**Transcript of “Overview of U.S Battery-Powered Toy Safety Requirements”**

**Slide 1**

*The slides in this presentation are intended to be used during an event with verbal elaboration by a knowledgeable presenter. These slides highlight key U.S. product safety requirements for discussion. 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. This presentation was prepared by CPSC Staff. It has not been reviewed or approved by the Commission and may not reflect its views.*

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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 you heard, 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 to not only inform on regulations, standards, and other safety requirements, but also to emphasize the importance of designing products with safety considerations in mind and best practices for enhancing safety in a variety of common consumer products.

The series covers common consumer products and their 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 slidedecks, 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.

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It’s great to be here today to speak on the topic of U.S. safety requirements for battery-operated toys. Please be aware that this technical presentation is intended mainly for manufacturers of battery-operated toys. We use quite a bit of technical terminology to explain the main issues of concern. This presentation follows earlier more general podcasts on the topics of electrical product safet and battery safety standards. In this podcast, we dive a bit more into the details.

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To begin, I want to discuss ASTM F963-17, which is the industry consensus standard for toy safety in the United States. Although industry consensus standards are typically not mandatory, this one is. The U.S. Congress made ASTM F963 a federal requirement, by law. CPSC enforces compliance with F963 as a technical regulation.

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Section 106 of the Consumer Product Safety Act makes F963 mandatory for toys available in commerce within the United States. Section 106(g) of the CPSIA requires that ASTM notify CPSC of any revisions. Revisions to F963 becomes a regulation, if within 180 days, CPSC does not notify ASTM that the revised standard does not improve the safety of toys. Once 180 days pass, the newly adopted version is indicated by the “year” after “F963.” The latest *Federal Register* notice for the public is provided as an example in the link below. The example *Federal Register* notice indicates that the public can submit comments before the notice expires.

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As far as the technical requirements, the main sections of F963 that relate to electrical and battery safety are located in Section 4 and Section 8. Although these are the main sections, the user is encouraged to look at all features of the toy product to determine if other sections of F963 are applicable, and if so, those requirements would also be mandatory for the given toy product.

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Section 4.4 of F963 requires that toys intended for connection to a 120 V AC circuit comply with 16 CFR section 1505, the Federal Hazardous Substances Act.

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* Section 4.25 of F963 has several requirements for Battery-Operated Toys that are listed on this screen. I want to encourage you to become thoroughly familiar with: **Clause 4.25.8.1 , which specifies Requirements for lithium-ion and lithium-ion polymer batteries, an**
* **Clause 4.25, which also requires flammability testing for battery connectors and that battery chargers be suitable for the battery chemistry and certified to applicable NRTL certifications (UL, CSA, TUV, VDE, MET, IEC)**
* **(NRTL stands for “Nationally Recognized Testing Laboratory.” This is a U.S. Department of Labor Laboratory System.) and**
* **Clause 4.25.11.1, which references specific battery and cell standards to consider when determining the suitability of the certification for the intended toy application (specific product).**

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* Now I want to discuss Section 8.17 of F963, which has several requirements for the Stalled Motor Test for Battery-Operated Toys. To do this test, you should start with a new toy and fresh alkaline batteries (or whichever batteries the product is intended to use.
* Then follow the test method described in 8.17.1 and 8.17.2.
* The test should not result in the battery operating outside its intended specifications.
* The test should not result in the battery temperatures exceeding those identified in 4.25.7.
* There should be no leaking, explosion, or fire as a result of the stalled motor test.

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Another important section is Section 8.18 of F963, which has multiple requirements for Tests for Battery-Power Ride-On Toys. For example, it includes a low power circuit determination, a maximum temperature test, and a stalled motor test for battery-powered ride-on toys. Others are listed on this slide.

All of these tests are descriptive. If you need more guidance, go to Section 2 Referenced Documents on the reference standards for additional test method details.

Section 2 overall is a great resource for additional test method guidance and background.

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Now I want to discuss Section 8.19 of F963, which reminds the user of secondary cells being rechargeable cells. Key points are to consider the specific battery chemistry. All battery chemistries need to be evaluated if more than one chemistry is intended to be used in the product. Finally, don’t mix different battery chemistries in the same circuit Also, don’t mix rechargeable and non-rechargeable cells in the same circuit!

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Section 2 of F963 is perhaps the most important section in the entire standard. This section is the framework of U.S., international standards, and other technical documents that allow F963 to come to an intersection to make toys safe and children safe while they play. This slide shows a list of all of the international reference and standards documents. As you can see, F963 includes many requirements from other standards. Since requirements are feature-specific, and consider intended use and foreseeable misuse, determine from your exhaustive list of featureswhat requirements may be applicable to those product features.

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For lithium battery safety, here are the basics: Be aware of different cell electrode chemistries and both its performance and safety consequences. Cells contain flammable electrolytes so be cautious of accidental or intentional cell abuse. Safety circuits are important to keep the cell from deviating outside of its predictable and normal operating regions.

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In 2017, there was a recall of a battery-powered remote control toy car. The product was manufactured for a company called Horizon Hobby. There were about 18,600 sold in the United States, and about 540 units were sold in Canada. The remedy provided in the recall was to replace the electronic speed control circuit.

The recall link is provided in the slide. In this recall example, the electronic speed control circuit was experiencing short circuiting. This product violated F963 because the short circuit condition should have been detected by the main circuit board and either open the main switch to the battery connections, or a fuse should have blown on the main board, either of which occurring would have prevented the incident fires related to this product.

Designing the product with an overall understanding of the regulation helps to avoid the pitfalls of electrical system issues. Electrical system issues can be mitigated by either the opening of an energy source circuit or circuitry to shut the electrical system down even if the system remains connected to the energy source.

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Safety circuits are important to keep the cell from deviating outside of its predictable and normal operating regions for temperature, current, and voltage, among other technical parameters. Here are technical graphs of safe operating regions during charging on the left, and during discharging on the right.

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In specific instances, charging may need to be disabled if a cell deviates below the safe cell voltage, typically if the voltage drops below 3.0 V DC for each cell. Balanced cells are important to keep cells in their safe operating regions. Finally, use a charger that is compatible with the product, and battery pack, including cell chemistry, and make sure the charger is certified.

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In this slide, you see some photos showing the use of thermal sensors applied to cell bodies within constructed and assembled battery packs. The importance of these devices cannot be overstated. These protective devices should be wired in series with the battery pack and operate like a switch to open the circuit to prevent charging or discharging in instances where the cell surface temperature is approaching its technical limits.

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In this slide, you see the top of a lithium-ion cell. There are two types of integral protection devices, one is called a current interrupt device and the other is called a resettable PTC (Positive Temperature Coefficient. The CID (Current Interrupt Device) opens in case of abnormally high internal pressure. The PTC limits the current and is more suitable for low drain applications. This is good for toys other than ride-on and other than motor-operated toys. The PTC does not protect against thermal runaway due to internal faults but does provide some level of protection to prevent pushing the cell more towards unsafe operating regions.

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For cells that are user replaceable, an integral BMS (Battery Management System) circuit needs to be provided as consumers do not know, understand, or appreciate the risks of handling bare lithium cells.

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Diligence is extremely important to confirm safety of lithium cells, from producer to user. Cell design, manufacturing should follow the processes described previously. Cells should be compatible with the charger provided. Use of high-quality cells and used according to the manufacturer’s specifications along with BMS circuits programmed to account for the manufacturer’s specifications. If cells are substituted, a full review of these practices must be considered, including potentially reprogramming the BMS safety circuits.

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CPSC staff recommends lithium-ion batteries and cells be properly marked with warning labels to inform and educate users of potential hazards and to closely follow manufacturer’s instructions and specifications. Remember, under the CPSC’s statutes, each entity in the supply chain is responsible for assuring that consumer products do not violate any CPSC safety rules or pose an unreasonable risk of injury or death.

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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 (show on screen). This mailbox is routinely monitored.

**Slides 28-33**

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 to check out CPSC’s regulatory robot, available in English, Chinese, and several other languages. The regulatory robot is an automated tool that can greatly facilitate identifying safety requirements for a large number of products. Many companies have found this tool to be extremely helpful.

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Thank you for downloading this presentation.