# IEC 62660-3

Edition 2.0 2022-03
REDLINE VERSION

# INTERNATIONAL STANDARD

colour inside

## Secondary lithium-ion cells for the propulsion of electric road vehicles – Part 3: Safety requirements



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## FOREWORD

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**This redline version of the official IEC Standard allows the user to identify the changes made to the previous edition IEC 62660-3:2016. A vertical bar appears in the margin wherever a change has been made. Additions are in green text, deletions are in strikethrough red text.**

IEC 62660-3 has been prepared by IEC technical committee 21: Secondary cells and batteries. It is an International Standard.

This second edition cancels and replaces the first edition published in 2016. This edition constitutes a technical revision.

This edition includes the following significant technical changes with respect to the previous edition:

a) The new method for the internal short-circuit test has been added in 6.4.4.2.2 and Annex C, as an alternative option to the test in 6.4.4.2.1.
b) The vibration test has been deleted.
c) The test conditions of overcharge (6.4.2.2) have been partially revised.

The text of this International Standard is based on the following documents:

| Draft | Report on voting |
|---|---|
| 21/1133/FDIS | 21/1137/RVD |

Full information on the voting for its approval can be found in the report on voting indicated in the above table.

The language used for the development of this International Standard is English.



This document was drafted in accordance with ISO/IEC Directives, Part 2, and developed in accordance with ISO/IEC Directives, Part 1 and ISO/IEC Directives, IEC Supplement, available at www.iec.ch/members_experts/refdocs. The main document types developed by IEC are described in greater detail at www.iec.ch/standardsdev/publications.

A list of all parts in the IEC 62660 series, published under the general title *Secondary lithium-ion cells for the propulsion of electric road vehicles*, can be found on the IEC website.



The committee has decided that the contents of this document will remain unchanged until the stability date indicated on the IEC website under webstore.iec.ch in the data related to the specific document. At this date, the document will be

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

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## INTRODUCTION

The electric road vehicles (EV) including hybrid and plug-in hybrid electric vehicles are beginning to diffuse in the global market with backing from global concerns on $CO_2$ reduction and energy, recent advances in technology and cost reduction. This has led to a rapidly increasing demand for high-power and high-energy density traction batteries represented by lithium-ion batteries.

For securing a basic level of quality of lithium-ion batteries for automotive applications, relevant international standards, i.e. IEC 62660-1, IEC 62660-2, ISO 12405-1 and ISO 12405-2, have been published. These standards specify the performance, reliability and abuse testing of lithium-ion battery cells, packs and systems for EV applications. Further, in the light of increasing concerns on the safety of lithium-ion batteries and demand for a referenceable international standard, safety requirements for lithium-ion battery packs and systems are defined in ISO 12405-3. Regulations, such as UN ECE R100, are also being revised that include acceptance criteria for rechargeable energy storage systems of EVs.

It is essential to specify the safety criteria at cell level in this standard, in order to secure the basic safety level of cells which differ in performance and design, and are applied to a variety of types of packs and systems. For automobile applications, it is important to note the design diversity of automobile battery packs and systems, and specific requirements for cells and batteries corresponding to each of such designs. Based on these facts, the purpose of this standard is to provide a basic level of safety test methodology and criteria with general versatility, which serves a function in common primary testing of lithium-ion cells to be used in a variety of battery systems. Specific requirements for the safety of cells differ depending on the system designs of battery packs or vehicles, and should be evaluated by the users. Final pass-fail criteria of cells are to be based on the agreement between the cell manufacturers and the customers.

# SECONDARY LITHIUM-ION CELLS FOR THE PROPULSION OF ELECTRIC ROAD VEHICLES –

## Part 3: Safety requirements

## 1 Scope

This part of IEC 62660 specifies test procedures and acceptance criteria for safety performance of secondary lithium-ion cells and cell blocks used for propulsion of electric vehicles (EV) including battery electric vehicles (BEV) and hybrid electric vehicles (HEV).

~~NOTE 1 Cell blocks can be used as an alternative to cells according to the agreement between the manufacturer and the customer.~~

~~NOTE 2 Concerning the cell for plug-in hybrid electric vehicle (PHEV), the manufacturer can select either the test condition of the BEV application or the HEV application.~~

This document determines the basic safety performance of cells used in a battery pack and system under intended use and reasonably foreseeable misuse or incident, during the normal operation of the EV. The safety requirements of the cell in this document are based on the premise that the cells are properly used in a battery pack and system within the limits for voltage, current and temperature as specified by the cell manufacturer (cell operating region).

The evaluation of the safety of cells during transport and storage is not covered by this document.



NOTE 1 The safety performance requirements for lithium-ion battery packs and systems are defined in ~~ISO 12405-3~~ ISO 6469-1. The specifications and safety requirements for lithium-ion battery packs and systems of electrically propelled mopeds and motorcycles are defined in ISO 18243. IEC 62619 covers the safety requirements for the lithium-ion cells and batteries for industrial applications, including, for example, forklift trucks, golf carts, and automated guided vehicles.



~~NOTE 4 Information on the cell operating region is provided in Annex A.~~

NOTE 2 Lithium cells, modules, battery packs, and battery systems are regulated by International Air Transport Association (IATA) and International Maritime Organization (IMO) for air and sea transport, and, regionally, by other authorities, mainly for land transport. Refer to IEC 62281 for additional information.

## 2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

~~*IEC 60050-482, International Electrotechnical Vocabulary – Part 482: Primary and secondary cells and batteries*~~

~~*IEC 61434, Secondary cells and batteries containing alkaline or other non-acid electrolytes – Guide to the designation of current in alkaline secondary cell and battery standards*~~

IEC 62619:—[1], *Secondary cells and batteries containing alkaline or other non-acid electrolytes – Safety requirements for secondary lithium cells and batteries, for use in industrial applications*

[1] Second edition under preparation. Stage at the time of publication: IEC FDIS 62619:~~2015~~2021.

IEC 62660-2:~~2010~~2018, *Secondary lithium-ion cells for the propulsion of electric road vehicles – Part 2: Reliability and abuse testing*

ISO/TR 8713, *Electrically propelled road vehicles – Vocabulary*

## 3 Terms and definitions

For the purposes of this document, the terms and definitions given in ~~IEC 60050-482~~ ISO/TR 8713 and the following apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- IEC Electropedia: available at http://www.electropedia.org/
- ISO Online browsing platform: available at http://www.iso.org/obp

**3.1**
**BEV**
**battery electric vehicle**
electric vehicle with only a traction battery as power source for vehicle propulsion

**3.2**
**cell block**
group of cells connected together in parallel configuration with or without protective devices (e.g. fuse or positive temperature coefficient resistor (PTC)) and not yet fitted with its final housing, terminal arrangement ~~and~~ or electronic control device



**3.3**
**cylindrical cell**
cell with a cylindrical shape in which the overall height is equal to or greater than the diameter



[SOURCE: IEC 60050-482:2004, 482-02-39]

**3.4**
**explosion**
failure that occurs when a cell container ~~, if any,~~ opens violently and ~~major components~~ its solid contents are forcibly expelled

**3.5**
**fire**
emission of flames from a cell or cell block for more than 1 s

Note 1 to entry: Sparks and arcing are not considered as flames.

**3.6**
**HEV**
**hybrid electric vehicle**
vehicle with both a rechargeable energy storage system and a fuelled power source for propulsion

**3.7**
**internal short-circuit**
unintentional electrical connection between the negative and positive electrodes inside a cell

**3.8**
**leakage**
visible escape of liquid electrolyte from a part, except for a vent, such as ~~casing~~ the case, sealing part, and/or terminals of the cell

**3.9**
**nominal voltage**
suitable approximate value of the voltage used to designate or identify a cell

[SOURCE: IEC 60050-482:2004, 482-03-31, modified – Deletion of "a battery or an electrochemical system" at the end of the definition.]

**3.10**
**pouch cell**
cell having the shape of a parallelepiped whose faces are rectangular and with a prismatic flexible laminate film case

**3.11**
**prismatic cell**
cell having the shape of a parallelepiped whose faces are rectangular and with a prismatic hard case

[SOURCE: IEC 60050-482:2004, 482-02-38, modified − The word "cell" has been added to the term, "qualifies a cell or a battery" has been replaced with "cell" in the definition, and "and with a prismatic hard case housing" has been added.]



**3.12**
**rated capacity**
$C_n$
~~quantity of electricity $C_3$Ah (ampere-hours) for BEV and $C_1$Ah for HEV declared by the manufacturer~~



capacity value of a cell in ampere hours (Ah) determined under specified conditions and declared by the cell manufacturer

Note 1 to entry: The subscript $n$ in $C_n$ is the time base in hours (h). In this document, $n$ = 3 for BEV application and $n$ = 1 for HEV application unless otherwise specified.

Note 2 to entry: Term and definition based on IEC 60050-482:2004, 482-03-15.

**3.13**
**reference test current**
$I_t$
reference test current in amperes (A) which is expressed as

~~$I_t$ (A) = $C_n$ (Ah)/n (h)~~

~~where~~

~~$C_n$ is the rated capacity of the cell;~~

~~n in $C_n$ is the time base (h).~~

$I_t = C_n / 1$

Note 1 to entry: 1 has a dimension of time in hours (h).

Note 2 to entry: See IEC 61434:1996, Clause 2.

~~**3.11**~~
~~**room temperature**~~
~~temperature of 25 °C ± 2 K~~

**3.14**
**rupture**
mechanical failure of a container case of a cell induced by an internal or external cause, resulting in exposure or spillage but not ejection of materials

**3.15**
**secondary lithium-ion cell**
~~**cell**~~
secondary single cell whose electrical energy is derived from the insertion/extraction reactions of lithium-ions between the ~~anode~~ negative electrode and the ~~cathode~~ positive electrode

Note 1 to entry: A secondary cell is a ~~basic~~ manufactured unit providing a source of electrical energy by direct conversion of chemical energy. The cell consists of electrodes, electrolyte, container, terminals and, if any, separators. The electrode can be monopolar or bipolar; the current collector of the former has active material of single polarity and the latter has positive and negative electrode active materials. The electrolyte includes an ionic conductive liquid or solid, or a mixture of them. The cell is designed to be charged electrically.

Note 2 to entry: ~~In this standard, "cell" means the "secondary lithium-ion cell" to be used for the propulsion of electric road vehicles.~~ Where the term "cell" is used alone in this document, it refers to a secondary lithium-ion cell.

**3.16**
**SOC**
**state of charge**
~~available capacity in a battery expressed as a percentage of rated capacity~~
quantity of electricity stored in a cell expressed as a percentage of rated capacity



**3.17**
**upper limit charging voltage**
highest charging voltage in the cell operating region, which is specified by the cell manufacturer



Note 1 to entry: Information on the cell operating region is provided in Annex A.

[SOURCE: IEC 62133-2:2017, 3.19, modified − Note to entry added.]

**3.18**
**venting**
release of excessive internal pressure from a cell in a manner intended by design to preclude rupture or explosion

## 4 Test conditions

### 4.1 General

Unless otherwise stated in this document, cells shall be tested at room temperature. For the purposes of this document, room temperature is 25 °C ± 2 K.

The details of the instrumentation used shall be provided in any report of results.

~~The cell can be tested under restraint to avoid swelling if acceptable according to the purpose of test. The restraint should refer to the battery design.~~

Cell blocks can be tested as an alternative to cells in accordance with the agreement between the cell manufacturer and the customer.

Concerning the cell for plug-in hybrid electric vehicles (PHEV), the cell manufacturer can select either the test condition of BEV application or of HEV application.

NOTE Test and measurement can be conducted in a fixture as recommended by the cell manufacturer.

## 4.2 Measuring instruments

### 4.2.1 Range of measuring devices

The instruments used shall enable the values of voltage and current to be measured. The range of these instruments and measuring methods shall be chosen so as to ensure the accuracy specified for each test.

For analogue instruments, this implies that the readings shall be taken in the last third of the graduated scale.

Any other measuring instruments may be used provided they give an equivalent accuracy.

### 4.2.2 Voltage measurement

The resistance of the voltmeters used shall be at least 1 MΩ/V.

### 4.2.3 Current measurement

The entire assembly of ammeter, shunt and leads shall be of an accuracy class of 0,5 or better.

### 4.2.4 Temperature measurements

The cell temperature shall be measured by use of a surface temperature measuring device capable of an equivalent scale definition and accuracy of calibration as specified in 4.2.1. The temperature should be measured at a location which most closely reflects the cell or cell block temperature. The temperature may be measured at additional appropriate locations, if necessary.

The examples for temperature measurement are shown in Figure 1. The instructions for temperature measurement specified by the cell manufacturer shall be followed.

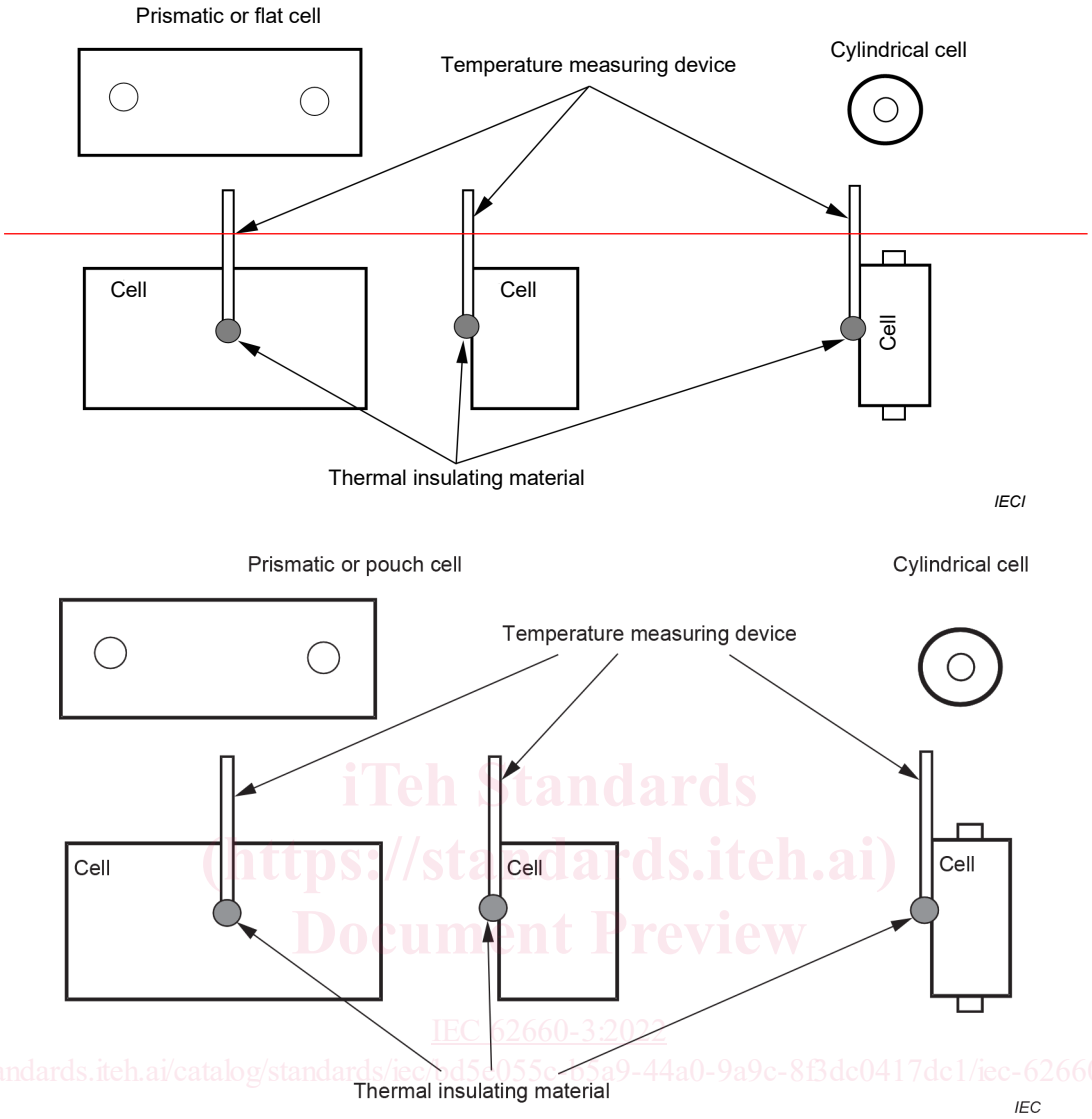




**Figure 1 – Example of temperature measurement of cell**

### 4.2.5 Other measurements

Other values ~~including capacity and power~~ may be measured by use of a measuring device, provided it complies with 4.3.

## 4.3 Tolerance

The overall accuracy of controlled or measured values, relative to the specified or actual values, shall be within the following tolerances:

a) ±0,1 % for voltage;

b) ±1 % for current;

c) ±2 K for temperature;

d) ±0,1 % for time;

e) ±0,1 % for mass;

f) ±0,1 % for dimensions.

These tolerances comprise the combined accuracy of the measuring instruments, the measurement technique used, and all other sources of error in the test procedure.