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Guidance Document

MANAGING LITHIUM BATTERY RISKS IN AVIATION OPERATIONS

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Photo: Ministry of Land, Infrastructure and Transport

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ABOUT WYVERN

Built on a Foundation of Safety Leadership

Since 1991, WYVERN has been a trusted leader in aviation safety, providing auditing and certification services to Fortune 100 companies that demand the highest standards for air charter operations.

To advance safety across the industry, WYVERN developed the Wingman Standard—the first comprehensive code of best practices for private and business aviation—setting the benchmark for excellence in flight operations, aircraft maintenance, and safety management systems.

Today, WYVERN is a globally recognized aerospace service provider, **certified to ISO 9001 and ISO 27001 standards**. Our clients include energy and power companies, aircraft manufacturers, corporate flight departments, charter operators and brokers, air medical providers, hospitals, fixed-base operators, and maintenance organizations worldwide.

We empower aviation stakeholders to make confident, informed risk management decisions through industry-leading education, training, consulting, auditing, coaching, advanced risk management software, and a comprehensive aviation safety intelligence database.

Driven by a commitment to continuous improvement, WYVERN pursues a clear vision: a world where every aerospace service provider operates with a strong and sustainable safety culture.

SCOPE

Lithium batteries are routinely carried aboard aircraft in a wide range of portable electronic devices, including phones, tablets, laptops, cameras, power banks, electronic cigarettes, and medical equipment. Although these batteries are generally safe when properly manufactured, handled, and used, damaged, defective, or overheating batteries can enter thermal runaway - a rapid, self-sustaining increase in temperature that may produce toxic fumes, smoke, fire, flammable gases, or explosion. This guidance is intended to help aircraft operators identify, assess, mitigate, and continuously monitor lithium-battery risks within their Safety Management System (SMS).

FAA classifies a lithium battery fire as a High-Energy Fire (HEF). An HEF is a fire involving a battery or other energy storage device that has components or materials with the potential to release a significant amount of additional energy that would further fuel the fire. This results in a heat release and rate of heat release that is higher than a typical Class A fire, can more easily harm nearby individuals, and be characterized as relatively unpredictable.

Lithium battery events involving smoke, fire, or extreme heat remain a recurring aviation hazard. FAA incident data continue to demonstrate the importance of proactive hazard identification, risk assessment, effective controls, and continued monitoring. Operators should review the FAA Lithium Battery Incident Database and Interactive Chart as part of their SMS activities. For U.S. operators, applicable FAA guidance and U.S. DOT hazardous-materials regulations establish the primary regulatory baseline, while international operations must also consider the current ICAO Technical Instructions, addenda, corrigenda, and applicable State variations.

REGULATORY NOTE

This document provides operational guidance and does not replace applicable U.S. regulations, FAA-approved or accepted company procedures, ICAO Technical Instructions, or applicable State variations. Because lithium battery requirements continue to evolve, operators should verify current FAA and ICAO requirements when establishing or revising company policies.

PRIMARY RISKS

The primary aviation risk associated with lithium batteries is an unpredictable and rapidly developing thermal-runaway fire event that may produce intense heat, smoke, fire, flammable gases, or explosion and may become difficult or impossible to control in flight. FAA AC 120-80B emphasizes the criticality of an in-flight fire, noting that a fire may become uncontrollable within minutes and that the time available to land can be limited. Lithium battery hazards and escalation factors include:

Thermal Runaway. may result from physical damage, internal defects, short circuits, excessive heat, improper charging, or damaged or recalled batteries. Warning signs include unusual heat, swelling, odor, hissing, popping, smoke, or visible flame.

Fire and Heat. A small battery can generate enough heat to ignite nearby cabin materials.

Smoke and Fumes. Battery failure may rapidly produce smoke and irritating or hazardous gases in a confined cabin.

Reignition. Extinguishing visible flames does not necessarily stop thermal runaway. Continued cooling and monitoring may be required.

Inaccessible Devices. Batteries inside baggage areas, inaccessible compartments, or powered seats may be difficult to reach after an event begins. This is especially important in small Part 135 cabins with limited crew staffing.

LITHIUM BATTERY-RELATED ACCIDENTS & INCIDENTS

Lithium-battery-related accidents and incidents have contributed to increased regulatory attention, operational controls, and safety initiatives. The following events illustrate the potential consequences of battery fires in both passenger and cargo operations:

Air Busan Flight 391 (January 2025): An Airbus A321 was destroyed by fire at Gimhae International Airport in South Korea before departure. ICAO subsequently cited the accident when explaining its 2026 power-bank restrictions, describing the fire as likely initiated by a short circuit in a lithium-ion battery in an overhead compartment. All occupants evacuated; the investigation remained the authoritative source for final causal findings. [1]

UPS Airlines Flight 6 (2010): A Boeing 747-400 freighter crashed near Dubai after an in-flight cargo fire. The shipment included a large quantity of lithium batteries. Both flight crewmembers were killed. The accident remains an important example of the hazards created by fire, smoke, and degraded flight-deck visibility. [2]

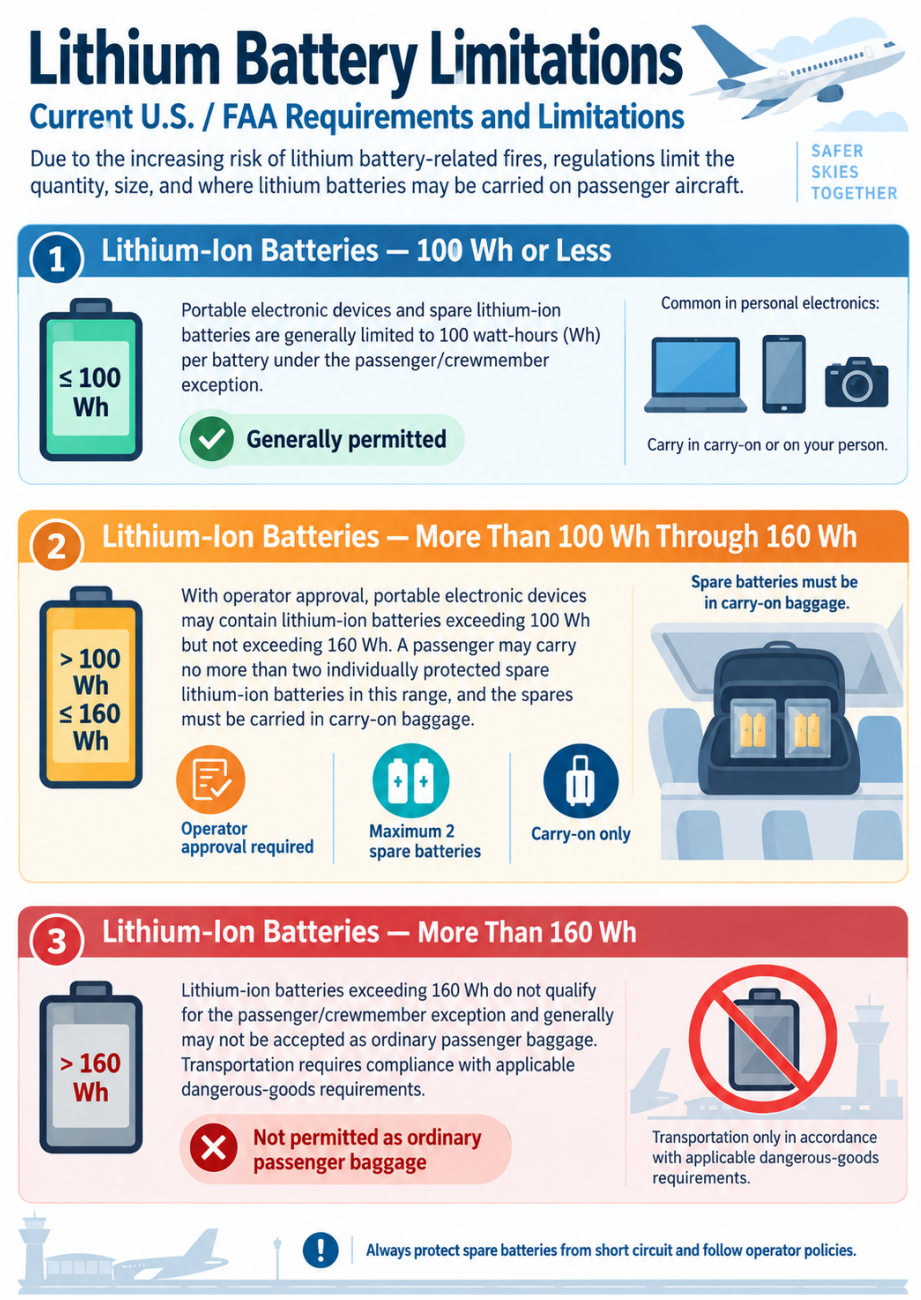
Asiana Airlines Flight 991 (2011): A Boeing 747 freighter carrying dangerous goods, including lithium batteries, experienced an in-flight fire and crashed into the sea near Jeju Island, resulting in two fatalities. [3]

These events differ in operating context and causal detail; they should not be treated as interchangeable. Their common relevance is the potential for lithium-battery events to develop rapidly, generate intense heat and smoke, and challenge continued safe aircraft operation.

Operators should consult official investigation reports and current regulator guidance when using accident or incident examples in training or risk assessments.

CURRENT U.S. FAA REQUIREMENTS AND LIMITATIONS

Current FAA and U.S. DOT requirements limit the quantity, size, preparation, and location of certain lithium batteries carried on passenger aircraft. Operators should verify current requirements before establishing or revising company procedures.



Source: FAA PackSafe guidance. Verify current requirements before use.

PORTABLE ELECTRONIC DEVICES

When lithium battery-powered portable electronic devices are placed in inaccessible baggage areas, applicable devices must be completely switched off (not in sleep or hibernation mode), protected against accidental activation, and protected against damage. A limited exception applies to very small batteries not exceeding 0.3 g lithium content or 2.7 Wh.

LITHIUM METAL BATTERIES

Lithium metal batteries are generally limited to 2 grams of lithium content per battery. With operator approval, certain portable medical electronic devices may contain lithium metal batteries exceeding 2 grams but not exceeding 8 grams, subject to the applicable conditions and spare-battery limits.

ELECTRONIC CIGARETTES AND VAPING DEVICES

- Must be carried on the passenger's person or in carry-on baggage.
- Must be protected against accidental activation.
- Must not be recharged aboard the aircraft.
- Must not be placed in inaccessible baggage areas.

DAMAGED OR DEFECTIVE BATTERIES

Batteries and battery-powered devices likely to create sparks or a dangerous evolution of heat are forbidden unless made safe or packaged to prevent the hazard. Operators should be alert for swollen, cracked, leaking, excessively hot, physically damaged or recalled batteries.

LITHIUM BATTERY MOBILITY AIDS

Lithium-ion battery-powered wheelchairs and mobility aids are subject to separate requirements. Where the battery must be removed, it must be carried in carry-on baggage and generally must not exceed 300 Wh. Applicable provisions may permit one spare battery up to 300 Wh or two spares up to 160 Wh each. The PIC must be advised of the location of applicable lithium-ion batteries aboard the aircraft.

INTERNATIONAL OPERATIONS – CURRENT ICAO LIMITATIONS

International operations should be evaluated against ICAO Annex 18 and ICAO Doc 9284, Technical Instructions for the Safe Transport of Dangerous Goods by Air, 2025-2026 Edition, including Addendum No. 1 (effective March 27, 2026), Corrigendum No. 2 (May 7, 2026), and applicable State variations. Addendum No. 1 introduced additional restrictions for passenger-carried power banks, including a limit of no more than two power banks per person and a prohibition on recharging power banks aboard the aircraft.

OPERATOR RISK ASSESSMENT AND MITIGATION STRATEGIES

Operators should address lithium battery hazards through their SMS and operating procedures. Each operator should perform a risk assessment appropriate to its aircraft, passenger profile, baggage configuration, staffing, and operating environment. Within a typical 5-by-5 SMS risk matrix, an in-flight lithium battery fire may initially be assessed as high risk because of its potentially catastrophic severity, even when likelihood is assessed as remote. Operators should apply their approved risk-assessment methodology and establish appropriate controls before accepting residual risk.

At a minimum, procedures should address:

- Passenger-carried batteries, spare batteries and power banks
- Electronic cigarettes and crew EFBs/electronic devices
- Mobility aids and battery-powered medical equipment
- Baggage compartment and powered-seat accessibility
- Emergency equipment and crew response
- Passenger notification and diversion considerations

Passenger-carried lithium batteries and battery-powered devices that present a credible in-flight thermal-runaway hazard should, to the greatest extent practicable and consistent with applicable regulations, remain accessible for detection, response, cooling, and monitoring. Before loading baggage into an inaccessible compartment, personnel should identify and remove applicable spare batteries, power banks, electronic cigarettes, and other battery-powered items as required by regulation or company policy.

EMERGENCY EQUIPMENT CONSIDERATIONS

Operators should evaluate the following equipment as part of their lithium battery fire-risk mitigation strategy:

Fire Containment Device - When selecting lithium battery fire-containment equipment, operators should consider products certified to ANSI/CAN/UL 5800, Standard for Safety for Battery Fire Containment Products. UL 5800 provides standardized testing and performance criteria for containment products intended to manage thermal-runaway events involving portable electronic devices, including requirements for construction, fire performance, marking, instructions, and packaging. FAA AC 120-80B recognizes the standard and notes that its testing and certification can help reduce the risk associated with in-flight thermal-runaway events. Certification provides additional assurance that a containment product has been independently evaluated against defined performance requirements rather than relying solely on manufacturer claims.

NOTE: ANSI/CAN/UL 5800 is a recognized consensus standard for battery fire-containment products. The FAA does not itself certify commercial fire-containment bags or cases. Operators should verify current FAA guidance and applicable certification or testing requirements when selecting equipment.

Emergency Vision Assurance System (EVAS) - A supplemental system designed to help pilots view critical flight instruments and controls through dense smoke. Operators considering smoke-vision technologies should evaluate aircraft compatibility, approval status, crew training, installation requirements, and integration with emergency procedures.

Portable Breathing Equipment (PBE or Smoke Hood) - A portable, self-contained breathing device used by flight attendants and cabin crew to protect against smoke, harmful gases, carbon dioxide, and oxygen deficiency during in-flight fire, smoke, or fume emergencies. Applicable operating rules should be reviewed to determine required PBE locations and quantities.

Portable oxygen equipment (walk-around bottle and mask) - Operators should evaluate whether portable oxygen equipment is appropriate for the aircraft, crew complement, and approved fire-response procedures.

SCENARIO-BASED TRAINING

Lithium battery awareness and emergency response should be included in initial and recurrent training appropriate to employee duties. Flight and cabin crew training should address:

- Recognition of thermal runaway and warning signs.
- Lithium battery fire characteristics and extinguisher use.
- Cooling procedures and smoke management.
- Protective equipment and passenger relocation.
- Device isolation, reignition and monitoring.
- Diversion considerations.

Scenario-based or hands-on training should be used when practical. Special consideration should be given to Part 135 flights conducted without a cabin attendant, where pilots may need to manage both the aircraft and the cabin emergency. Ground, flight operations, charter sales, and other customer-facing personnel should receive sufficient awareness training to identify batteries or devices requiring further review.

EMERGENCY RESPONSE

Initial Flight Crew Response

According to FAA AC 120-80B, initial flight crew priorities during a high-energy fire include:

1. **FLY THE AIRCRAFT:** Designate one flight crewmember to establish and maintain control of the aircraft.
2. **OXYGEN MASK AND GOGGLES:** Don oxygen mask and goggles and verify the regulator is set to 100 percent, in accordance with the aircraft and operator procedures.
3. **DIVERT:** Consider immediate descent and landing at the nearest suitable airport.
4. **ELIMINATE THE THREAT:** Promptly determine the high-energy-fire source, gain access, and apply the appropriate firefighting procedure.

FAA SAFO 25002 emphasizes that lithium battery events warrant specific operational planning because thermal runaway can escalate rapidly, may be difficult to detect when a battery is stowed, and may continue after visible flames are suppressed. Operators should incorporate this hazard into emergency-response planning and realistic drills that address:

- Immediate crew notification and coordination between the cabin and flight deck.
- Access to devices in difficult-to-reach locations.
- Use of appropriate extinguishing equipment.
- Sustained cooling with water until the cells have discharged their energy.
- Protection of passengers from smoke.
- Continued monitoring for heating or reignition.

These exercises should also evaluate whether company procedures, equipment placement, passenger communication, and crew training are effective under actual operating conditions.

HUMAN FACTORS CONSIDERATIONS

Lithium battery fires present a significant human-factors challenge because they require pilots to manage an abnormal, rapidly evolving cabin emergency while continuing to safely operate the aircraft. Unlike many emergencies supported by well-rehearsed checklists, lithium battery events may require recognition, extinguishing, sustained cooling, containment, and continued monitoring for reignition. Limited hands-on training and inconsistent operator procedures can therefore create differences in crew expectations, task sequencing, and role assignment at the exact time that workload and stress are rapidly increasing.

Task saturation is a primary concern. The crew may simultaneously need to maintain aircraft control, communicate with ATC, divert, assess weather, manage passengers, and respond to the fire. If one pilot leaves the flight deck to address the cabin emergency, the remaining pilot effectively assumes single-pilot responsibility for aircraft control, navigation, communications, diversion planning, and monitoring of the developing cabin situation. This creates increased vulnerability to divided attention, loss of situational awareness, communication errors, and degraded decision-making, particularly during night operations, IMC, high-workload phases of flight, or when aircraft equipment is degraded.

Effective mitigation therefore depends heavily on crew coordination and preparation. Clearly defined Pilot Flying and Pilot Monitoring responsibilities, predetermined criteria for recalling a pilot from the cabin, realistic assumptions about passenger capabilities, scenario-based recurrent training, and consideration of MEL limitations can reduce the likelihood that the fire emergency creates a secondary aircraft-control or decision-making problem. The central human-factors risk is not the fire alone, but the combined effect of stress, competing tasks, reduced crew resources, and rapidly changing operational priorities.

MEL AND DEGRADED-SYSTEM CONSIDERATIONS

An aircraft released with MEL-deferred equipment may face additional risks if a lithium battery fire requires one pilot to leave the flight deck to assist in the cabin. The preflight MEL review should therefore consider not only the acceptability of each deferment for normal operations, but also its effect on the remaining pilot's ability to manage the aircraft during an emergency. Degraded navigation, communications, or alerting systems may increase workload and reduce available safety margins during a time-critical diversion.

Operators should incorporate these combined risks into their SMS hazard assessments, dispatch decisions, and emergency response training. Crews should consider how MEL limitations could affect a temporary reduction in flight-deck staffing and establish clear procedures for maintaining aircraft control, communicating with the cabin, and prioritizing an expeditious landing. Training should include realistic scenarios involving deferred equipment, high workload, and a cabin lithium battery event.

Passenger oxygen systems also warrant consideration during a lithium battery fire. Standard passenger oxygen masks are intended primarily to provide supplemental oxygen during decompression and generally do not provide the respiratory protection needed against smoke and toxic combustion products. This limitation reinforces the importance of prompt fire suppression, appropriate smoke-removal procedures, use of approved protective equipment, and an expeditious landing in accordance with the aircraft's procedures.

PASSENGER AWARENESS AND COMMUNICATION

Passenger education should begin before arrival at the aircraft whenever practical. Operators conducting for-hire passenger transportation must maintain a system that effectively informs passengers about hazardous materials they are prohibited from transporting. For Part 135 certificate holders, procedures necessary to implement that system should be included in an operations manual or other appropriate manual. Lithium battery information should be incorporated, as appropriate, into booking confirmations, trip information, baggage acceptance, passenger websites or apps, FBO or passenger lounge information, and preflight safety briefings. Crews should instruct passengers to keep applicable batteries and battery-powered devices accessible during flight and to immediately notify a crewmember if a device becomes unusually hot, swells, emits an unusual odor, hisses, smokes, or catches fire.

Sample Passenger Briefing

Lithium Battery Safety: Please keep spare batteries, power banks, and electronic cigarettes with you in the cabin and protected from damage. Electronic cigarettes must not be charged aboard the aircraft. Follow crew instructions concerning the use or charging of other electronic devices. If any device becomes unusually hot, swells, produces an unusual odor, hisses, or begins to smoke, notify a crewmember immediately.

*For international flights subject to current ICAO requirements, passengers should also be advised that no more than two power banks may be carried per person and that power banks may not be recharged aboard the aircraft. Operators should verify applicable State and operator variations before use.

ACCESSIBILITY

Lithium battery accessibility should be evaluated in the context of the aircraft's actual cabin and baggage configuration. Unlike many air carrier aircraft, private aircraft typically do not have overhead bins and instead use internal closets, aft or forward baggage compartments, side compartments, or other dedicated storage areas. Consistent with FAA SAFO 25002, operators should identify any location where a lithium battery could become obscured, difficult to access, or unavailable for monitoring during flight, because delayed access can significantly increase the risk if a battery begins to overheat, smoke, or enter thermal runaway.

Part 135 operators should therefore establish procedures that discourage or restrict the placement of spare lithium batteries, power banks, and other high-risk battery items in baggage compartments that cannot be accessed in flight. When baggage must be placed in such compartments, operators should have a process to identify and remove applicable lithium batteries before loading whenever required by regulation or company policy. Passenger briefings and crew procedures should reinforce that lithium batteries should remain in locations where a developing event can be detected, reached, cooled, and monitored promptly.

WYVERN OPERATOR ACTION CHECKLIST

Operators should be able to demonstrate the following key controls:

- ☐ Prevent prohibited, damaged, defective, recalled, or improperly prepared batteries from being carried.
- ☐ Keep applicable batteries accessible and transport them in accordance with current regulations and company procedures.
- ☐ Keep applicable batteries accessible and transport them in accordance with current regulations and company procedures.
- ☐ Inform passengers before and during the flight about applicable restrictions, warning signs, and reporting expectations.
- ☐ Train crews to recognize, extinguish, cool, isolate, and monitor lithium battery events.
- ☐ Equip aircraft appropriately to manage a lithium battery emergency until landing, consistent with the aircraft and operator procedures.
- ☐ Conduct realistic emergency-response drills that include lithium battery events.
- ☐ Include lithium battery fire risks in the operator's SMS to support ongoing risk management, safety assurance, and continuous monitoring.

For U.S. operations, 49 CFR and current FAA guidance establish the baseline. For international operations, operators must additionally evaluate the current ICAO Technical Instructions, applicable addenda and corrigenda, and State variations. Lithium batteries should be managed as both a dangerous-goods compliance issue and an operational fire hazard within the operator's SMS.

REFERENCES AND ADDITIONAL GUIDANCE

FAA Resources

FAA Lithium Battery Incident Database and Interactive Chart
Events involving smoke, fire or extreme heat; FAA notes the list is not complete.
https://www.faa.gov/hazmat/resources/lithium_batteries/incidents

FAA Lithium Battery Resources
https://www.faa.gov/hazmat/resources/lithium_batteries

FAA PackSafe - Airline Passengers and Batteries
https://www.faa.gov/hazmat/packsafe/airline-passengers-and-batteries

FAA PackSafe - Lithium Batteries
https://www.faa.gov/hazmat/packsafe/lithium-batteries

FAA PackSafe - Portable Electronic Devices Containing Batteries
https://www.faa.gov/hazmat/packsafe/portable-electronic-devices-with-batteries

FAA PackSafe - Baggage Equipped with Lithium Batteries
https://www.faa.gov/hazmat/packsafe/baggage-with-lithium-batteries

FAA SAFO 25002 - Managing the Risks of Lithium Batteries Carried by Passengers and Crewmembers
Safety risk management, accessibility, passenger communication, crew training and mitigation.
https://www.faa.gov/other_visit/aviation_industry/airline_operators/airline_safety/safo/all_safos/SAFO25002.pdf

FAA AC 120-80B - Firefighting of General and High-Energy In-Flight Fires
Applicable to Parts 91, 91K, 121, 125 and 135.
https://www.faa.gov/regulations_policies/advisory_circulars/index.cfm/go/document.information/documentID/1041699

ICAO Guidance

ICAO Annex 18 - The Safe Transport of Dangerous Goods by Air
https://www.icao.int/safety/dangerousgoods

ICAO Doc 9284 - Technical Instructions for the Safe Transport of Dangerous Goods by Air, 2025-2026 Edition; Addendum No. 1 (March 27, 2026); Corrigendum No. 2 (May 7, 2026)
https://www.icao.int/Dangerous-Goods/Technical-Instructions

Accident Investigation Sources

[1] Republic of Korea Aviation and Railway Accident Investigation Board (ARAIB), Preliminary Report of Air Busan HL7763 (BX391), February 26, 2025.
https://araib.molit.go.kr

[2] UAE General Civil Aviation Authority (GCAA), Final Air Accident Investigation Report, AAIS Case Reference 13/2010, Boeing 747-44AF N571UP (UPS Flight 6).
https://www.gcaa.gov.ae/en/departments/airaccidentinvestigation/invigation-reports

[3] Republic of Korea Aviation and Railway Accident Investigation Board (ARAIB), Aircraft Accident Report, Asiana Airlines B747-400F HL7604 (Flight 991).
A copy of the report is available through FAA.
https://www.faa.gov/sites/faa.gov/files/2022-11/Asiana991_Final_Report.pdf

Industry Standard

ANSI/CAN/UL 5800 - Standard for Safety for Battery Fire Containment Products
https://webstore.ansi.org/standards/ul/ansiul58002020