Transcript of 2020 CPSC Podcast Series
Selling Electrical Products to the U.S. Market

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Hi, my name is Sylvia Chen, and I want to welcome you to this podcast presentation today.

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As CPSC's Director of International Programs, Richard O'Brien stated, design of safe products at the outset is critical. CPSC is a United States federal government agency charged with protecting the public from unreasonable risks of injury or death associated with the use of consumer products under the agency's jurisdiction. We have developed this podcast series not only to inform about regulations, standards, and other safety requirements, but also to emphasize the importance of designing products with safety considerations in mind, and to offer best practices for enhancing safety in a variety of common consumer products.

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The series covers seven common consumer products and the requirements for keeping consumers safe, focusing on products affecting millions of consumers, such as electronics, apparel, bicycles, mattresses, infant and toddler products, carriages and strollers, and toys. In this podcast series, you can expect to learn about the key hazards and risks of the product, important design and manufacturing considerations, regulations and standards that CPSC uses to ensure product safety, best practices you can employ, and what resources are available to assist you in understanding and implementing the requirements.

The podcasts include English and Chinese slide decks, and Chinese narration to make this important safety information as accessible as possible. Additionally, CPSC has established a dedicated email box, where listeners can send in any questions at their convenience, in English or Chinese. Our staff will monitor and respond to your questions. Transcripts in English are available on this site.

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The slides used in this podcast are not a comprehensive statement of legal requirements or policy, and thus, should not be relied upon for that purpose. You should consult official versions of U.S. statutes and regulations, as well as published CPSC guidance when making decisions that could affect the safety and compliance of products entering U.S. commerce. Note that references are provided at the end of the presentation.

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And now, I would like to introduce the presenter, Mr. Andrew Trotta. Mr. Trotta is the Director of the Electrical and Fire Sciences Division at the CPSC's National Product Testing and Evaluation Center. His presentation is on selling safe electrical products to the U.S. Market.

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Thank You, Sylvia. As Sylvia mentioned, my name is Andrew Trotta, and I'm the Director of the Division of Electrical Engineering and Fire Sciences at CPSC. I sincerely appreciate you taking time from your busy schedules to join us today to learn about CPSC's approach to ensuring the safety of electrical products purchased and used by the American public. We're excited to share this important information with you today. So let's get right into it.

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As you can see from this slide, we are going to be covering a lot of information in our podcast today. If you don't have the time to listen to the entire podcast, or you are particularly interested in a specific topic, you can use the hyperlinks seen here to jump to that section.

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Electricity is a powerful, useful energy source; but, it is potentially hazardous. Product failures or misuse can cause fires, electric shock, thermal burns (like from touching a hot surface), chemical burns (such as an electrolyte leaking from a battery), injuries (such as laceration from moving parts), or loss of a critical function (like a smoke alarm doesn't sound during a fire). Equipment that generates, distributes, or uses electrical energy should comply with standards and be installed according to the applicable electrical codes to mitigate safety risks.

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The two primary hazards in the electrical area are fire and shock. The fires were attributed mostly to electrical distribution systems equipment, electrical cooking equipment, and electric heating and cooling equipment.

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CPSC staff promotes electrical safety through a multipronged approach supporting improvements to voluntary standards, creating and enforcing technical regulations and bans, recalling products with defects by identifying hazards through surveillance methods, and disseminating safety information to consumers.

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Electrical product safety relies heavily on compliance and voluntary industry consensus standards. Most electrical product safety standards have been developed and maintained by Underwriters Laboratories (UL). Other standards developers in the electrical arena are the Institute of Electrical and Electronic engineers (IEEE) and the National Electrical Manufacturers Association (NEMA). There are only five technical regulations for electrical products under CPSC's jurisdiction.

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There are two mandatory standards for electrical products. The regulation at 16 CFR part 1505 describes requirements for electric operated toys for children, and 16 CFR part 1204 is a safety standard for CB base-station antennas.

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In addition to these two regulations, there are three electrical products that are Section 15(J) listed items. Items on this list are deemed a substantial product hazard if they are missing certain key identifiable characteristics that are known to reduce hazards. A rule under Section 15(J) of the Consumer Product Safety Act, referred to also as the 15(J) rule, is not a consumer product safety rule that imposes performance or labeling requirements for newly manufactured products.

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The first product under the 15(J) rule are household and commercial hand-held hair dryers which require an integral immersion protection circuit interrupter plug as per UL 859 or UL 1727. Handheld hair dryers without this feature are considered to be substantial product hazards.

The second product category under the 15 J rule consists of seasonal and decorative lighting products. Minimal wire size requirements, sufficient strain relief and integral over current protection as described in UL 8588 defined what requirements are needed for these products in order to be a non-substantial product hazard.

The third category is extension cords. They also require minimum size of wire, sufficient strain relief, and proper polarization. And for indoor use cords, they require outlet covers and outlets. For outdoor use, cords are required to be jacketed. These are all per UL 817. Extension cords that don't meet these requirements are considered unsafe, can be recalled and will be recalled

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CPSC regulations do not require third party certification for electrical products, except for electric toys, because they are regulated. However, CPSC staff strongly recommends that manufacturers or exporters and importers seek third party certification for their electrical products as a means of hazard mitigation. In general, there is a high rate of voluntary participation and third party testing. Many retailers will only sell product if the product has been third party certified. Some states and municipalities require third party certification. And the Occupational Safety and Health Administration (OSHA) requires third party certification for electrical products used in the workplace.

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Because CPSC staff relies heavily on voluntary standards, rather than mandatory requirements for electrical products, staff actively participates in the process of maintaining the standards, by addressing emerging hazards through development and adoption of new or modified requirements. This is an ongoing process that begins with reviewing incident information from CPSC data collection systems.

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CPSC is roughly a 500-person agency with jurisdiction over 15,000 types of products. Therefore, the staff relies on incident data to help guide the efforts toward mitigating the most serious risks. Staff learns about product-related incidents from five databases. The injury and potential injury incident database or IPII includes information from the medical examiner and coroner alert program, news clippings, hotline calls, internet reports, compliance reports, federal and state agency referrals, and other sources. The second database is the death certificate database or DTHS. This consists of death certificates from all 50 states. The in-depth investigation or IDI database is a collection of CPSC field staff investigation reports. Although these are anecdotal reports, IDI reports are a very important tool in staff's hazard analyses, because they include more detailed product and incident information than any other databases.

The National Electronic Injury Surveillance System, or NEISS system, is a representative sample of approximately 100 emergency departments across the United States that report on consumer product-related injuries that receive treatment in their hospital. It provides detailed information on the injury patterns related to a product category, and the data can be extrapolated to estimate national averages.

Finally, the National Fire Incident Reporting System, or NFIRS, which is operated by the U.S. Fire Administration, is a collection of voluntarily reported fire incidents that were attended by a fire service. This is not a statistical sample, but the data are used in conjunction with the National Fire Protection Association's annual national survey to develop estimates of fires and their causes. These two data sets were used to develop the estimate of the number of annual structure fires from the electrical equipment presented earlier in slide 3.

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There is a continuous process that staff follows to improve voluntary safety standards, starting with analysis of our data systems for hazard patterns that result in injuries and deaths. Then we review relevant product standards to identify gaps that result in addressable risks of injuries and deaths. And we may do some tests and evaluation to support the gap analysis. Then the next step is to develop proposed changes to the standards, based on the analysis and the testing. And then finally, we participate in the voluntary standards committees to support those proposed changes to get them accepted. Once the changes become part of a standard, then the

process starts all over. If the changes are rejected, a technical regulation may become necessary.

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To illustrate staff participation in the voluntary standards process, I'd like to present two case studies. First in 2004, staff noticed that document-shredding machines were implicated in a number of hand injuries to small children.

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CPSC staff reviewed incident databases for paper shredder incidents to determine the causes and scenarios that led to these hand injuries.

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The most severe injuries, finger amputations, occur when a child was feeding paper into a shredder, even when an adult was present, and did not leave the paper in time, and their hands were pulled into the opening.

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Staff agrees that the relevant voluntary standard for paper shredders was UL 60950-1, the requirements that address the accessibility of moving parts.

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Then staff acquired 10 different paper shredders for analysis. We examined them for design variations and to assess effectiveness of various accessibility probes, and assessing whether contact can be made with the moving parts.

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We issued a technical report showing our test results and also illustrating the design and standards vulnerabilities that need to be addressed. We proposed a working group to discuss approaches to fill the gaps and develop requirements along with stakeholders.

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We participated in a UL 60950-1 working group, developing new test requirements to reduce this hazard of accessibility to moving parts. The working group submitted proposed changes to the standards technical panel for 60950 for balloting.

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The STP voted to accept the proposed changes to UL 60950-1 to address the moving parts for accessibility.

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Here's the second case study illustrating the process. In the early 2000s, flexible lighting products, also referred to as rope lights, were becoming a popular product in the United States. A rope light is a string of lights or series parallel connected non-replaceable lamps enclosed in a flexible polymeric tube or extrusion.

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At the time, there was not an applicable voluntary safety standard. Staff was also receiving reports of incidents involving rope lights, which have been primarily in use as a commercial product, but also were being sold for residential use.

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And this raised concerns about the risk of shock and fire. As I said before, there was no standard for rope lights. And although they are similar to holiday lights, and in other respects, there are several differences in their construction, including their installation longer than 90 days, which puts them outside the scope of UL 588. We have participated in the UL 60950-1 working group, developing new test requirements.

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Staff examined a number of rope lights and defined the areas of concern for residential use. For example, such as allowing field configuration, which means that they would cut the length of the strings, which is probably acceptable for commercial use, but not for residential use.

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We proposed developing a standard to include requirements for rope lights based on the identified potential hazards.

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On July 3, 2002, UL issued the first edition of UL 2388, Standard for the Safety of Flexible Lighting Products.

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A safe installation helps to ensure electrical safety.

The National Electrical Code (NEC) covers the installation of electrical equipment in public and private premises. Product standards requirements are aligned with the NEC requirements to form a safety system. The NEC is a consensus code published by the National Fire Protection Association, but it is not a national standard. It is widely adopted by states and local municipalities for enforcement as law.

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Another important authority that CPSC has is the authority to recall products. Products that have been determined to create a substantial product hazard must be recalled, *i.e.,* removed from sale and from consumers' hands through some remedies, such as a repair, replacement, or refund. Typically, manufacturers work cooperatively with the CPSC to conduct recalls.

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In addition to working to make product safer, staff strives to empower consumers to be proactive about safety in their homes. Please be sure to go to the CPSC website to view the home safety guides for the examples of safety messaging.

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The website picture is here along with a hyperlink to the site.

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Typically, CPSC staff follows a comprehensive multipronged approach, using as many of the strategies that are available as possible, such as blocking unsafe products at the ports, removing unsafe products from the market, upgrading voluntary standards, or promulgating regulations to address emerging hazards, and informing consumers about the potential dangers a product may pose, and how to avoid getting hurt. I'll share two case studies as examples.

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In the first study, ingestions of small batteries like button and coin cell batteries are causing serious internal injuries, sometimes resulting in deaths. Button and coin cell batteries that are lodged in the esophagus can cause an electrical current to flow between the exposed poles and hydrolyzed bodily fluids. This leads to hydroxide burns. This can lead to severe injuries and death in as little as 2 hours. Victims can present nonspecific flu-like symptoms, and delayed treatment allows excessive tissue damage to occur – fistulas, perforations, necrosis, stricture and vocal cord paralysis are some of the damages that can occur.

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So CPSC staff set out to educate consumers about this hazard, upgrade voluntary standards, improve battery compartment design, improve packaging, improve warning labeling, and explore improvements of the battery design to mitigate or lessen this hazard. I'll describe each of these efforts in more detail.

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Our plan was to educate consumers on how dangerous battery ingestion is. As we mentioned, damage can occur very quickly, so quick recognition of symptoms is essential. To help educate

the public on this risk, we created safety alerts, posters, safety quizzes, tips, and a video. We also worked on some international outreach because this is a universal problem worldwide.

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Button and coin cells are used in more than 50 product categories addressed by a voluntary standard. Two standards already had requirements to prevent access by children, namely ASTM F 963, which is a toy safety standard, and ASTM F 2923-11, which is a children's jewelry standard. Our goal was to apply inaccessibility requirements for batteries more broadly so as to minimize exposure. In February 2015, UL adopted UL 4200A, which is the *Safety Standard for Products Incorporating Button or Coin Cell Batteries of Lithium Technologies*.

This is a horizontal standard, which means it can be referenced by other standards for other products that use button cell batteries to minimize the risk of children removing and ingesting or aspirating batteries.

That way, the individual product standards don't need to develop those requirements in each standard. Instead, they can just refer to UL 4200A.

UL 4200A includes requirements for a battery compartment door or closure to be secured by a fastener or two motions. Enclosure/door/closure shall withstand a 1-meter drop, 2-joule steel ball impact, and 330 Newton crush force.

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Previously, coin cells were easily removed from non-child-resistant coin cell packaging.

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New child-resistant coin packaging was developed. Some require scissors to open, others require much more difficult means than just tearing packaging open. There are also improved warnings, including “Keep out of reach” pictograms.

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The cells also include markings and safety tabs that need to be removed before using the coin cell. This directly informs the user of the hazard. The stamping or etching on the battery stays on the battery so that it is always evident of what the hazard is.

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The other approach for the battery design improvements is technological developments. Various researchers have been exploring ways to improve battery designs.

Examples include:

- Using state-change coatings (which means that the cell is non-conductive under non-use conditions, such as when there’s saliva or warmth).

- Using different anode metals to slow fluid hydroxylation. That way, it takes longer for damage to occur to the tissues.
- Looking at colorants to alert caregivers that a child has ingested a cell. Again this goes back to the fact that immediate recognition of symptoms is important.

Currently, we have had limited success in these endeavors, but they're still in the early stages of the process.

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Our second example of a multipronged safety approach concerns cooking fires on electric cooktops. Cooking fires and cooktops have been a leading cause of fires for products under CPSC's jurisdiction.

In most cases, the range was left unattended, allowing food to overheat and ignite. Standards did not address overheating of food.

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The staff set out to develop new requirements for the standard to address this hazard. Part of this investigation included developing experimental ignition-resistant ranges to demonstrate technical feasibility of new requirements for voluntary standards.

Part of the research focused on determining what parameters were good at indicating pending ignition. As it turns out, the pan temperature provides a very good indication of pending ignition.

Subsequently, control systems were designed to measure and respond to overheating, using pan temperature measurements.

With stakeholders, we worked on developing a test method to justify this change.

Simultaneously, we also educated consumers about the dangers of unattended cooking.

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We developed new requirements. In 2010, the CPSC sponsored the development of a control system for electric coil, glass-ceramic radiant, and gas cooktop elements to limit pan temperatures, which would prevent ignition without significantly prolonging normal cooking time. Based on the development of these experimental systems, in March 2014, a Coil Surface Unit Cooking Oil Ignition Test was developed for UL 858. This was first accepted in March 2015.

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As I mentioned, we strive to educate consumers about safe cooking practices through brochures, seasonal video tips, and posters. On this screen you can see a few examples of different documents that we developed.

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The applicable regulations, standards, and the NEC are highly effective ways to mitigate hazards from equipment that generates, distributes, or uses electrical energy. The responsibility to comply lies with manufacturers and importers, retailers and distributors. Importers relying on foreign producers are directly responsible for the safety of products that they bring into the United States.

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Manufacturers and importers should follow best practices to ensure that their products do not pose a substantial risk of injury and the need to be recalled.

They should:

- Comply with consensus standards and technical regulations, as required;
- Obtain third party certification for products; and
- Maintain quality and configuration control by assessing the impact of material or component substitutions.

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Next, we are going to cover nine case studies of manufacturing problems that have led to recalls. In our first case study, this hairdryer is missing an immersion-detection, current interrupter, or an IDCI plug. Under Section 15(J), this constitutes a substantial product hazard. The product was seized at the port.

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The second case study concerned an uncertified decorative lighting string that did not meet UL 588 requirements because the wire was undersized, the plug lacked current protection, and the strain relief was inadequate. They only need tests according to the 15(J) rule. The product was a substantial product hazard and was seized at the port.

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In this third case study, an uncertified luminaire did not meet the UL153 requirement. It was assembled with poor workmanship, lacked proper strain relief on the power cord, and did not have a polarized plug. All of these inadequacies pose fire and shock hazards. These products were held at the port during the investigation. They were conditionally released and subsequently recalled.

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In our fourth example, this uncertified handheld work light did not meet the UL 153 requirement either. The deficiencies included assembly with poor workmanship, undersized wire, inadequate strain relief on the cord, and substandard components. These all pose as fire

and shock hazards. Again, these products were held at port, conditionally released, and subsequently recalled.

In these cases, it is important to comply with the voluntary standard. Even in the absence of the 15(J) rule, these products are unsafe because they don't comply with the voluntary standard's requirements.

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And in our fifth example, an uncertified portable electric fan did not meet UL 507 requirements. The deficiencies included a motor without thermal protection, undersized wire, inadequate strain relief from the power cord, and lack of integral overcurrent protection in the plug. These deficiencies posed fire and shock hazards. The products again were held at port, conditionally released, and later recalled.

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This next product was an uncertified six-outlet current tap that did not meet UL498A. It was poorly constructed from inadequate materials. The sheet metal was too thin and flimsy and lacked strength to contain the plug blades properly. This results in loose connections, which can arc and overheat. The ground pin was also poorly fastened to the grounding bus. All of these substandard constructions pose fire and shock hazards. Again, these products were held at port, conditionally released, and later recalled.

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For this next example, we have an uncertified power tap that did not comply with the voluntary standard. The power cord and internal wiring were severely undersized, and the cord's strain relief was inadequate. The sheet metal buses were too thin, flimsy, and deformed when the plug was inserted. Internal connection was poorly made and easily came loose, posing a shock and fire hazard. These products were held at the port and conditionally released before being recalled.

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Following up on these categories where it's important to comply with the voluntary standard, our next example shows that you need to use the circuit. It's not just using certified parts. You also have to use the certified parts within their specifications.

This is a case study on hover boards or self-balancing electric scooters. They're powered by a rechargeable, lithium-ion battery pack. When they were introduced into the U.S. market, there was no safety standard. There was a battery pack standard, but hover board manufacturers did not follow the battery pack standard, UL 2272. In general, manufacturers did not follow best practices in the design and construction of these units.

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Since their introduction in 2015, hover boards have caused more than 280 fires in 43 states, resulting in 3 deaths and more than $9 million in property damage. Incidents have occurred during and after charging and during and after riding (so basically in all aspects of this product's use).

Another hazard with these products is that they cause falls. There've been more than 50,000 emergency room visits due to hover boards. Sudden stops and starts cause riders to fall, and they result in head injuries and fractures.

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CPSC staff thoroughly tested and analyzed the units on the market in 2015 when they first came out. Staff found that many hover boards used uncertified lithium-ion cells and chargers and did not follow the typical safety practices of cell operation to protect against operation at excessive temperatures during overcharging and during over-discharging. Units posed fire hazards. Fire incident units exhibited signs of thermal runaway, leading to catastrophic failure of the entire battery pack.

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In response to requests from retailers and manufacturers, UL issued UL 2272, which was an Outline of Investigation for electrical systems for self-balancing scooters in January 2016, only a few months after the product's introduction into the market. This was to certify units for electrical system safety, which covers the electric drive train, including the rechargeable battery and charger system combination for use in self-balancing scooters.

Subsequently, UL assembled a Standard Technical Panel to convert the Outline of Investigation to an industry consensus standard. UL published the first edition of UL 2272 - Electrical Systems for e-Mobility Devices in November 2016. There's an ASTM international group that's also looking at requirements for mechanical safety, and CPSC safety experts are contributing.

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This final example is a third party certified dehumidifier involved in fire incidents. In this case, the product was on the market. It was certified to the voluntary standard, but poor manufacturing practices resulted in problems. Poor record-keeping and a failure to follow process controls allowed non-flame-resistant plastic resins to be used in the enclosure molding in place of the approved polymeric material. The insufficient flame resistance allowed internal failures to ignite the surrounding plastic and propagate flames beyond units. This resulted in a recall of 2 million units.

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To summarize, electrical system safety requires diligence from producer to user.

Electrical products should:

- Comply with CPSC technical regulations, as required;
- Be designed and manufactured in accordance with the applicable voluntary standards;
- Have third party certification from an accredited laboratory;
- Be built consistently with proper quality and safety in mind;
- Have product safety standards that are continuously updated to address hazards that are identified by incident data.

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Thank you, and we hope you enjoyed this podcast. If you have any questions on the presentation, please do not hesitate to submit your questions in English or Chinese to the mailbox mentioned earlier: CPSCinChina@cpsc.gov. This mailbox is routinely monitored.

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We also wish to remind viewers that CPSC has many technical documents and resources available in Chinese. The conclusion of this presentation provides many links to resources viewers may find useful.

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We encourage viewers to be sure especially to check out CPSC's Regulatory Robot, available in English, Chinese, and several other languages. The Regulatory Robot is an automated tool that can help identify safety requirements for many different types of products. Many companies have found this tool to be extremely helpful.

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Finally, please see the following links for resources specific to electrical products and information covered in today's podcast. Thank you for downloading this presentation.