

POWERING COMPLIANCE: Lithium-Ion Battery & Packaging Testing for Regulatory Success

White Paper



Americase®

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INSIGHTS FROM AMERICASE'S COLLABORATION WITH REGULATORY COMMITTEES AND ADVANCED TESTING EXPERTISE

Overview

Lithium-ion batteries are essential to modern industries, powering consumer electronics, electric vehicles, aerospace applications, and large-scale energy storage systems. However, if misused, mishandled, neglected, or abused, their high energy density and chemical composition can present safety challenges, such as thermal runaway or explosion. To mitigate these dangers, regulatory bodies have begun to develop expanded and increasingly stringent compliance measures to govern the manufacturing, transportation, storage, and disposal of these batteries.

For compliance standards to be effective, they must be supported by rigorous, repeatable testing protocols that validate battery safety in real-world conditions. Regulators must account for evolving battery chemistries, battery construction/assembly, cell formfactors, packaging innovations, and worst-case failure scenarios while ensuring that compliance measures remain practical and enforceable. Industry leaders with specialized expertise—such as manufacturers, airlines and aeronautical engineering companies, and we at Americase—play a crucial role in this process by conducting compliance testing, evaluating results, developing containment solutions, and providing essential data that informs regulatory decision-making.

This paper examines the key testing needs of regulatory committees, the challenges involved in developing lithium-ion battery safety standards, and Americase's role in shaping compliance measures. Through case studies and best practices, it highlights how collaboration between regulatory bodies and technical experts leads to stronger, science-backed safety standards that protect people, infrastructure, equipment, supply chains, and brand reputation.

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THE GROWING NEED FOR LITHIUM-ION BATTERY SAFETY AND COMPLIANCE TESTING

The demand for lithium-ion batteries has surged in recent years, driven by advances in electric vehicles, renewable energy storage, and consumer electronics. [According to market forecasts](#), global demand for lithium-ion batteries will increase more than sevenfold by 2030. However, this rapid expansion has also amplified the potential safety risks associated with battery failures, making rigorous safety testing a priority.

Lithium-ion batteries are inherently safe, but failures can result from several factors, including manufacturing defects, overcharging, short circuits, mechanical damage, misuse, mishandling, abuse, or neglect. These failures can lead to a thermal runaway, where internal battery temperatures rise uncontrollably, potentially causing fires or explosions. The U.S. Consumer Product Safety Commission has reported [an increase in lithium-ion battery-related incidents](#), particularly in consumer electronics and energy storage systems.

One of the most widely recognized lithium-ion battery failures occurred in 2013, when Boeing's 787 Dreamliner fleet was [grounded due to battery overheating incidents](#). This prompted an urgent review of lithium-ion battery containment and transport policies, leading to stricter aviation safety measures. Similarly, in 2023, a fire at a South Korean energy storage facility killed 22 workers, leading to calls for more rigorous safety testing in large-scale lithium-ion storage applications.

As these cases demonstrate, lithium-ion battery failures can have potentially dangerous consequences. Regulatory agencies worldwide have responded by developing compliance standards that mandate testing and containment measures. However, creating and enforcing these standards requires extensive real-world data, repeatable testing methodologies, and collaboration with industry leaders.

THE TESTING NEEDS OF REGULATORY COMMITTEES

Regulatory agencies establish compliance requirements to ensure lithium-ion batteries can be safely transported, stored, and disposed of. Some of the key regulatory bodies overseeing lithium-ion battery compliance include:

- **The United Nations Subcommittee on the Transport of Dangerous Goods**, which classifies lithium-ion batteries as hazardous materials and establishes global shipping requirements.
- **The U.S. Department of Transportation (DOT)**, which sets regulations for transporting lithium-ion batteries, particularly damaged, defective, or recalled (DDR) batteries.
- **The International Civil Aviation Organization (ICAO)**, which enforces stringent safety measures for transporting lithium-ion batteries via air.
- **SAE International**, which develops voluntary industry standards for lithium-ion battery packaging and storage.

Despite existing regulations, regulatory bodies face several challenges in developing standardized testing methodologies. As battery manufacturers continue to develop new lithium-ion chemistries, the entire logistical chain, from packaging designs to end of life cycles, is affected as existing compliance standards may become outdated. Regulators must continuously update testing requirements to ensure they remain relevant.

Additionally, there is no universal method for testing lithium-ion battery packaging and containment systems. Some tests focus on impact resistance, while others evaluate a package's ability to withstand thermal runaway. The lack of uniform global testing standards makes it difficult to assess the effectiveness of safety measures across all industries and applications.

To address these challenges, regulatory agencies rely on industry experts who conduct real-world testing and provide critical data to refine safety requirements.

"One of the most rewarding parts of my work is the privilege of working with regulatory agencies and committees focused on Li-ion safety and compliance," says Americase President and CEO Robby Kinsala. "Recently, the SAE G-27 base standard was released, which led to a lot of important outcomes – namely, a repeatable testing methodology that could be replicated from lab to lab, and the introduction of slash sheets for additional hazard mitigation."

The SAE G-27 committee has been on the forefront of driving the efforts to develop standardized testing methods for lithium battery packaging safety, particularly for air transport. Over seven years, the committee worked with seven to ten independent laboratories worldwide, conducting round-robin testing to ensure consistent, statistically valid results. The team focused on evaluating packaging performance in containing hazards from thermal runaway, such as flames, gas emissions, and projectiles. Test engineers designed and



conducted various tests—including thermal runaway propagation, heat and flame exposure, and mechanical impact simulations—to verify packaging integrity under real-world conditions. Standardization efforts posed challenges, including maintaining consistent test execution across labs and addressing differences in battery chemistry and form factors. To ensure reproducible results, the committee introduced slash sheets detailing specific methodologies. Despite funding constraints, with individual labs shouldering the majority of the costs, the committee's work continues to influence industry practices and future ICAO regulations. Moving forward, the team aims to refine safety standards, expand testing to additional battery formats, and incorporate real-world transport conditions to enhance aviation safety.

AMERICASE'S CONTRIBUTIONS TO LITHIUM-ION BATTERY AND PACKAGING SAFETY TESTING

Americase has established itself as a leader in lithium-ion battery safety, working closely with regulatory bodies to develop and refine compliance testing protocols. The company is actively involved with:

- **SAE G-27:** Lithium Battery Packaging, is a technical committee in SAE's General Projects Systems Group with the responsibility for the development and maintenance of minimum performance package standards that support the safe shipment of lithium batteries as cargo on aircraft)
- **SAE J3303:** a subcommittee on Lithium and Lithium-Ion Cell and Battery Containment Performance Recommended Practice for Storage. J3303 is focused on crafting standards and regulations for safe storage of lithium-ion batteries.
- **United Nations Hazard-Based Classification Working Group**, which seeks to refine how lithium-ion batteries are categorized based on their energy density, failure potential, and containment effectiveness.
- **MDTC** (Medical Device Transport Council), formed to promote the safe transport of medical devices and their components.



Americase supports the work of the above organizations and committees by providing specialized safety testing services and expertise, including:

- **Thermal runaway containment testing**, simulating worst-case battery failure scenarios.
- **Thermal runaway propagation testing**, which involves initiating a thermal runaway reaction within a package and assessing its ability to contain flames, gas emissions, and projectiles (resulting from cell disassembly).
- **Impact and drop testing**, ensuring that lithium-ion battery packaging can withstand mechanical stress.
- **Heat exposure and flame exposure testing**, which simulates prolonged heat exposure to assess packaging integrity.
- **Hazardous material transport testing**, validating compliance with DOT and UN regulations.
- **Gas flammability and volume testing**, which involves initiating a thermal runaway to gather data for analysis or validation.

As a leading designer and manufacturer of industry-leading containment solutions, Americase has an in-house testing laboratory to ensure our packaging solutions meet or exceed all performance and regulatory standards. The in-house laboratory, Fulcrum Testing, also provides continued insights that inform our processes and add to our understanding and expertise.

“The world-class capabilities of our in-house testing lab give our customers an enormous advantage,” says Chris Egloff, VP of Strategic Business Opportunities at Americase. “We’re able to create custom test plans for virtually any scenario. The lab’s robust testing infrastructure and capabilities – including everything from drop and impact tests to flame and thermal resistance to environmental analysis – leave no stone unturned and make the challenge to ‘standardize’ much easier.”

CASE STUDY: LARGE-SCALE LITHIUM-ION BATTERY RECALL AND TESTING

In 2016, a global consumer electronics company faced an urgent recall of more than two million smartphones due to defective lithium-ion batteries. These batteries were overheating, catching fire, and posing serious safety risks. The company needed an immediate solution to test, package, and transport the recalled devices in compliance with all applicable regulations.

Americase developed a cutting-edge containment and transport system that met all UN and DOT regulatory requirements. The company conducted extensive testing on the recalled batteries, assessing potential failure conditions and developing packaging capable of containing thermal events.



The recall served as a key learning opportunity for future compliance measures, reinforcing the importance of proactive testing and safety planning in large-scale lithium-ion battery management.

“This recall gave us the opportunity to bring all of our knowledge and capabilities together when it really counted most,” says Robby Kinsala, President and CEO at Americase. “While we didn’t know at the time, we were essentially creating a playbook for how to handle significant mass recalls. It was the largest mass recall of a Li-ion battery-powered-device in history.”

BEST PRACTICES FOR REGULATORY TESTING AND COMPLIANCE

Ensuring the safe use, transport, and storage of lithium-ion batteries requires structured testing methodologies that align with, and inform, regulatory requirements while also addressing real-world safety risks.

Risk Based Assessment

One of the most effective approaches to compliance testing is risk-based assessment, where testing procedures prioritize the most critical failure modes—such as thermal runaway, puncture resistance, and fire containment. Testing should simulate real-world conditions, including impact forces from transportation, potential exposure to high temperatures, and battery defects that may occur due to manufacturing inconsistencies.

Furthermore, leading laboratories make a practice of sharing data with one another, helping to ensure that findings are repeatable (and therefore controllable). This gives additional confidence and accuracy to the body of knowledge that we rely on for the safe, efficient handling of Li-ion batteries.

Proactive Regulatory Engagement

Another key best practice is proactive regulatory engagement. Companies that work directly with agencies and organizations such as SAE, DOT, ICAO, IATA, and UN contribute valuable real-world data that can inform and improve compliance standards. Rather than merely reacting to regulatory changes, industry leaders should play an active role in shaping safety policies.

Standardization of Testing Methods

Additionally, standardization of testing methods across industries is critical. Lithium-ion batteries are used in consumer electronics, electric vehicles, medical devices, aerospace, and industrial applications, yet testing procedures can vary significantly between sectors. Developing universal best practices for containment, transport, and packaging will create greater consistency in compliance enforcement and reduce overall safety risks.

Continuous Adaptation of Safety Protocols

Finally, continuous adaptation of safety protocols is necessary as lithium-ion battery technology evolves. Emerging innovations in solid-state batteries, higher energy-density chemistries, battery construction/assembly, cell formfactors such as prismatic and pouch cells, and flexible battery designs introduce new safety considerations that existing compliance standards may not fully address. Testing methodologies must be updated regularly to reflect these advancements and ensure that safety regulations remain effective.



FINAL THOUGHTS

The increasing reliance on lithium-ion batteries presents a unique set of regulatory challenges that demand rigorous, science-based safety testing. As demand for these energy-dense cells continues to rise, ensuring their safe transport, storage, and disposal will be more critical than ever.

Industry leaders like Americase play a vital role in supporting compliance efforts by conducting real-world testing, developing containment solutions, and collaborating with regulatory agencies to refine policy standards. Through proactive engagement, advanced and consistent testing methodologies, and continuous improvement, lithium-ion battery manufacturers and transporters can ensure safety while remaining compliant with evolving regulatory requirements.

The path forward requires ongoing cooperation between regulatory bodies, battery manufacturers, and technical experts. By prioritizing rigorous testing, standardized compliance frameworks, and adaptive regulatory policies, the industry can create effective, relevant lithium-ion battery standards that protect people, infrastructure, and global supply chains.

Whatever challenge you might be facing, and no matter how complex your company's regulatory requirements might be, Americase can help you develop a clear, concise, and compliant testing plan and packaging solution that gives you, your employees, and your customers peace of mind. Contact us at [americase.com](https://www.americase.com) to get started.

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