Hoverboards from seasonal headline to safety standards in short order

Ken Boyce, Principal Engineer Manager at Underwriters Laboratories, explains how the holiday season horror story became a milestone in rapid test standard development.

Batteries are truly ubiquitous in our lives. Our homes and workplaces are filled with them, they are in our cars and buses and airplanes, and we carry them with us most everywhere. As electronics proliferate, and we as a society want to do more things from most anywhere without worrying about recharging or heavy weights, we see an incredible demand for batteries with longer life and more capacity. This increasing energy density, which is what makes them attractive to us as users, also presents challenges in safety. The attributes of lithium-ion chemistries generally best suit what we as a society seek, and it is the workhorse technology of today and the near future, but careful attention is needed to mitigate thermal runaway vulnerabilities for lithium-ion batteries.

I am very fortunate to lead the global team of UL’s Principal Engineers in Energy & Power Technologies. This is an amazingly dynamic sector, including renewable energy, but perhaps the most dynamic segment of all is batteries and energy storage. UL has a dedicated team of battery & energy storage technology (BEST) experts proactively working around the world to holistically support safe deployment of any kind of energy storage through conducting scientific research, developing standards, working with safety organizations, and performing consumer education and outreach.

Our Principal Engineer team dedicates themselves to play an influential role in BEST safety in many ways.

First, we work with UL’s world-class battery research scientists to review and adapt the scientific findings into practical risk mitigation strategies. We accomplish this by capturing the safety science into specific battery safety standards for the United States and Canada, as well as actively developing global standards. These standards play a critical role in supporting safety of batteries and battery-powered products by identifying essential construction and performance requirements to address the inherent risks that batteries can present.

Second, by developing and publishing requirements, UL identifies principles for safe battery and battery product design and development, and lays the groundwork for real life, targeted assessments of the battery design and manufacturing processes. Active engagement of industry, academia and other research institutions, government experts, battery users, consumers and other experts drive consensus standards. Our team also provides technical leadership to global test engineers and technicians who do those critical assessments of products to demonstrate that they really comply with the necessary requirements. As battery designs rapidly evolve, it is imperative to stay on the
bestsafety

cutting edge of technology, proving that innovations do not bring latent hazards and that safety improvements effectively accomplish their objectives.

And third, UL has been leading technical initiatives in the battery, energy storage and battery product sector for many years. In the last several years we have published important new battery standards to add to the established portfolio, including new standards for the safety of large format batteries, motive batteries and energy storage systems. However, the newest of the battery-related standards perhaps best highlights the complexities and challenges we see in the global battery product marketplace.

Many of us had not heard of hoverboards until the holiday season of 2015, when they were the must-have gift. And due to the large number of incidents, the whole world is aware of the hoverboard. This industry grew incredibly fast as demand for these products grew exponentially – the scenario has been described as a ‘templlosion’, a situation that explodes across the world over a very short period of time. While there are established companies that manufacture self-balancing scooters, many of the companies were new market entrants. Some of these companies did not have the required background in safe battery integration; coordination of the system comprised of the charger, batteries and load; and battery management system design. The lack of applicable safety standards meant that there were no clear guidelines about how to address these issues.

Hoverboards generally incorporate approximately twenty lithium-ion batteries in a dense pack, and thermal runaway events in one or more of the batteries could quickly cascade to significant safety hazards. What resulted was a series of fires and explosions that created a worldwide crisis just as demand for these new products was peaking. The concerns led to a ban on hoverboards being brought in to aircraft, trains, college campuses and even some cities.

Enter UL. We quickly mobilized our battery scientists, researchers, and engineers to extrapolate UL’s deep expertise in cells, batteries, battery packs and battery operated products into this new area. UL’s Standard for Safety of Battery Systems for Self-Balancing Scooters, UL 2272, was developed to address the crisis of confidence related to the emerging technology of hoverboards, a type of self-balancing scooter. Our experts led by the Principal Engineer team wrote UL 2272 in just a few weeks to build a tailored set of hoverboard battery system requirements. To develop new tests that address the unique application for personal mobility, taking into account the environmental issues, we used hazard-based safety engineering. We addressed the critical requirements for functional safety in the software and hardware in the battery management systems to minimize the risk of fires and explosions due to root causes like cell imbalance, overcharging and over-discharging. To prove out compliance, we established and announced the UL 2272 assessment program on February 2nd, 2016. We also worked with government regulators in North America and around the globe to help them fulfill their goals of keeping the public safe in their countries and jurisdictions; recognizing the importance of the new requirements, the U.S. Consumer Product Safety Commission on February 18th, 2016 publicly urged compliance.
University of California San Diego to address safety of applied uses such as electric vehicle batteries that are being repurposed into the infrastructure. New chemistries will be moved forward and we are connected with leading researchers such as the team at the Joint Center for Energy Storage Research (JCESR) at Argonne National Laboratories to help promote safety as a foundation for those future deployments. We also continue to work to mitigate injuries from button cell battery ingestions by children through working with industry, the medical community, and consumer experts, and through public education and outreach. So across the spectrum of the smallest stored energy to the largest systems, UL is there.

Our world is rapidly evolving, and BEST will play a critical role in its societal and technological progress. UL looks forward to continued collaboration with industry and interested parties on batteries, ensuring that we enable all of the many benefits of energy storage by working together to make safety foundational.

But our work is never done. BEST will play a key role for our society going forward. We know that innovators will continue to find new and creative ways to use batteries, and we will be there to proactively help them do it safely. I like to use the metaphor that UL puts the guardrails and the new onramps onto the innovation superhighway, letting innovators move at their speed and be creative in how they use new ideas within a defined, safe environment.

We also continue to look wide and deep in the energy storage sector. We are collaborating with first responders, transport professionals, insurance companies and others to help make sure they are best positioned to see batteries manufactured, transported, used and reclaimed safely. We are actively addressing how to safely leverage the benefits of energy storage in unlocking the maximum benefit from renewable energy. Our work at the UL BEST Test Center, in collaboration with the Battery Innovation Center, continues to address battery innovation and testing protocols. We are working with leading academic institutions such as the University of California San Diego to address safety of applied uses such as electric vehicle batteries that are being repurposed into the infrastructure. New chemistries will be moved forward and we are connected with leading researchers such as the team at the Joint Center for Energy Storage Research (JCESR) at Argonne National Laboratories to help promote safety as a foundation for those future deployments. We also continue to work to mitigate injuries from button cell battery ingestions by children through working with industry, the medical community, and consumer experts, and through public education and outreach. So across the spectrum of the smallest stored energy to the largest systems, UL is there.

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Contact us if you have any questions; it would be our pleasure to assist and serve you. We can be reached at batteries@ul.com, and for more information on what we do check out www.ul.com/batteries and www.ul.com/hoverboards.