RECHARGEABLE LITHIUM-ION BATTERIES FOR SYSTEMS

CERTIFICATION UPDATES
Rich Byczek, 11/15/11
• IEC 62133 adoption, transition
• Certification options for Lithium-Ion Batteries
• End product requirements and application
• Transportation requirements for Lithium-Ion Batteries
North American Certification Capabilities

IEC 62133:  Cortland, New York (CBTL)
             Detroit (CBTL)

UL 2054:    Detroit, MI and Cortland, NY

UL 1642:    Detroit, MI and Cortland, NY

UN-DOT:     Detroit, MI

Battery Performance: Detroit, MI

Battery Advisory Service: Detroit/ Cleveland
US-Based Standards:

UL-1642: Lithium Batteries
- Focus on single-cells
- Used for Lithium-Metal (PRIMARY)
- Used for Lithium-Ion (SECONDARY)

UL-2054: Household and Commercial Batteries
- Focus on Portable Batteries
- Typically Battery Packs
- References UL 1642 for Lithium Cells
IEC - Based Standards:

IEC-60086
- Primary Batteries (Non-rechargeable)
- Covers Performance and Safety

IEC-62133
- Secondary Batteries (Rechargeable)
- Focus on Lithium-ion Batteries
- First Edition, October 2002
- Second Edition in process, potential 2012 release
BACKGROUND:

- For many years, IECEE (“CB SCHEME”), has accepted the UL Standard as the basis for accepting batteries.
  - Based on common usage of UL 1642/ 2054 for battery packs.
- Proposal in place to fully accept IEC 62133 within IECEE, as standard has been released since 2002.
  - Proposal includes transition period.
At the moment, IEC is working with product level groups to enforce the IEC62133 standard into the product level standard.

Some product level committees are making revision changes to their standard to comply with battery requirement.

CMC accepted a firm and final enforcement date of May 1, 2012 for battery standard IEC 62133, phasing out UL 1642 entirely, except for standards IEC 60950-1 and 60065, at the request of TC 108, responsible for those two standards.

Example
TRANSITION TESTING:
NOW until April 30, 2012:
- Assuming battery is already tested and certified to UL-1642:
- “Delta” testing to be performed on UL-1642 certified cells.

From May 1, 2012, full testing to IEC 62133 required

THIS TIMELINE IS NOW IN EFFECT, for products in most IEC/CB categories!!
Who is affected by this regulatory change?

- Portable Battery
  - IEC 62133
    - Medical Devices
      - IEC60601
    - Powertools
      - IEC60745
    - Household App
      - IEC60335
    - Other (Except Telecom and A/V)
Who is NOT YET affected by this regulatory change?

Portable Battery
Use UL standards

Audio Video
IEC60065

ICT
IEC60950

NOTE: TC 108 expects to adopt IEC 62133 2nd edition by 2013
DELTA TESTING: For Lithium Cells already certified to UL-1642, the following tests must be applied

APPLIES TO CELLS ONLY

Required:
- 25 cell samples
- Copy of the cell manufacturer’s ISO-9001/13485 or similar Quality System certification.
- Rating in Ah (Amp-hours)
- Maximum Charge Voltage
- Minimum Discharge Voltage (“cutoff”)
- Maximum and Nominal Charge Current
- Maximum and Nominal Discharge Current
TESTS and EVALUATIONS REQUIRED

1.4 IEC - Parameters measurement tolerances:
2 IEC - General Safety Considerations:
2.1 IEC - Insulation and Wiring:
2.2 IEC - Venting:
2.4 IEC 62133 – Terminals Contacts:
2.5 IEC – Assembly of Cells into Batteries:
2.6 IEC – Quality Plan:
3 IEC – Type test conditions:
4.2.1 IEC – Continuous Low Rate Charging –
4.2.3 IEC – Moulded case stress at high ambient temperature
4.3.3 IEC – Free Fall
4.3.6 IEC – Crushing of cells
4.3.9 IEC - Overcharge for lithium systems
5 Annex A and B IEC - Information for Safety
6.1 IEC – Cell Marking per IEC 61960, IEC 61951-1, -2, IEC 61436, IEC 61440, 60285
6.2 IEC – Battery Marking: IEC 61960, IEC 61951-1, -2, IEC 61436, IEC 61440, 6028
BATTERY MANUFACTURER LEVEL for CB:

CELLS MUST BE IEC-62133 TO CERTIFY THE BATTERY

DELTA TESTING ON CELLS (ALREADY CERTIFIED TO UL-1642)

- Requires 25 cell samples
- Provided CB cert for those cells
- Can be used until April 30, 2012
- Re-certification not required after May 2012 if they complete in time.
BATTERY MANUFACTURER LEVEL for CB:

BATTERY PACK TEST to IEC-62133 (Cells already IEC 62133):
- Requires 35 packs
- Copy of the battery manufacturer’s ISO-9001/13485 or similar Quality System certification.
- Battery Bill of Materials (BOM)
- 2D layout drawing with Label Artwork (or representative label)
- Rating in Ah (Amp-hours)
- Maximum Charge Voltage
- Minimum Discharge Voltage (“cutoff”)
- Maximum and Nominal Charge Current
- Maximum and Nominal Discharge Current
- Full IEC 62133 (1st edition) evaluation on packs, with CB report.
END PRODUCT LEVEL for CB:

SCENARIO: END product to IEC 60601-xx, Cells are UL-1642, pack has no certification, “portable” device
- Previous Slide applies

SCENARIO 2: END product to IEC 60601-xx, Cells are UL-1642, pack has no certification, Non-portable device
(Ie: device is not hand portable, battery is not user-replaceable)
- Cell-level IEC -62133 DELTA Testing applies
- pack level testing per end-product battery req’s
  - Short Circuit : depends on end product construction eval.
  - Molded case stress: If battery utilizes plastic enclosure.
  - Overcharge: depends on end product construction eval

PROVIDES CB CERT FOR THE CELLS, BUT NOT FOR THE PACK

- IF END PRODUCT STANDARD SPECIFIES IEC-62133, then full certification must be performed
NOTE:

IEC 62133 Battery Certification is **REQUIRED** for IEC 60601-1 3\textsuperscript{rd} Edition Certification
ETL CERTIFICATION OPTIONS

BATTERY MANUFACTURER LEVEL (US, non-CB):

CELL TESTING TO UL-1642 (if not already certified):
- Requires 150 cell samples
- Note that preconditioning may require up to 90 days of charge/discharge cycling.
- Need to know the rated life expectancy in charge/discharge cycles
- ETL Recognition for the cells

BATTERY PACK TEST to UL-2054 (Cells already UL-1642):
- Requires 55 packs (15 sealed, 40 opened)
- Reduced samples may be possible if samples can be reused after individual tests (depends on actual test results for each group of 5 samples)
- Requires Bill of Material and Description of all safety, current-limiting, and current interrupting circuits.
- ETL Recognition or Listing on Packs

END-PRODUCT LEVEL TEST to UL-2054: (depends on size of battery)
- Battery will be an unlisted component
- Short Circuit, Overcharge testing applies
- Depends on end-product construction evaluation if additional tests required.
IF....

END-PRODUCT STANDARD NOTES SPECIFIC BATTERY STANDARD REQUIREMENTS (such as UL-2054), then

Full testing must be performed at the battery level
UN / USDOT Battery Designations for Lithium/ Li-Ion Batteries

- Class 9 Material
- UN3090: Lithium (Lithium Metal) Batteries
- UN3091: Lithium Batteries contained in equipment
- UN3480: Lithium-Ion Batteries
- UN3481: Lithium-Ion Batteries contained in equipment
- IATA 966, etc

- All mean the same!!!
LATEST and GREATEST UN MANUAL:

(Issued December 2009)

Section 38.3 refers to “Lithium Battery Testing Requirements”

Per Federal register 49 CFR sections 171.7

- 5th edition since January 2011
# Tests T1 – T8

<table>
<thead>
<tr>
<th>Test</th>
<th>Description</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>T1</td>
<td>Altitude Simulation</td>
<td></td>
</tr>
<tr>
<td>T2</td>
<td>Thermal Test</td>
<td></td>
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<tr>
<td>T3</td>
<td>Vibration</td>
<td></td>
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<tr>
<td>T4</td>
<td>Shock</td>
<td></td>
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<tr>
<td>T5</td>
<td>External Short Circuit</td>
<td></td>
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<tr>
<td><strong>T6</strong></td>
<td><strong>Impact (Primary and Rechargeable Cells Only)</strong></td>
<td><strong>(Primary and Rechargeable Cells Only)</strong></td>
</tr>
<tr>
<td><strong>T7</strong></td>
<td><strong>Overcharge (Rechargeable Batteries Only)</strong></td>
<td><strong>(Rechargeable Batteries Only)</strong></td>
</tr>
<tr>
<td><strong>T8</strong></td>
<td><strong>Forced Discharge (Primary and Rechargeable Cells Only)</strong></td>
<td></td>
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</table>
**Samples Needed: SECONDARY CELLS (5th edition)**

<table>
<thead>
<tr>
<th>Type</th>
<th>FULLY CHARGED</th>
<th>FULLY DISCHARGED</th>
<th>1st Cycle 50% CHARGE</th>
<th>50 Cycle DISCHARGED</th>
<th>TOTAL</th>
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</thead>
<tbody>
<tr>
<td>Cylindrical</td>
<td>10</td>
<td>5</td>
<td>10</td>
<td>10</td>
<td>35</td>
</tr>
<tr>
<td>Prismatic</td>
<td>10</td>
<td>10</td>
<td>10</td>
<td>10</td>
<td>40</td>
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</tbody>
</table>

Tests T1-T5, T6 and T8 are required
Samples Needed: SECONDARY BATTERIES (5th edition)

**SMALL BATTERY:**
Gross Mass up to 12 kg

**LARGE BATTERY:**
Gross Mass over 12 kg

Tests T1-T5 and T7 are required

<table>
<thead>
<tr>
<th></th>
<th>1st Cycle CHARGED</th>
<th>25 Cycle CHARGED</th>
<th>TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Small Batteries</td>
<td>8</td>
<td>8 (50 cycles)</td>
<td>16</td>
</tr>
<tr>
<td>Large Batteries</td>
<td>4</td>
<td>4 (25 cycles)</td>
<td>8</td>
</tr>
</tbody>
</table>
Samples Needed: additional criteria

- Lithium Ion Rechargeable Packs
  - Up to 6,200 Wh rating
  - Cells/Modules already tested
  - 1 (or 2) sample(s) only, cycled 25 times, fully charged
  - Tests 3, 4, 5 and 7 only

- More than 500g Lithium or 6,200 Wh Rating
  - Cells/Module already tested
  - No testing required if BMS in place
Basic information needed to quote your test program:

- Nominal Voltage and Capacity (Ah) rating
- Maximum charging current and voltage
- Maximum discharge current and voltage
- Normal discharge current
- Cutoff voltage (voltage at which output is cut off or battery is considered "dead")
- Fully charged current/voltage (current and voltage points where battery is considered fully charged)
- Schematics of battery packs and protection circuitry (if applicable)
- For UL 2054 Limited Power Source test on Request only
- Existing certifications on cells or packs
- Chemistry used (MSDS, Shipping requirements)
- Please use the Q&A box and type questions.
Thank You.

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