IEC 62133 2nd Edition: All you need to know about the new standard

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Agenda

Introduction to IEC 62133

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- Status

Differences between the 1st and 2nd edition

- Brief overview of differences
- Changes to construction requirements
- Changes to tests for nickel cells and batteries
- Changes to tests for lithium ion cells and batteries
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How will these changes impact the industry?

- Samples and documentation
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- Certification options

Introduction to IEC 62133

Scope

IEC 62133, 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

- Safety standard
- Nickel and lithium ion cells and batteries
- Intended for portable applications\
- Addresses use and misuse

Status

IEC 62133 1st edition published in

October 2002

EN 62133 1st edition published in

April 2003

IEC 62133 2nd edition published in

December 2012

Differences between the 1st and 2nd edition

Brief overview of differences

•Criteria between nickel and secondary lithium chemistries diverge

•Nickel requirements – small changes

•Lithium requirements – significant changes
- Focus on cell operating region
- Removal of transport type tests from the test program
- Battery pack focus - maintaining cells within operating region

Changes to construction requirements

Important Definitions

Polymer cell –
Cell using gel polymer electrolyte or solid polymer electrolyte, not liquid electrolyte

Upper limit charging voltage –
The highest charging voltage in the cell operating region specified by the cell manufacturer

Maximum charging current –
The maximum charging current in the cell operating region which is specified by the cell manufacturer

Changes to construction requirements

Nickel and Lithium Batteries

Terminal contacts

No polarity marking required for “keyed” battery terminals designed to fit only one way in specific products

Packaging

Packaging designed prevent short circuit during transport

Temperature/voltage/current management

- Batteries shall be designed to be within temperature, voltage and current limits specified by the cell manufacturer
- Batteries shall be provided with specifications and charging instructions for equipment manufacturers

Assembly of cells into batteries

- Multiple batteries within a single pack
- Cells should have closely matched capacities
- Cells should be of same design, chemistry and manufacturer
- Independent control and protection
- Battery mfg. – “shall provide a test report confirming the compliance according to this standard”

Changes to construction requirements

Design recommendation for lithium systems only

Recommendations for battery pack controls/protections to maintain cells within their operating region

- Should provide this protection in the pack unless it is to be built into the electronic end product device
- battery consisting of a single cell or a single cellblock (no series connections)
- Do not exceed cell upper limit charging voltage
- Battery consisting of series-connected plural single cells or series-connected plural cellblocks –
  - Do not exceed the cell/cell block upper limit charging voltage by monitoring each cell/cell block
  - Stop charging when upper limit charging voltage of any cell/cell block is exceeded by measuring the voltage of every cell/cell block

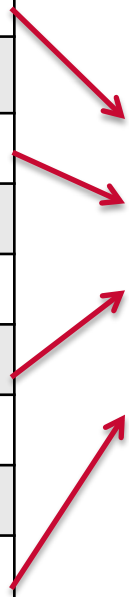
Changes to tests for nickel cells and batteries

Some minor changes to nickel test program

Item	Change
Samples	Age at test: 6 months or less, sample no the same
External short circuit test	External resistance - 80 mΩ ± 20 mΩ
Free fall test	1 hour rest after drop before inspection of samples
Mechanical shock (crash hazard) test	1 hour rest after shock conditioning before inspection of samples
Temperature cycling	24 h rest period after cycling rather than 7 day

Changes to tests for lithium ion cells and batteries

1st Edition Tests:
4.2.1 Continuous low-rate charging
4.2.2 Vibration
4.2.3 Moulded case stress at high ambient temperature
4.2.4 Temperature cycling
4.3.2 External short circuit
4.3.3 Free fall
4.3.4 Mechanical shock (crash hazard)
4.3.5 Thermal abuse
4.3.6 Crushing of cells
4.3.7 Low pressure
4.3.9 Overcharge for lithium systems
4.3.10 Forced discharge
4.3.11 Cell protection against a high charging rate (lithium systems only)



Tests not needed if UN transport documents are provided (2nd Ed)

Changes to tests for lithium ion cells and batteries

2nd Edition Tests:
8.2.1 Continuous charging at constant voltage (cells)
8.2.2 Moulded case stress at high ambient temperature (battery)
8.3.1 External short circuit (cell)
8.3.2 External short circuit (battery)
8.3.3 Free fall
8.3.4 Thermal abuse (cells)
8.3.5 Crush (cells)
8.3.6 Over-charging of battery
8.3.7 Forced discharge (cells)
8.3.8 Transport tests*
8.3.9 Design evaluation – Forced internal short circuit (cells)#
* Documentation used for compliance # Difference for JP, FR, KR and SW

Changes to tests for lithium ion cells and batteries

Charging Methods have been modified

Method 1:

- Same as 1st edition method
- Applicable to all tests except external short circuit, thermal abuse, crush and forced internal short circuit tests

Method 2:

- Applicable to cells and batteries subjected to the external short circuit, thermal abuse, crush and forced internal short circuit tests.
- Condition cell/battery at either the upper or lower limit charge temperature of the cell operating region for 1-4 h
- CV Charge cell/battery at the upper limit charge voltage of the cell operating region until the charging current is reduced to 0.05 I_t A

Upper limit charging voltage	Maximum charging current	Charging temp. Upper limit	Charging temp. Lower limit
4.25 V/cell	Specified by cell manufacturer	45 °C	10 °C

Changes to tests for lithium ion cells and batteries

8.2.1 Continuous charging at constant voltage (cell)

- Replaces the Continuous low-rate charging
- Continuous CV charge per mfg specifications for 7 days

8.3.1 External short circuit (cell)

- Charge method 2
- total external resistance of 80 mΩ ± 20 mΩ
- Test at 20 °C ± 5 °C only

8.3.2 External short circuit (battery)

- Charge method 2
- total external resistance of 80 mΩ ± 20 mΩ
- Test at 55 °C ± 5 °C only
- In case of rapid decline in short circuit current, the battery pack remains on test an additional hour after the current reaches a low end steady state condition (*e.g. battery with series connections voltage is below 0.8 V and decreasing < 0.1 V/ 30-minute period*)

Changes to tests for lithium ion cells and batteries

8.3.3 Free fall

- Cells/Batteries are examined 1 hour after dropping

8.3.4 Thermal abuse (cells)

- Charge method 2
- Large cells (i.e. gross mass > 500 g) held at 130°C for 30 min rather than 10min.

8.3.5 Crush (cells)

- Charge method 2
- Force can also be stopped when 10 % of deformation of initial dimension of cell has occurred (*or when 13 ± 1kN force is reached or abrupt drop of 1/3 original OCV, whichever is reached first*)
- Crush only wide side of prismatic cells

Changes to tests for lithium ion cells and batteries

8.3.6 Over-charging of battery

- CC charge at 2.0 I_t A, using a supply voltage:
  - that does not exceed the max voltage supplied by the recommended charger or
  - 5.0 V/cell if charger max voltage unknown
- Charging supply is sufficient to maintain 2.0 I_t A throughout the duration of test or until supply voltage is reached (switch to CV charge).
- TC placed on battery surface/pack casing
- Charging continued until the temperature of the outer casing reaches steady state conditions *(less than 10 °C change in 30-minute period*) or returns to ambient

8.3.8 Transport tests

- Cells and batteries shall comply with transport test (reference IEC 62281)
- Documentation is sufficient to determine compliance

Changes to tests for lithium ion cells and batteries

8.3.9 and Appendix A.5 Design evaluation – Forced internal short circuit (cells) – New test

- Applicable to cells for Japan, France, Korea and Switzerland
- Not applicable to polymer cells
- Sample preparation critical
  - Charge method 2
  - Disassembly of cell and placement of particle conducted in special environment with special non-conductive tools
  - Must be completed in < 30 minutes to prevent electrolyte evaporation
  - Requires special calibrated particles
  - Particle placed in one or two locations depending upon design of cell
  - Sample placed in sealed bag at end and conditioned in chamber

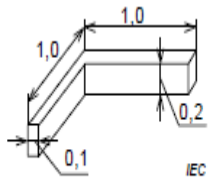


Figure A.2 – Shape of nickel particle

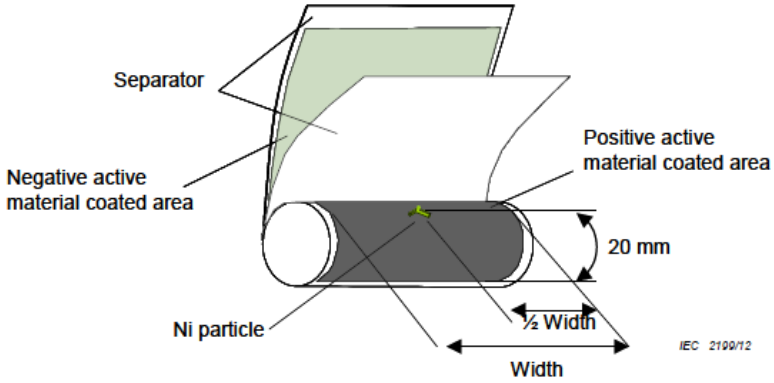


Figure A.3 – Nickel particle insertion position between positive and negative active material coated area of cylindrical cell

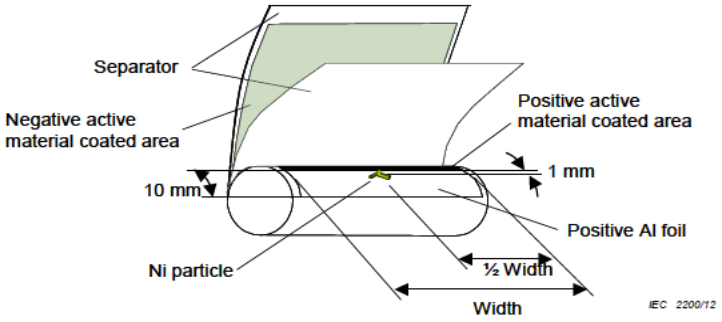


Figure A.4 – Nickel particle insertion position between positive aluminum foil and negative active material coated area of cylindrical cell

Changes to tests for lithium ion cells and batteries

8.3.9 Design evaluation – Forced internal short circuit (cells)(con.t)

Test Method

1. Uses special press equipment
2. Prepared samples conditioned for 45± 15 min at +10 °C and +45 °C in sealed bag
3. Remove samples from sealed bag and place in press equipment
   - Press conducted ≤ 10 minutes after removing heated samples from bag to prevent electrolyte evaporation
4. Monitor temperature, OCV and Force
5. Press at 0.1 mm/sec rate until:
   - > 50 mV OCV drop or
   - Force of 400 N for prismatic/800 N for cylindrical reached

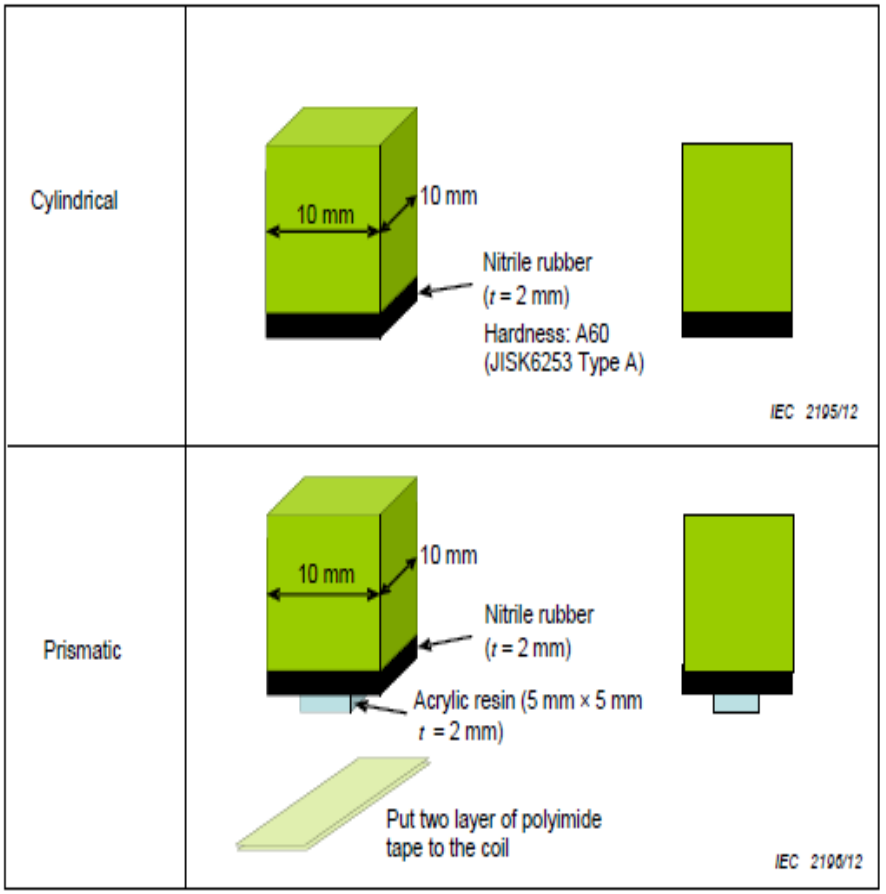


Figure 2 – Jig for pressing

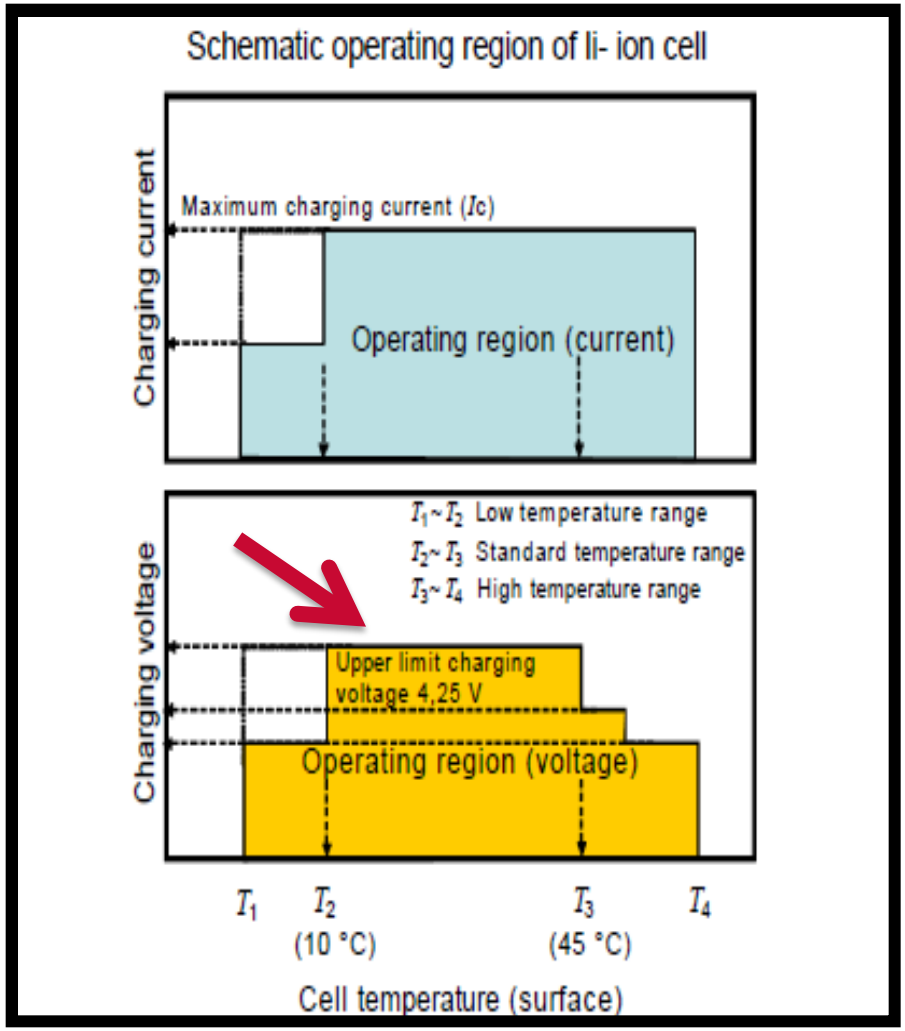
Annex A – Normative Annex

A.3.2 Upper Limit Charging Voltage (ULCV) (4.25 V)

- Charging not to exceed ULCV specified by battery mfg.
- battery mfg. shall verify the safety of secondary cells, which are charged at the specified battery ULCV
- A suitable protection device shall also be provided, assuming the possible failure of charge control by charger

A.3.2.3 Safety requirements, when different upper limit charging voltage is applied (> 4.25 V)

- Provide documentation and tests validating higher ULCV
- Charge at higher ULCV for charge method 2 at temp limits



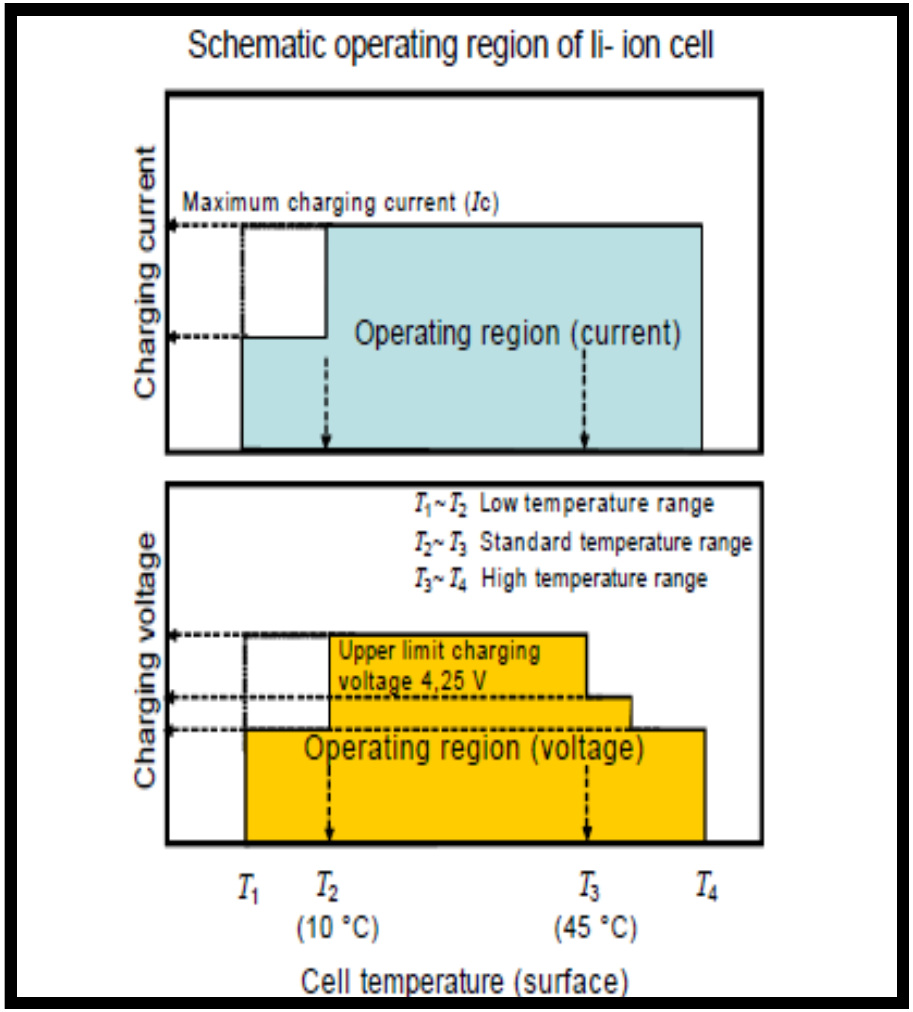
Annex A – Normative Annex

A.4.2 Recommended temperature range (T2 – T3)

- highest limit and the lowest limit of recommended standard temperature (i.e. 10°C and 45°C)
- Charge method 2 at recommended T2 and T3

A.4.2.2 Safety consideration when a different recommended temperature range is applied

- Temperature range other than 10°C to 45°C applied
- Provide documentation and tests proving safety of new recommended range
- Charge method 2 using new T3 + 5°C and new T2 – 5°C



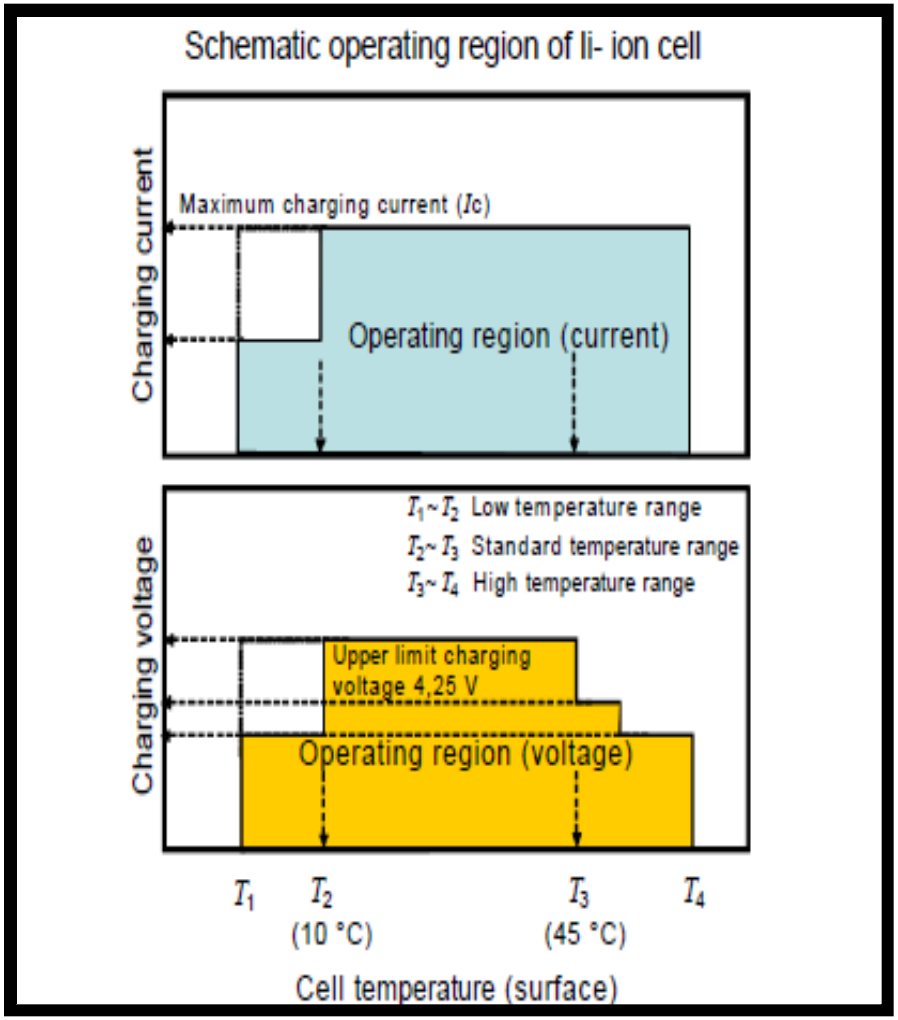
Annex A – Normative Annex

A.4.3 High temperature range (T3 – T4)

- a different charging condition which is specially specified for high temperature range is applied
- No charging above upper limit of high temperature range

A.4.3.4 Safety consideration when specifying new upper limit in high temperature range (>T4)

- If testing at higher than upper limit high temperature range (beyond T4 in figure, i.e. > 50°C)
- Documentation and test data verifying safety of new upper limit of high temperature range
- Test with cells charged at T4 + 5C for charging method 2



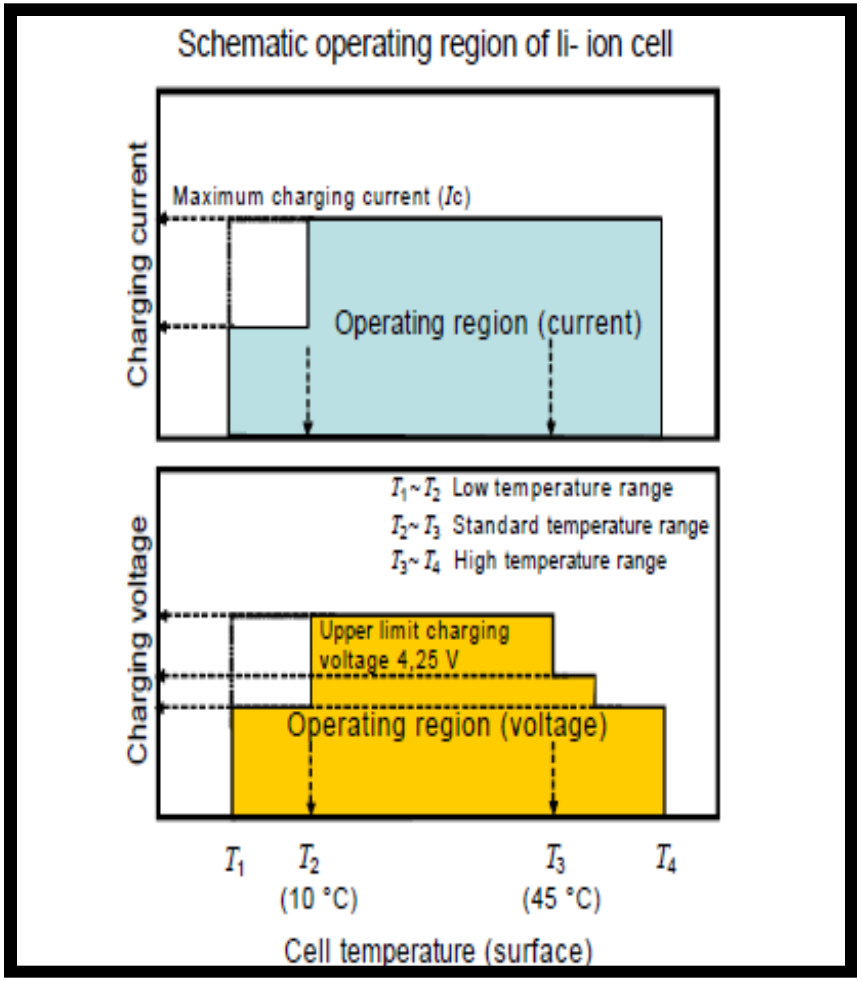
Annex A – Normative Annex

A.4.4 Low temperature range (T1-T2)

- If cell temp < the lower limited test temperature, (< T2) different charging conditions as specified are applied (i.e. lower charging current and voltage)
- Do not charge if cell's surface temperature is < than T1 (i.e. < 5°C)

A.4.4.4 Safety considerations when specifying new lower limit in the low temperature range (< T1)

- Documentation and test data proving safety of new lower limit low temperature range (beyond T1 in figure, i.e. less than 5°C)
- Test cells using new low temperature limit minus 5°C for Charge method 2



How will these changes impact the industry?

Samples and Documentation

Lithium ion Tests	Cells 43 min.	Batteries 21 min.
8.2.1 Continuous charging	5	-
8.2.2 Moulded case stress	-	3
8.3.1 External short circuit (cell)	5/temp	-
8.3.2 External short circuit (battery)	-	5/temp
8.3.3 Free fall	3	3
8.3.4 Thermal abuse	5/temp	-
4.3.5 Crush	5/Temp	-
8.3.6 Overcharge		5
8.3.7 Forced discharge	5	-
8.3.8 Transport Tests [a]	(20)	(6)
8.3.8 Forced internal short circuit [b]	5/Temp	-

[a] - *Documentation can be provided for compliance. Sample number in parenthesis indicates additional samples needed if including transport tests with IEC 62133 test program*.
[b] – *Required for Japan, South Korea, France and Switzerland*

Samples and Documentation

Cell Documentation	Battery Documentation
Intended countries for use	Intended countries for use
General cell construction information	Cell compliance information and cell and battery operating region specifications
Cell Operating Region specifications	Construction information including critical components
Documentation and test data if operating region exceeds recommended values	Documentation including schematics of protection mechanisms used to maintain cell(s) within operating region
UN test compliance documentation	Test data confirming compliance to 5.6.1
Cell markings and instructions/ information provided with cell	Markings and instructions/information provided with battery
Packaging information	Packaging information
Mfg. quality system documentation	UN test compliance documentation
	Mfg quality system documentation

IECEE Decisions

IECEE CB Scheme decisions regarding compliance to IEC 62133:

1. IEC 62133 1st edition:

- After May 1, 2012, lithium ion batteries used in portable products whose standards fall under the CB scheme had to be evaluated in full to IEC 62133 (1st edition)
- Exceptions: Standards under IEC TC 108 (ITE and AV products)

IECEE Decisions

2. IEC 62133 2nd edition:

- EN 62133 publication TBD, but typically within 1 year
- Publication of the TRF for IEC 62133 in first half of 2013
- IECEE CB scheme recommended transition period for 2nd edition TBD
- All three TC 108 standards for ITE and A/V products (IEC 62368-1, IEC 60950-1, and IEC 60065) will contain normative references to the 2nd edition of IEC 62133
- IEC 60950-1 Ed. 2 Amendment 2, referencing IEC 62133, is expected to be published during the first half of (May 2013)
- IECEE CB Scheme will be announcing a transition period for batteries used in ITE and A/V products to come into compliance with the 2nd edition of IEC 62133

Certification Options

What to do in the interim regarding CB Scheme for IEC 62133 2nd edition?

1) Continue to have products evaluated to IEC 62133 1st edition and UL 1642/2054, pending IECEE recommendations to require 2nd edition and end product standard references for ITE to submit for IEC 62133 2nd edition; or

2) Submit products for combined evaluation to UL/IEC 62133 1st edition and 2nd edition now
   - Many tests are the same and can cover requirements for UL/IEC conducting additional testing only for those tests that are not the same to save time and samples
   - An IEC 62133 1st edition CB report and certificate can be provided with additional testing covering UL 1642 and IEC 62133 2nd edition until transition period is completed
   - At end of transition period, minor updates to report and updated certificate can be provided to show full compliance to IEC 62133 2nd edition (paperwork only)

Certification Options KC Mark

- As of July 25, 2012, there was a regulation change on Li-ion secondary cells and battery packs which the standard is similar to IEC 62133 1st edition and the scope is below:
  - Lithium secondary cells equal or more than 400 Wh/L
  - Batteries assembled by the cells for use in portable devices
  - Cells and batteries for use in portable devices with a function of navigation (regardless the energy density per dimension)
- Difference between K62133 and IEC 62133:
  - Identical except storage time for temperature cycling is only required for 24 hours after testing
- Practice:
  - KTL accepts UL CBTC/CBTR without additional test based on the MOU between UL and KTL

Certification Options

How can UL assist the certification process?

UL has CBTLs for IEC 62133 including capability to run 8.3.9 FISC capability.

Other Battery Testing Capability -

UN Testing

CTIA CATLs

DENAN services for Japan

KC mark for Korea

Thank you!

More questions?
Contact: batteries@ul.com
ul.com/batt

or contact North America Batteries Program Manager
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