

## Product Responsibility Best Practices

### SUBJECT

Technology: Lithium-ion Power Banks

### LAST UPDATE

May 11, 2016

### APPLIES TO

- Suppliers
- Distributors

### FOCUS ON

The critical need for safety and certification when sourcing Lithium-ion power banks to keep you and your channel partners on the right side of compliance.

### QUICK LINKS

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

Available For Purchase: PPAI Sourcing And Compliance Manual: [www.ppai.org/shop/product-safety](http://www.ppai.org/shop/product-safety)

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

A portable power bank is essentially 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, 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 laptops 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, it is helpful to understand a few terms.

- **mAh or Ah**—Milliamp hours or amp hours: the amount of power expected 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**—Watt hours: a measure of electrical energy equivalent to a power consumption of one watt for one hour. A simple way to determine the 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**—Lithium-ion: 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, lithium batteries are not rechargeable.

### Risks And Hazards With Power Banks

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 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 is charging 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.

**Main Hazards:**

- Explosion
- Fire
- Overheating and fire dangers

**Primary Causes:**

- Improper charging
- Improper use
- Overheating
- Electrical abuse
  - Over current
  - Over voltage
  - Over temperature
- Other abuses
  - Internal short circuit
  - Transportation
  - Miscellaneous



UL 1642 (cells)

IEC 62133 (batteries and cells)

UL 62133 (batteries and cells)

NEMA C18.2M Part 2 (portable rechargeable cells and batteries)

## 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 2 <sup>nd</sup> 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

## Standards

The CPSC staff promotes safety by monitoring and providing technical support for voluntary standards activities covering a wide range of consumer products. Standard organizations including *ASTM*, *CSA Group*, *ISO*, *UL* and others, 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 product, including promotional products, to be fully compliant with applicable voluntary standards.”

## Common Lithium-ion Standards

UL 2054 (batteries)

UL 2056 (power banks)

## Certified Products

Safety standards have been developed to address hazard issues and to ensure the battery or power bank is safe both under normal use and foreseeable misuse. Standards and testing protocols provide manufacturers with guidance and direction for how to safely manufacture and use li-ion batteries. Certified products are those that have been tested by a certified laboratory to meet these specific standards.

Tests are designed to evaluate:

- The electrical circuit design
- Whether the product meets the manufacturer’s specified ratings
- Battery construction and materials

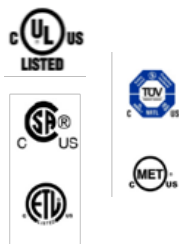
- Battery protection circuit
- Plastic enclosure material

### Marks and Certifications

Knowing what to look for makes the difference when determining compliance. 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 the lab is accredited to provide the proper marking.

### Look for Product Markings

- Company name
- Model designation
- Electrical ratings
  - Capacity (mAh, Ah or Wh)
  - Voltage
- Certification and regulatory marks



*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 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.

The official 2016 list of recognized NRTLs according to the U.S. Department of Labor include:

- **Canadian Standards Association (CSA)**
- **Curtis-Straus LLC (CSL)**
- **FM Approvals LLC (FM)**
- **Intertek Testing Services NA, Inc. (ITSNA)**
- **MET Laboratories, Inc. (MET)**
- **Nemko-Communication Certification Laboratory, Inc. (CCL)**
- **NSF International (NSF)**
- **QAI Laboratories, LTD (QAI)**
- **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 Lithium-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:

### UL New Science:

<http://newscience.ul.com/articles/thermal-analysis-of-lithium-ion-batteries>

**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/>

**Occupational Safety & Health Administration (OSHA):**  
<https://www.osha.gov/>

**Nationally Recognized Testing Laboratory (NRTL):** <https://www.osha.gov/dts/otpc/nrtl/>

**Current List of NRTLs:** <https://www.osha.gov/dts/otpc/nrtl/nrtlist.html>

**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](http://newscience.ul.com/wp-content/uploads/2014/04/UL_WP_Simulation_Of_Internal_Short_Circuits_In_LI_v5.pdf)

### Safety Issues for Lithium-Ion Batteries:

[http://www.ul.com/global/documents/newscience/whitepapers/firesafety/FS\\_Safety%20Issues%20for%20Lithium-Ion%20Batteries\\_10-12.pdf](http://www.ul.com/global/documents/newscience/whitepapers/firesafety/FS_Safety%20Issues%20for%20Lithium-Ion%20Batteries_10-12.pdf)

**UL 2054:** [http://ulstandards.ul.com/standard/?id=2054\\_2](http://ulstandards.ul.com/standard/?id=2054_2)

**UL 2056:** <http://ulstandards.ul.com/standard/?id=2056>

**UL 60950-1:** <http://ulstandards.ul.com/standard/?id=60950-1&edition=2&doctype=uliec>

### UL 62133:

<http://ulstandards.ul.com/standard/?id=62133&edition=1&doctype=uliec>

### International Electrotechnical Commission (IEC):

<http://www.iec.ch/>

**IEC 62133:** <https://webstore.iec.ch/publication/6515>

**IEC 62281:** <https://webstore.iec.ch/publication/6750>

**IEC 60950-1:** <https://webstore.iec.ch/publication/4024>

**IEEE:** <https://www.ieee.org/index.html>

**IEEE 1625:** <https://standards.ieee.org/findstds/standard/1625-2008.html>

### National Electrical Manufacturers Association (NEMA):

<http://www.nema.org/pages/default.aspx>

**NEMA C18.2M Part 2 (portable rechargeable cells and batteries):** <http://www.nema.org/Standards/ComplimentaryDocuments/Contents%20and%20Scope%20ANSI%20C18.2M,%20Part%202-2014.pdf>

**CFR 49:** [http://www.ecfr.gov/cgi-bin/text-id?tpl=/ecfrbrowse/Title49/49tab\\_02.tpl](http://www.ecfr.gov/cgi-bin/text-id?tpl=/ecfrbrowse/Title49/49tab_02.tpl)

### Electronics Recycling Coordination Clearinghouse

**(ERCC):** <http://www.ecycleclearinghouse.org/>

### Civil Aviation Regulator (UKCAA) Video: Lithium Battery – Passenger Handling - Example Thermal Runaway:

[http://www.youtube.com/watch?v=g\\_c6bRPdO\\_8](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>

**UL Power Bank Video:** <http://industries.ul.com/high-tech/batteries/power-bank-stay-in-charge-stay-charged/>

### 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/>

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