacturer or supplier must confirm to the consigner that the batteries have passed these tests. Without this proof, they may only be transported under more stringent conditions as prototypes or as small series (≤ 100) batteries.

Rules and regulations on these batteries also apply to aircraft passengers. Few were worried about the danger of children's toys, such as hoverboards, and the airlines had to respond in order to protect lives.

These regulations vary depending on the airline, but all agree on that spare (uninstalled) lithium ion and lithium metal batteries must be in carry-on baggage only and must be protected from short circuiting.

The danger from lithium batteries does not begin and end in the air. There are also demands on shipping companies in other forms of transport. There have already been several incidents in distribution centres and vehicles and it is almost impossible to test every package for its potential danger.

Here the responsibility lies partly with the senders. They must be made aware, because what seems new and annoying today will become commonplace in the future. The danger is not readily visible; there are no large danger symbols or leaflets on lithium batteries. With technically undamaged batteries that

are properly handled, the danger is certainly calculable.

According to REACH, lithium batteries are classified as 'articles', unlike potentially dangerous hazardous chemicals. Thus, no safety data sheet is required to describe proper handling and educate participants along the supply chain about potential risks. The Regulation in this instance fails to communicate the dangers, as it should do in order to protect human health and the environment.

The safe transport of lithium batteries is therefore not easy for individuals and businesses. Risk minimisation and accident prevention should be a matter of concern for all participants.

In the future, new types of lithium batteries will place even greater demands on transport regulations and make transportation even more complex.

Philipp Lisecki, project manager at Knoell Germany, also contributed to this article. The views expressed are those of the expert author and are not necessarily shared by Chemical Watch



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