Product Responsibility Best Practices

SUBJECT

Tech Products: Power Banks / Chargers

LAST UPDATE

July 2018

APPLIES TO

- Suppliers
- Distributors

FOCUS ON

The need for safety certification and what you must know when sourcing and selling power banks and chargers.

QUICK LINKS

- PPAI Corporate Responsibility: www.ppai.org/corporate-responsibility/
- UL: industries.ul.com/premiums-promotional-and-licensed-goods
- Consumer Product Safety Commission: www.cpsc.gov

Intended for intermediate compliance programs

Italic grey text indicates a hyperlink listed in the Online Resources section of this document.

Background

Technology products are one of the industry's hottest product categories. Despite their popularity, there are inherent risks associated with these products. Professionals in the promotional products industry that source and sell tech products must be aware of and understand the risks and their obligation to protect their customers and consumers from serious injury.

In order to mitigate issues that could lead to fines, liability claims, injury and/or brand damage, it is important for companies to address the critical need for safety and certification when sourcing Lithium-ion (Li-ion) batteries and other electronics in today's complex regulatory environment before an incident occurs. The absence of certified products opens companies and individuals to product liability claims, fines, penalties, and brand damage. Product liability is the area of law in which everyone in the supply chain—manufacturers, distributors, suppliers, retailers, and others—are held responsible for the injuries caused by those products.

The internal components of consumer tech products like power banks and chargers are comprised of complex circuitry. Due to the small size of most power banks and chargers it is difficult for manufacturers to make a high-quality product at affordable prices. Thus, the market is prone to including *counterfeit and poor-quality products* that the unknowing buyer or end user assumes to be safe. Sellers (suppliers and distributors) of technology products are responsible for providing compliant products that meet established standards, both voluntary and mandatory, per the *Consumer Product Safety Commission (CPSC).*

Certified Products

Safety standards have been developed to address hazard issues and to ensure the battery or tech device is safe under both normal use and foreseeable misuse. Standards and testing protocols provide manufacturers with guidance and direction for safely manufacturing and using Li-ion batteries, power banks, plug-in chargers, and other electronics. Certified products are those that have been tested by a certified laboratory to meet these specific standards. Electrical products are also categorized by class according to standards established in the *National Electric Code (NEC*). The NEC classifies circuits based on different energy levels.

- Class 1 devices can operate between 120-600 volts (V) based on power source and other requirements, although 120 volts is most common. Examples include washing machines and irons.

- Class 2 devices are the most common in the promotional products industry. These are lower energy circuits designed to protect against fire hazards by limiting current and potential for electrical shock from the power source. Output current is limited to under 8 amps (A) when used under normal and single fault conditions. Output power is limited to under 100 volt amps (VA) under normal and single fault conditions. Output voltage is limited to 42.4V peak for alternating current and 60V for continuous direct current under normal and single fault conditions. Examples include hair dryers, consumer electronics and coffee makers.

- Class 3 also has power limitations but with higher limits of current than class 2, which requires class 3 to have more safeguards in place. Examples include low voltage lighting, home theatre, or other sound system wiring.

Standards

The CPSC promotes safety by monitoring or providing technical support for voluntary standards activities covering a wide range of consumer products. Standard organizations like *ASTM*, *CSA Group*, *ISO*, *UL*, and other facilitate the development of voluntary standards for individual consumer products through voluntary standards committees. These committees bring together industry groups, technical experts, government agencies, and consumer groups to gain consensus on best practices for consumer product safety.

These voluntary standards are considered industry best practices or "industry consensus" standards. The most important thing to understand about voluntary standards is that there is nothing voluntary about them. They are not optional according to the *Consumer Product Safety Commission (CPSC)*. Marc Schoem, prior deputy director, Office of Compliance and Field Operations for the CPSC, told members of the 2015 *PPAI Product Responsibility Summit*, "The commission expects all consumer products—including promotional products—to be fully compliant with applicable voluntary standards."

Third party certifications and safety standards for the workplace may be mandatory as required by OSHA. However, for the general public, there are few federal mandatory safety requirements. Most mandatory standards are those regulated state by state, or by military specification, or local jurisdiction.

There are several standards that were established to address electrical, mechanical, and fire safety. While they are all similar, each individual standard has slightly different requirements based on voltage ratings, current, and power source.

Common Lithium-ion Standards

UL 2054 (batteries)
UL 2056 (power banks)
UL 1642 (cells)
IEC 62133 (batteries and cells)
UL 62133 (batteries and cells)
NEMA C18.2M Part 2 (portable rechargeable cells and batteries)

Lithium Ion Products

Power banks are used to provide power to a device or replace energy within batteries such as Li-ion devices. The most common types of devices in the promotional products industry are wall or direct plug-in, vehicle chargers, or battery packs/power banks with USB outputs. Power banks are also referred to as power units, power supplies, USB chargers, and battery chargers.

The standard used for wall or direct plug-in chargers in the United States (U.S.) is "*UL 1310 – Standard for Class 2 Power Units*" and in Canada "*CSA-C22.2 No 223 - Power Supplies with Extra-Low-Voltage Class 2 Outputs.*" These standards cover indoor and outdoor use Class 2 power supplies and battery chargers. In addition, "*UL/CSA 60950-1 - Information Technology Equipment - Safety - Part 1: General Requirements*" is a harmonized standard that covers mains-powered or battery-powered information technology equipment, with a rated voltage not exceeding 600V.

This checklist can be used to help verify the product meets the scope of the standards UL1310 and CSA-C22.2 No 223 or UL/CSA 60950-1:

- Does the product contain a fuse?
- Blade dimensions must meet ANSI/NEMA WD6
- Perimeter of the face section from which the blades project shall not be less than 0.20 inch (5.1 mm) from any point on either blade for UL and 8.0 mm for CSA or toy standards
- Fire and electrical enclosures required – Ask if the product's plastic enclosure meets UL94V-1 or UL94V-0 flammability ratings. Ask for a plastic molders certificate to verify
- Blade security – pull, push and tug
- Spacings and dielectric – Look and ask
- Components that should have certification marked on them – printed circuit board, capacitors, fuses

Note: Blade refers to the prongs on an electrical wall connector (plug). To reduce the risk of fire or injury various types of blade standards exist to create non-interchangeable connections based on current, voltage and grounding.

Test Name	Purpose of Test	Additional Considerations
CAPACITANCE DISCHARGE TEST	Measurement of energy available to the user when the device is unplugged	Voltage/energy must discharge to lower than 37% of measured maximum within 1 seconds.
WORKING VOLTAGE MEASURE-MENT TEST	Measurement of voltages generated in device. Used to determine spacing and dielectric values	For small direct plug-in devices with USB outputs we will see around 450 V
HEATING TEST	Measurement of compo-nents maximum tempera-tures during normal use	All components have temperature limits
DIELECTRIC STRENGTH	Test to ensure materials are suitable for use.	Input blades to output USB electric strength value used would be 4242 Vdc and input blades to enclosure would be a minimum of 2121 Vdc
COMPONENT FAILURE TEST	One by one fault compo-nents to ensure the device remains safe.	Device does not need to remain opera-tional but the product must remain safe and all fires remain internal to the fire enclosure
MECHANICAL TESTS	Drop, blade securement, resistance to crushing, mold stress, ball pressure	No access to user to internal parts – electrical enclosure
POWER SUP-PLY SHORT CIRCUIT	While the device is operat-ing normally we simulate a short circuit on the output	The device must remain safe
POWER SUPPLY OVERLOAD	We slowly start to overload the device until ultimate outcome is reached	The device must remain safe
CLASS 2 OR LIMITED POWER TEST	Output cannot exceed 8 A, or 100 W while voltage is within limits	Output fusing is allowed to achieve the results

Chart provided courtesy of UL

The standard for **vehicle chargers** in the U.S. is "*UL 2089 – Standard for Vehicle Battery Adapters*" and in Canada "*CSA-C22.2 No. 107.1 – General Use Power Supplies*" or "*UL/CSA 60950-1.*" These standards cover portable vehicle battery adapters rated 24Vdc or less that are intended to be supplied power from a vehicle cigarette lighter receptacle or power outlet. UL 2089 states that the output must be provided with a cord and that cord can be detachable.

This checklist can be used to help verify the product meets the scope of the standards UL 2089 and CSA-C22.2 No. 107.1 (+) or UL/CSA 60950-1:

- Output must be provided with a cord and that cord can be detachable – UL 2089
- A switch or an overcurrent-protection device shall be located within the unit enclosure
- The diameter of the center (positive) contact shall not be less than 9/64 in (3.57 mm)
- The overall mass of the cigarette lighter connector shall not exceed 250 g (8.8 oz). The product of (the total mass) and (the distance between the center of gravity and the input contact positioned to simulate full insertion into a power outlet) shall not exceed 13500 g-mm (18.7 oz-in).
- Fire and electrical enclosures required
- Spacings and dielectric
- Components

Test Name	Purpose of Test	Additional Considerations
NOTE – ALL TESTS ARE CONDUCTED WITH AN ACTUAL VEHICLE BATTERY OR A DC SOURCE WITH ENOUGH CURRENT TO SIMULATE A BATTERY (100 A OR MORE)		
WORKING VOLTAGE MEASUREMENT TEST	Measurement of voltages generated in device. Used to determine spacing and dielectric values	For small direct plug-in devices with USB outputs we will see around 450 V
HEATING TEST	Measurement of components maximum temperatures during normal use	All components have temperature limits
DIELECTRIC STRENGTH	Test to ensure materials are suitable for use.	Input blades to output USB electric strength value used would be 4242 Vdc and input blades to enclosure would be a minimum of 2121 Vdc
COMPONENT FAILURE TEST	One by one fault components to ensure the device remains safe.	Device does not need to remain operational but the product must remain safe and all fires remain internal to the fire enclosure
MECHANICAL TESTS	Drop, resistance to crushing (75 lbs), mold stress	No access to user to internal parts – electrical enclosure
POWER SUPPLY SHORT CIRCUIT	While the device is operating normally we simulate a short circuit on the output	The device must remain safe
POWER SUPPLY OVERLOAD	We slowly start to overload the device until ultimate outcome is reached	The device must remain safe
CLASS 2 OR LIMITED POWER TEST	Output cannot exceed 8 A, or 100 W while voltage is within limits	Output fusing is allowed to achieve the results

Chart provided courtesy of UL

Lithium Ion Power Banks

Portable power banks are basically a rechargeable battery with its own charger and a circuit that allows it to charge mobile devices when a wall outlet is not available. Power banks come in many sizes. The larger the bank, generally, the more current or voltage is provided based on the configuration. Typically, power banks plug into a wall outlet and use Li-ion batteries to store the power. They may also come with a USB port to attach to computers for charging, while others can be charged with solar power.

Every power bank has some basic information printed on it. To understand the power bank's abilities, you'll need to understand a few terms.

- **mAh or Ah** – Stands for milliamp hours or amp hours, which is the amount of power you can expect over time. The higher the number the more capacity. It is the electric charge (current) that passes by a specified circuit in one hour.

- **Wh** – Stands for watt hours, which is a measure of electrical energy equivalent to a power consumption of one watt for one hour. A simple way to determine current deliver current delivered by the power bank is to divide the watts by the voltage rating of the device. Electrical power is measured in watts and power equals the voltage multiplied by the current (amp).

- **Li-Ion** – Stands for Lithium-ion, which is the type of battery used in the power bank. There are other types of batteries, but Li-ion is the most common type used in most promotional products. It is important to understand the Li-ion term and the difference between lithium batteries and Li-ion batteries. While Li-ion batteries are popular due to being rechargeable, plain lithium batteries are not rechargeable.

The standards for **battery packs** or power banks in the U.S. are "*UL 2056 - Outline of Investigation for Safety of Power Banks*" and "*UL 2054 - Standard for Household and Commercial Batteries Units*." UL – 2056 covers power banks, sometimes also known as portable USB chargers or portable back-up battery power, which are standalone devices that incorporate batteries for mobile powering of low voltage electronic devices. UL 2054 covers portable primary (non-rechargeable) and secondary (rechargeable) batteries for use as power sources in products. Again, *UL/CSA/IEC 60950-1 - Information Technology Equipment - Safety - Part 1: General Requirements* is also used here as it covers mains-powered or battery-powered information technology equipment, with a rated voltage not exceeding 600V.

Another harmonized standard is *UL/IEC 62133 - Standard For Safety For Secondary Cells And Batteries Containing Alkaline Or Other Non-Acid Electrolytes - Safety Requirements For Portable Sealed Secondary Cells, And For Batteries Made From Them, For Use In Portable Applications* that covers requirements and tests for the safe operation of portable sealed secondary cells and batteries (other than button) containing alkaline or other non-acid electrolyte, under intended use and reasonably foreseeable misuse.

Potential Safety Issues

Not all power banks or chargers are equal. USB outputs on computers have different power ratings (USB 1.0. 2.0 and 3.0). Some wall chargers are stronger than others. These differences, indicated by markings and certifications on the product, are

essential to communicating the proper use of these products. In turn this is how sellers and users can avoid the inherent dangers associated with tech products.

UL1310 and *CSA C22.2 No. 223* require output to meet Class 2 limits while *UL/CSA 60950-1* does not require limited power source (LPS), but USB specifications call out USB ports to meet Class 2 or LPS limits. So labs will generally test USB output to those limits.

The market is full of counterfeit and non-certified power banks and chargers. Counterfeiters and off-brand manufacturers tend to use inexpensive, lower-end feedback circuits while brand name, certified power banks and chargers typically contain specialized integrated circuits (IC). There are several problems related to poor design in these lower quality products that can result in damage to products being charged by the power bank or charger, slow charge times, inability to charge certain devices, fire, and much more.

The use of Li-ion batteries has grown exponentially in recent years. While Li-ion batteries are widely used in consumer electronics, many users are not aware that these batteries are considered hazardous goods by the *Consumer Product Safety Commission (CPSC)* and the *Department of Transportation (DoT)* due to a risk of overheating, fire, and short circuits.

When a Li-ion battery is being charged or being used to charge another device, it can overheat and cause a fire hazard. This is referred to as thermal runaway. Even when not in use or being charged, the battery's internal temperature may rise, yielding destructive and dangerous results. The fires that result from these batteries are difficult to extinguish.

Even with the number of batteries in use compared to a relatively low failure rate, the degree of danger presented by a failure is the reason for strict standards and regulations. Well publicized incidents have resulted in numerous product safety recalls.

- Electrical shock or fire
- Burn hazards due to excessive temperatures
- Component failures
- Output abnormal tests (short-circuit or overload)
- Integrity of enclosure due to a drop or excessive heat
- Integrity of blades for direct plug-in chargers
- Compliance with Class 2 or Limited Power Source (LPS) requirements under normal and single fault conditions
- Safety of lithium-ion batteries and their protective circuitry
  - Explosion or fire due to overheating
  - Leakage of electrolyte
  - Fault testing and/or evaluation of the charging and discharging circuit within a battery pack or power bank

Lithium-Ion Battery

A battery is made from one or more electrochemical cells connected by an enclosure and containing safety circuitry or connectors. The completed unit provides power to another piece of equipment. Lithium-ion (Li-ion) batteries can be charged and

Safety Testing Protocols and Standards for Lithium-Ion Battery Power Banks

	Power Banks		
Test Name	UN Manual of Tests and Criteria, Part III, Section 38.3	UL 2056	IEC 62133 2nd Ed.
External Short Circuit	•	(•)^	•
Abnormal Charge	•	(•)^*	•
Forced Discharge		(•)^	
Vibration	•		
Temperature Cycling	•		
Low Pressure (Altitude)	•		
Abusive Overcharge		(•)^*	
Limited Power		(•)^	
Temperature		(•)^*	
250 N Steady Force		(•)^	
Mold Stress Relief		(•)^	•
Drop Impact		(•)^	•
Power Input		•	
Overload of Output Ports		•	
Flammability of Photovoltaic Cells		•	
Capacity Verification		•	
Direct Plug-in Unit Tests		•	
	Mandatory	Depends on Application	Mandatory for Intl. Markets

(•)^ - Adopted from UL 2054
(•)^* - Adopted from UL 2054 with some variations

Although similar tests exist in the 3 standards, testing for UN, UL, and IEC standards do not have the same test methods, sample requirements, and/or defined sample condition.

Chart provided courtesy of UL

recharged multiple times without a decrease in performance. These batteries have a high energy density meaning they can contain a lot of power in a small package.

A cell is a component of a battery. It is a single encased device with one positive and one negative terminal (or electrode) that creates chemical reactions through voltage differential across the positive and negative terminals. By itself, a cell cannot be used in a product. Connection circuitry must be added in order for the cell to work properly.

Common types of li-ion batteries include: lithium iron phosphate (LiFePO4), lithium cobalt oxide (LiCoO), lithium manganese oxide (LMO), and lithium nickel manganese cobalt oxide (NMC).

A Li-ion battery stores energy. “Lithium ions move through an electrolyte from the negative electrode (‘anode’) to the positive electrode (‘cathode’) during battery discharge, and from the positive electrode to the negative electrode during charging.” – UL Safety Issues for Lithium-Ion Batteries.

Marks And Certifications

Knowing what to look for makes the difference when determining compliance. Your technology products must have identification marks to be in compliance. Many labs are authorized to and will use the UL standards to when applying their own marking. Always check to ensure that your lab is accredited to provide the proper marking.

Look for Common Product Markings

- Company name
- Model number/designation
- Input and output electrical ratings (voltage, current, frequency, power)
  - Capacity (mAh, Ah or Wh)
- Certification and regulatory marks
- Date of manufacture (coded)
- Product identifier for UL1310 and CSA C22.2 No. 223
  - a) Class 2 battery charger
  - b) Class 2 transformer
  - c) Class 2 power supply
  - d) Class 2 power unit

- Product identifier for UL/CSA 60950-1
  - a) Information technology equipment power supply
  - b) I.T.E. power supply
- Product identifier for UL 62133 and UL 2056
  - a) Product identification (secondary Li-ion battery, etc.)
- Product identifier for UL 2056
  - a) Product identification (power bank, etc.)

Safety Testing Protocols and Standards for Lithium-Ion Battery Cells and Packs

	Lithium Cells			Lithium Battery Packs		
Test Name	UN Manual of Tests and Criteria, Part III, Section 38.3	UL 1642	IEC 62133 2nd Ed.	UN Manual of Tests and Criteria, Part III, Section 38.3	UL 2054	IEC 62133 2nd Ed.
External Short Circuit	•	•	•	•	•	•
Abnormal Charge		•	•	•	•	•
Forced Discharge	•	•	•		•	
Crush	•	•	•			
Impact		•				
Mechanical Shock	•	•		•		
Vibration	•	•		•		
Heating		•	•			
Temperature Cycling	•	•		•		
Low Pressure (Altitude)	•	•		•		
Projectile		•				
Abusive Overcharge					•	
Limited Power					•	
Temperature					•	
250 N Steady Force					•	
Mold Stress Relief					•	•
Drop Impact					•	•
Continuous Charging			•			
Internal Short Circuit			(•)			

Mandatory | Depends on Application | Mandatory for Intl. Markets | Mandatory | Depends on Application | Mandatory for Intl. Markets

Although similar tests exist in the 3 standards, testing for UN, UL, and IEC standards do not have the same test methods, sample requirements, and/or defined sample condition.

Chart provided courtesy of UL

- Other markings may include other international marks for safety or for other voluntary or mandatory testing (EMC, wireless, etc.)
- Additional secondary warning notices and cautionary markings that are used to identify and reduce potential risks posed by products. These markings shall be prefixed by the signal word "CAUTION" or "WARNING" in letters not less than 1/8 inch (3.2 mm) high. The remaining letters shall not be less than 1/16 inch (1.6 mm) high.

Note: The CE Mark is a European conformance marking signifying compliance with certain requirements for products being sold in the European Union. A CE Mark is not a safety certification and is based on self-declaration rather than third-party testing.

UL Listing

The *UL Mark* is one of the most common product identification marks. Products that carry the UL Mark meet all of UL's safety requirements for fire, shock, and electrical safety. There are three *UL Listing Mark* variations:

- United States only
- The C-UL Mark for Canadian only
- C-UL-US Mark for both Canadian and U.S. requirements.

Recognized Testing Labs

Nationally Recognized Testing Laboratories (NRTL) are independent facilities that are recognized and accredited by the *Occupational Safety and Health Administration (OSHA)* to test products against consensus product safety standards developed by standards-writing bodies. NRTLs evaluate and test products to determine compliance and are authorized to place a Listed Mark to certify passing products. NRTLs are not always accredited to perform the same tests so it is important to work with each lab to determine whether they are recognized to certify and mark the product.

Commonly recognized NRTLs include:

- *Canadian Standards Association (CSA)*
- *Communication Certification Laboratory, Inc. (CCL)*
- *Curtis-Straus LLC (CSL)*
- *FM Approvals LLC (FM)*
- *Intertek Testing Services NA, Inc. (ITSNA)*
- *MET Laboratories, Inc. (MET)*
- *NSF International (NSF)*
- *QPS Evaluation Services Inc. (QPS)*
- *SGS North America, Inc. (SGS)*
- *Southwest Research Institute (SWRI)*
- *TUV SUD*
- *TUV Rheinland*
- *UL, LLC. (UL)*

Transporting Lithium-Ion Batteries

The U.S. Department of Transportation issues *Hazardous Material Regulations (HMR)* under the U.S. code of federal regulations *49 CFR*. The HMR covers all modes of transportation in the U.S. including air, vessel (water) and vehicle (road), and also determines fines for non-compliance.

When transporting Li-ion batteries, in most cases they are required to have strong outer packaging and a safety vent or other system to prevent violent rupture during normal transport. Transporting regulations apply to any person who offers a hazardous material for transport, causes a hazardous material to be transported, or transports a hazardous material.

Refer to the PPAI best practice *Technology Transportation* for more information regarding the transportation of Li-ion batteries.

Disposal

Rules regarding the destruction and recycling of Li-ion batteries vary from state to state, leaving stakeholders with a patchwork of regulations to follow. According to the *National Center for Electronics Recycling (NCER)*, there are currently 25 states with electronics recycling laws. A listing of state-specific laws is provided by the *Electronics Recycling Coordination Clearinghouse (ERCC).*

Summary

It is important for companies to understand the complex regulatory environment surrounding Li-ion batteries before a recall ever occurs. This will help avoid any delays that could lead to additional fines, liability or brand damage.

In order to ensure the standards have been applied for a particular product and to protect consumers from thermal runaway conditions, always insist on certified technology products from suppliers and factories. Ensure that the products you buy and sell have proper markings on them for identification. This includes model number, ratings, file number, or other unique identifier as specified by the standards covered in this best practice.

Online Resources:

Occupational Safety & Health Administration (OSHA): https://www.osha.gov/
Nationally Recognized Testing Laboratory (NRTL): https://www.osha.gov/dts/otpca/nrtl/
Current List of NRTLs: https://www.osha.gov/dts/otpca/nrtl/nrtllist.html
Style Manual for UL Standards for Safety: http://ulstandards.ul.com/wp-content/uploads/2015/01/ULStyleManual_v1_2014.pdf
UL 2054: http://ulstandards.ul.com/standard/?id=2054_2
UL 2056: http://ulstandards.ul.com/standard/?id=2056
UL 1642 Standard for Lithium Batteries: http://ulstandards.ul.com/standard/?id=1642_5
UL 1310: http://ulstandards.ul.com/standard/?id=1310
CSA-C22.2 No. 223: http://shop.csa.ca/en/canada/general-standards/c222-no-223-15/invt/27008392015
UL/CSA 60950-1: https://standardscatalog.ul.com/standards/en/standard_60950-1_2
UL 2089: http://ulstandards.ul.com/standard/?id=2089
CSA-C22.2 No. 107.1: http://shop.csa.ca/en/canada/general-standards/c222-no-1071-01-r2011/invt/27015172001
UL 94: http://www.ul.com/wp-content/uploads/2014/04/ul_UL94CertificationsAndLimitations.pdf
National Electrical Manufacturers Association (NEMA): http://www.nema.org/pages/default.aspx
ANSI/NEMA WD6: https://www.nema.org/Standards/Pages/Wiring-Devices-Dimensional-Specifications.aspx
UL Mark: http://www.ul.com/marks/
CE Mark: http://ec.europa.eu/growth/single-market/ce-marking/index_en.htm
National Electric Code (NEC): http://www.necconnect.org/
International Electrotechnical Commission (IEC): http://www.iec.ch/
Power Supply Safety Testing Service Information: http://industries.ul.com/consumer-technology/power-supplies
EMC Testing Service Information: http://industries.ul.com/emc
Safety Issues for Lithium-Ion Batteries: http://library.ul.com/?document=safety-issues-for-lithium-ion-batteries
UL Power Bank Video: http://youtu.be/GEXOk8_KqtQ
CPSC Certification and Testing FAQs: http://www.cpsc.gov/Business--Manufacturing/Testing-Certification/FAQs-Certification-and-Testing-for-General-Use-or-Non-Childrens-Products/
CPSC General Use Product Testing: http://www.cpsc.gov/en/Business--Manufacturing/Testing-Certification/General-Use-Products-Certification-and-Testing/
CPSC Standards and Bans: http://www.cpsc.gov/Regulations-Laws--Standards/Regulations-Mandatory-Standards-Bans/#L
RoHS FAQs: http://www.rohsguide.com/rohs-faq.htm
Proposition 65: http://oehha.ca.gov/prop65/p65faq.html
Energy Star Certification: http://www.energystar.gov/index.cfm?c=third_party_certification.tpc_index
DoE (Department of Energy) Appliance and Equipment Standards Program: http://energy.gov/eere/buildings/appliance-and-equipment-standards-program
List of Consumer Products requiring energy efficiency: http://energy.gov/eere/buildings/standards-and-test-procedures
Tiny, cheap, and dangerous: Inside a (fake) iPhone charger: http://www.righto.com/2012/03/inside-cheap-phone-charger-and-why-you.html
iPad charger teardown: inside Apple's charger and a risky phony: http://www.righto.com/2014/05/a-look-inside-ipad-chargers-pricey.html
Provides a detailed discussion of safety requirements for power supplies: Safety Considerations in Power Supply Design - http://www.ti.com/sitesearch/docs/universalsearch.tsp?searchTerm=power%20supply%20design%20tool#linkId=1&src=top
Civil Aviation Regulator (UKCAA) Video: Lithium Battery – Passenger Handling - Example Thermal Runaway: http://www.youtube.com/watch?v=g_c6bRPdO_8
Good Morning America - Samsung Cellphone - Non-OEM Battery Fire: http://abcnews.go.com/GMA/video/cell-phone-catches-fire-24737967
Simulation of Internal Short Circuits in Lithium-Ion Cells: http://newscience.ul.com/wp-content/uploads/2014/04/UL_WP_Simulation_Of_Internal_Short_Circuits_In_LI_v5.pdf
AP Specialties Recalls Power Bank Chargers Due to Fire Hazard - November 2014: http://www.cpsc.gov/en/Recalls/2015/AP-Specialties-Recalls-Power-Bank-Chargers/#remedy
DGL Group Recalls Vibe USB Mobile Power Bars Due to Fire Hazard; Sold Exclusively at Five Below - April 2014: http://www.cpsc.gov/en/recalls/2014/dgl-group-recalls-vibe-usb-mobile-power-bars/
Gemini Recalls Power Adaptor/Chargers Due to Burn Hazard - July 2014: http://www.cpsc.gov/en/recalls/2014/gemini-recalls-power-adaptor-chargers/
US Dept of Transportation: https://www.transportation.gov/
ASTM: http://www.astm.org/
CSA Group: http://www.csagroup.org/
ISO: http://www.iso.org/iso/home.html
UL Standards: http://ulstandards.ul.com/

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