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Global demand for lithium-ion battery technology has skyrocketed in recent years, with forecasts predicting 18 percent annual growth in the years to come. This will be driven largely by the transformational electrification of our transportation sector - above all through electric vehicles (EVs). Realistic projections show EVs making up more than 50 percent of new car sales by 2040, and advances in EV science may well see this happen sooner.

The unrelenting consumer demand has pushed manufacturers to engineer lithium-ion batteries in ever greater density. As a result, today's batteries offer an unbeatable combination of performance, lightweight, and efficiency. But this energy density also heightens the risks if the batteries are not transported properly. The airline industry, in particular, is concerned about the lack of awareness of the potential danger posed by lithium-ion batteries and increasing incidents of intentionally mis-declared or non-compliant lithium batteries in cargo shipments.

Lithium-ion battery technology entered public consciousness in the early 1990s, enabling a new generation of portable, rechargeable electronics like laptops and camcorders. Their importance grew by magnitudes with the advent of the smartphone in the early 2000s. Today, they power nearly all the gadgets that define our daily lives, from earbuds to e-scooters. Lithium-ion battery technology is so fundamental to our modern society that its inventors were awarded the Nobel Prize in Chemistry in 2019.

Officially, yes: Lithium-ion batteries are governed under the United Nations regulations UN3480 and UN3481 as Class 9 "miscellaneous dangerous goods." Two dangers stand out: First, improperly packaged lithium-ion batteries can lead to short circuits if they come into contact with each other or with other conductive surfaces. Second, thermal runaway can occur if improperly packaged or secured lithium-ion batteries suffer damage to their internal circuitry when shaken or dropped. Either of these situations can end in fire or explosion.

Unfortunately, most people are unaware that lithium-ion batteries are hazardous and cannot be shipped like other goods. This awareness gap, coupled with the complexity and inadequacy of current regulations, has fueled the widespread and growing noncompliance that is of such concern to the airline industry.

But there is good news: Lithium-ion batteries can be shipped safely by air if shippers take proper precautions. As with all hazardous goods, safely shipping lithium-ion batteries by air requires having personnel with the appropriate expertise and training and complying with strict labeling and packaging requirements. That is why the International Air Transport Association (IATA) is promoting the increased viability of air transport for lithium-ion batteries through a four-part approach:

As mentioned above, transporting lithium-ion batteries is regulated by UN3480 (for batteries "contained in or

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packed with the equipment, but not attached to the source") and UN3481 ("contained in or packed with the equipment, installed/integrated at the source"). There are also IATA regulations for air transport. Shippers must follow these rules, be appropriately certified, and have the training and expertise to prepare lithium-ion batteries for safe air transport.

Lithium-ion batteries must be packaged in compliance with regulations including UN3480, UN3481, and IATA-specific rules. (Picture credit: GWP Group)

Lithium-ion batteries in transit may not exceed a defined maximum state of charge (SoC) - their level of charge relative to capacity. According to the IATA, the SoC must not exceed 30 percent, and it is the shipper's responsibility to ensure compliance with this regulation.

Lithium-ion batteries shipped alone must be packaged in isolation from one another and other conductive surfaces to avoid short circuits. They must also be isolated from certain other dangerous goods. Their packaging must prevent undue movement in transit and damage if dropped to protect against thermal runaway.

Lithium-ion batteries must be appropriately labeled so everyone handling them can comply with the relevant guidelines for Class 9 dangerous goods. The required information on the label may include the type, weight, dimensions, and capacity of the battery, along with the mode of transport.

Ultimately, shippers are solely and entirely responsible for compliance and legally liable in the event of accidents due to non-compliance, so it is in their own self-interest to familiarize themselves with the UN and IATA requirements.

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