UL Standards & Engagement

Empowering Cabin Crew, Educating Passengers:

Roadmap for Strengthening Battery Safety on Flights

The proliferation of lithium-ion batteries in personal electronic devices has introduced new safety considerations for the aviation industry. UL Standards & Engagement's recently published report, "Lithium-Ion Battery Incidents and Their Impact on Aviation Safety," finds that thermal runaway incidents involving lithium-ion batteries on board airplanes have reached a five-year high, with a 28% increase from 2019 to 2023 and an average of two thermal runaway incidents reported weekly in ULSE's Thermal Runaway Incident Program database.

To capture a snapshot of current practices and challenges faced by airline cabin crew in managing lithium-ion battery risks, ULSE conducted a comprehensive survey of 805 airline cabin crew members between June and August 2024. The survey respondents offer a cross-section of the global aviation workforce, mirroring the industry's complex landscape. Respondents hailed from 45 countries and 11 airlines, offering insights across various corporate cultures, operational models, and customer service contexts.

Cabin crew are well-informed about lithium-ion battery hazards, but they believe passengers need better education. While 97% of crew understand the potential for battery fires and explosions, only 46% think airlines effectively communicate these risks to passengers. This perception aligns with findings from separate ULSE surveys of U.S. airline passengers, which reveal that many remain largely unaware of the risks associated with these batteries. This striking dichotomy between crew knowledge and passenger awareness highlights the critical need for improved passenger education through prominent signage, verbal announcements, and more detailed safety briefings.

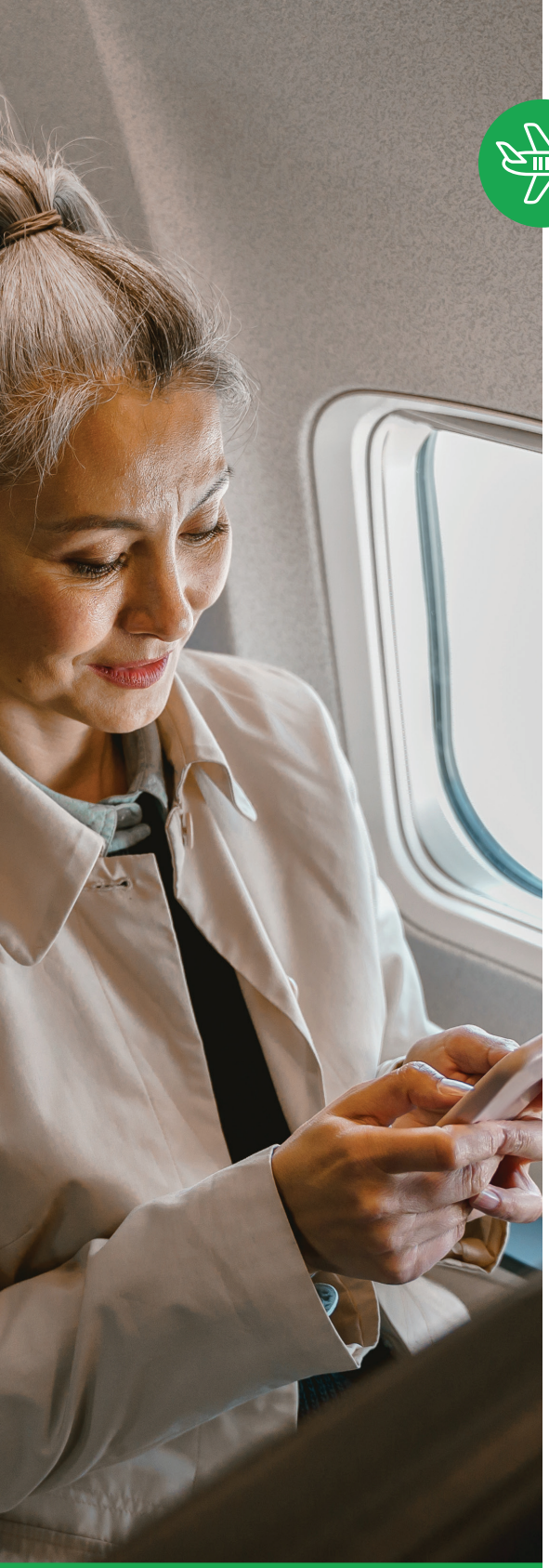
Airline crew members are largely confident in their ability to identify and respond to battery incidents, thanks to clear procedures and training. However, availability of fire containment devices to suppress lithium-ion battery fires is not universal and a notable minority of crew members still lack full confidence that passenger safety is assured — highlighting critical areas for further improvement.

Satisfaction with current lithium-ion battery regulations is high, but opinions are divided on whether government agencies and airlines are doing enough. Over 70% of respondents are satisfied with national regulations, industry standards, and airline-specific rules. However, more than one-third believe that regulators and airlines should take additional steps to improve battery safety.

The results of ULSE's cabin crew survey underscore both the progress made and the work still to be done in ensuring the safety of airline passengers and crew from lithium-ion battery incidents. Based on these insights, stakeholders should prioritize passenger awareness initiatives, refined crew training, and collaborative efforts to strengthen safety protocols. By proactively addressing lithium-ion battery risks, the industry can enhance the safety of crew and passengers alike.

An Increasing Risk

One in five passengers that fly at least once a year have experienced an issue with their mobile device that is linked to thermal runaway.



87% of cabin crew are very or somewhat concerned about lithium-ion battery incidents occurring on an aircraft.

High Awareness of Risks, Desire for More Passenger Education

Airline cabin crew have a strong grasp of the risks associated with lithium-ion batteries on flights, but there's a notable gap in passenger awareness and education. This disconnect suggests a need for airlines to reassess and bolster their passenger education efforts related to lithium-ion batteries.

Widespread Understanding of Thermal Runaway Dangers: An overwhelming 97% of surveyed cabin crew report being very or somewhat aware of the potential for battery thermal runaway, which can lead to fire and even shrapnel ejection. This near-universal understanding underscores the effectiveness of current training programs in educating front-line staff about the potential hazards of these ubiquitous power sources. In contrast, only 65% of airline passengers from ULSE's consumer-focused surveys say they are aware of thermal runaway risks associated with lithium-ion batteries, highlighting a significant knowledge gap between crew and passengers.

Elevated Concerns About In-Flight Battery Incidents: Cabin crew concerns about these risks are also pronounced, with 87% expressing that they are very or somewhat concerned about lithium-ion battery incidents occurring on an aircraft. These apprehensions are understandable given the challenges of managing a battery fire in the confined space of an airplane cabin, where smoke and fumes can quickly create hazardous conditions. Notably, passenger concerns are also significant, with 68% expressing concern about the potential risks, despite lower overall awareness of specific dangers.

Perceived Gaps in Passenger Education Efforts: Nearly 30% of passengers who were asked to gate-check their carry-on bag were NOT asked if it contained any rechargeable or lithium-ion batteries. Cabin crew see significant room for improvement in educating passengers about lithium-ion battery safety, as only 46% agreed that airlines are providing passengers with sufficient information on this topic. While 60% of respondents found their airline's website to be effective in conveying safety information, only 36% said the same about airport signage. This perception aligns with passenger experiences: 41% of airline travelers say they do not recall seeing signage or hearing announcements about lithium-ion battery safety. The theme of missed messages carries over when gate-checking bags as well: 29% of passengers do not recall being asked if they had any rechargeable or lithium-ion batteries in their bag.

94% of respondents expressed confidence in their ability to recognize potential battery hazards during flights.

Crew Are Confident in Training and Procedures But Point to Areas for Improvement

The survey findings paint a generally positive picture of cabin crew preparedness to identify and respond to lithium-ion battery incidents. Though, in some instances, perceived preparedness does not match up with actual resources on hand to contain hazards.

Strong Capability to Recognize Battery Hazards: Mirroring their high awareness levels, an impressive 94% of respondents expressed confidence in their ability to recognize potential battery hazards during flights, and 88% are confident in their ability to identify personal electronics or portable electronic devices powered by or containing lithium-ion batteries.

Aligning Crew Confidence With Safety Resources: Nearly all crew members feel their airline has clear procedures in place for handling battery emergencies (97%) and that they are adequately prepared for such incidents (97%). However, there is a notable gap in the deployment of relevant safety resources on board: 25% reported that their airline either does not provide fire containment devices (19%) or that they are unfamiliar with such equipment (6%). This gap between perceived readiness and actual resources presents a key opportunity for airlines to support crew capabilities.

Lingering Doubts About Overall Passenger Safety: The survey also reveals that while crew training and procedures are strong, cabin crew confidence in lithium-ion battery safety measures is concerningly low. Only 27% feel "very confident" about passenger safety from potential battery incidents, while 55% are merely "somewhat confident" — a lukewarm assurance at best for such a critical safety concern. Alarmingly, 18% lack confidence altogether, feeling either "not very confident" or "not confident at all". And they may be right: 25% of passengers admit they store one or more rechargeable products in their checked luggage, a practice which heightens the risk of thermal runaway incidents going unnoticed and escalating beyond control.

37% of cabin crews feel that airlines need to take additional steps to ensure battery safety.

Satisfaction With Regulations, Divided on Adequacy

There is broad satisfaction with current regulations governing the transport of lithium-ion batteries on passenger flights, but a significant proportion of cabin crew believe more needs to be done by both government agencies and airlines.

> Only 36% believe that regulators like the U.S. Federal Aviation Administration and U.K. Civil Aviation Authority should be doing more to ensure lithium-ion battery safety on flights.

Mixed Opinions on Airline Efforts: Opinions are mixed among cabin crew regarding the adequacy of airline actions — 37% feel that airlines themselves need to take additional steps to ensure battery safety. Again, among respondents from the U.K., this figure rises to more than half (52%). These mixed perspectives underscore the complexity of lithium-ion battery safety and the challenges of satisfying all stakeholders.

High Approval of Multilevel Regulatory Framework: Cabin crew indicated that they are generally satisfied with their airline's specific rules regarding lithium-ion battery safety (85%), national regulations (78%), and voluntary industry standards (71%). This finding suggests that airlines and regulatory bodies have made significant strides in developing and implementing effective lithium-ion battery safety protocols.

Divergent Views on Sufficiency of Government Actions: However, the survey also highlights divergent views on whether current efforts by government agencies and airlines are sufficient. More than a third (36%) believe that regulators like the U.S. Federal Aviation Administration and U.K. Civil Aviation Authority should be doing more to ensure lithium-ion battery safety on flights. While sentiment among U.S.-based crew aligns with this figure, among respondents from the U.K., this figure rises to nearly half (49%).

Standards for Li-Ion Battery Safety in Aviation

UL 1642, Lithium Batteries, and UL 2054, Household and Commercial Batteries

UL Standards & Engagement has more than 80 standards that reduce the risks associated with lithium-ion batteries and the devices that rely on them. Two of these standards — UL 1642, and UL 2054 — cover the batteries and cells in portable devices that consumers often pack while traveling, including smartphones, tablets, laptops, personal care items, toys, and medical devices.

In order to conform to these standards, batteries must be designed and manufactured according to rigorous construction and performance requirements that reduce the risk of fire or explosion.

For example, the construction requirements require that battery casings must have the strength and rigidity to resist the abuses they may encounter in normal use, such as mechanical shock from being dropped during security screening, or a crushing force in the reclining mechanism of an airline seat. This requirement is evaluated through several tests, including the round bar crust test, in which a cell is crushed between a round steel bar and a flat surface, and the impact test, in which a weight is dropped onto the battery. Additional tests include the short-circuit test, abnormal charging test, vibration test, and heating test. Batteries are monitored during these tests, and will not pass if they exhibit signs of thermal runaway — including explosion or catching fire.

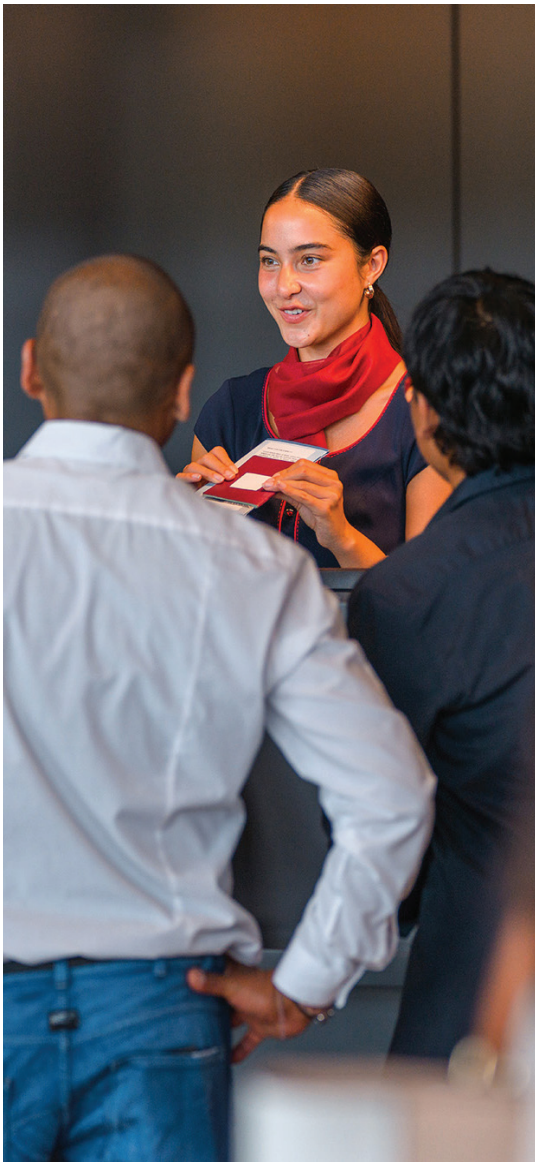
UL 5800, Battery Fire Containment Products

Thermal runaway incidents from lithium-ion batteries during air travel are infrequent, but they are nonetheless dangerous. To mitigate these potentially catastrophic incidents when they do occur, ULSE collaborated with aviation industry experts to develop a safety standard for battery fire containment products.

Battery fire containment products are typically insulated bags or hard cases, large enough to hold a laptop computer, which are designed to suppress the flames and smoke from lithium-ion battery fires. The FAA does not currently require airlines to have this equipment on aircraft, but some airlines have taken the initiative to stock their fleets.

Under required testing in UL 5800, a lithium-ion cell is placed inside a containment product and intentionally driven into thermal runaway. The containment product is placed on a softwood surface and covered with white tissue paper and a single layer of cheesecloth. Temperature and smoke release rate measurements are recorded throughout testing. In order to conform to UL 5800, a containment product must contain all flames, visible smoke, and shrapnel from the thermal runaway event. Its surface must not exceed specified temperatures, and it must not allow flames to breach and ignite the cheesecloth or tissue paper.

Additionally, UL 5800 requires clear instructions and cautionary markings on the outside of the product, to facilitate ease of use by trained personnel in an emergency situation.



Recommendations

The insights gleaned from ULSE's cabin crew survey offer valuable guidance for industry stakeholders seeking to bolster lithium-ion battery safety on passenger flights.

1. Airlines should **prioritize the development and implementation of robust passenger education initiatives.** Efforts may include prominent signage at check-in counters and gates, targeted information campaigns on airline websites and mobile apps, and the incorporation of battery safety information into pre-flight safety briefings. The goal should be to ensure that every passenger is aware of the risks associated with lithium-ion batteries and knows how to comply with relevant regulations and guidelines.
2. Airlines must **continue to invest in crew training programs to maintain high levels of preparedness and confidence in dealing with battery incidents.** Regular training updates, hands-on simulations, and universal provision of safety equipment such as fire containment devices that meet safety standards can all help crew feel better equipped to handle these challenging situations. Airlines should also foster a culture of open communication and feedback, encouraging crew to share their experiences and concerns related to battery safety.
3. Government agencies and airlines should **prioritize collaboration and information sharing to identify areas for improvement in current regulations and practices.** This may involve convening industry working groups, conducting further research on emerging battery technologies and risks, and engaging with frontline employees to gather on-the-ground perspectives.

Methodology

These results were primarily taken from a ULSE Insights survey of 805 airline cabin crew members, conducted between June 2024 and August 2024. For margin of sampling error calculation, we conservatively assume a wide range for the target population between 20,000 and 50,000 cabin crew members employed by participating airlines. Under this assumption, at 95% confidence for aggregate results, margin of error is +/- 3.4%. Sampling error is larger for subgroups of the data.

Supplemental results on airline passengers were taken from a separate ULSE Insights survey series of a cumulative 16,146 U.S. adults, conducted between August 2023 and July 2024, are also included in the report. The margin of sampling error at 95% confidence for aggregate results is +/- 0.7%. Sampling error is larger for subgroups of the data. Respondents who fly at least once a year were considered airline passengers.

All studies were designed and formulated by UL Standards & Engagement. Surveys were administered online by BV Insights. As a member of the Insights Association and ESOMAR (the European Society for Opinion and Marketing Research), BV Insights adheres to industry ethics and best practices, including maintaining the anonymity of respondents.

As with any survey, sampling error is only one source of possible error. While non-sampling error cannot be accurately calculated, precautionary steps were taken in all phases of the survey design and the collection and processing of the data to minimize its influence.

Note: All numbers are percentages unless otherwise noted. Figures may not total 100% due to rounding.