IEC TR 62660-4

Edition 1.0 2017-02

TECHNICAL REPORT

colour inside

Secondary lithium-ion cells for the propulsion of electric road vehicles – Part 4: Candidate alternative test methods for the internal short circuit test of IEC 62660-3

IEC TR 62660-4:2017-02(en)

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

ICS 29.220.20

ISBN 978-2-8322-3715-1

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

Part 4: Candidate alternative test methods for the internal short circuit test of IEC 62660-3

FOREWORD

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IEC TR 62660-4, which is a Technical Report, has been prepared by IEC technical committee 21: Secondary cells and batteries.

The text of this Technical Report is based on the following documents:

Enquiry draft	Report on voting
21/891/DTR	21/899/RVC

Full information on the voting for the approval of this Technical Report can be found in the report on voting indicated in the above table.

This document has been drafted in accordance with the ISO/IEC Directives, Part 2.

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 "http://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- withdrawn,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.

A bilingual version of this publication may be issued at a later date.

IMPORTANT – The 'colour inside' logo on the cover page of this publication indicates that it contains colours which are considered to be useful for the correct understanding of its contents. Users should therefore print this document using a colour printer.

INTRODUCTION

IEC 62660-3 provides the 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). IEC 62660-3 specifies the internal short circuit test to simulate an internal short circuit of a cell caused by the contamination of conductive particle, based on IEC 62619. Because the test method based on IEC 62619 requires opening of the cell and care to be taken, the industry needs alternative test methods that could also be applied under certain conditions. This document provides candidates of alternative test procedures.

NOTE This test is to be conducted in a facility suitable to contain the potential for hazardous reactions up to and including an explosion and with staff trained to manage the risks.

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

Part 4: Candidate alternative test methods for the internal short circuit test of IEC 62660-3

1 Scope

This Part of IEC 62660 provides the test data on the candidate alternative test methods for the internal short circuit test according to 6.4.4.2.2 of IEC 62660-3:2016. The internal short circuit test in this document is intended to simulate an internal short circuit of a cell caused by the contamination of conductive particle, and to verify the safety performance of the cell under such conditions.

This document is applicable to the 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 This document does not cover cylindrical cells.

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 62619:2017, *Secondary cells and batteries containing alkaline or other non-acid electrolytes – Safety requirements for secondary lithium cells and batteries, for use in industrial applications*

IEC 62660-3:2016, *Secondary lithium-ion cells for the propulsion of electric road vehicles – Part 3: Safety requirements*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 62660-3 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.

4 General provisions for alternative test

The internal short circuit test is specified in 6.4.4.2.1 of IEC 62660-3:2016. The other test methods to simulate the internal short circuit of cell caused by the contamination of conductive particle may be selected if the following criteria are satisfied, and agreed between the customer and the supplier:

a) The case deformation shall not affect the short circuit event of cell thermally or electrically. The energy shall not be dispersed by any short circuit other than the interelectrode short circuit.

b) One layer internal short circuit between positive and negative electrode shall be simulated (target).

c) Approximately the same short circuited area as that of 7.3.2 b) of IEC 62619:2017 shall be simulated.

d) The short circuited locations in the cell shall be the same as described in 6.4.4.2.1 of IEC 62660-3:2016.

e) The test shall be repeatable (see Table 1 of IEC 62619:2017).

The detailed test conditions and parameters of an alternative test shall be adjusted before the test according to the agreement between the customer and the cell manufacturer, so that the above criteria can be satisfied. The test result shall be evaluated by the disassembly of the cell, X-ray observation, etc.

If the test result shows more than one layer internal short circuit, or larger short circuited area, the test may be deemed as valid alternative test, provided that the acceptance criteria in 6.4.4.3 of IEC 62660-3:2016 are satisfied. The failure in an alternative test does not mean the failure in the test according to 6.4.4.2.1 of IEC 62660-3:2016, because the test condition of the alternative test may be more severe than the prescribed criteria.

NOTE In case the internal short circuit cannot be simulated, the test is invalid and the test data are reported.

5 Alternative test method

5.1 Alternative test method description

5.1.1 General

This subclause describes the test method of the indentation induced internal short circuit test as a candidate of alternative test methods in Clause 4. Table 1 provides the recommended test specifications of the test.

Table 1 – Recommended test specifications

Item	Recommendation
Test temperature (temperature of the test bench and cell)	25 °C ± 5 °C
State of charge (SOC) of the cell	Maximum SOC specified by the cell manufacturer
Press speed	0,1 mm/s or less
Press speed accuracy	± 0,01 mm/s
Position stability after pressurizing	± 0,02 mm
Maximum pressurizing capability	1 000 N or more
Pressure measuring method	Directly measured with a load cell
Pressure measuring period	5 ms or less
Temperature measuring period	1 s or less
Voltage measuring period	5 ms or less
Time to stop the indenter after voltage drop is detected	100 ms or less

5.1.2 Test preparation and test set-up

5.1.2.1 Cell preparation

For flat or pouch cell, no preparation is needed.

For prismatic cell with hard casing, casing could be thinned or removed by an appropriate method recommended by the cell manufacturer. Thinning or removal of casing should be conducted before the charging of cell and SOC adjustment. This operation should be conducted taking all the safety measures needed.

5.1.2.2 Test setup

The cell should be held in a manner not to move during the test. The cell should be electrically isolated from test bench.

A flat or pouch cell requires a fixation device. Figure 1 and Figure 2 show examples of the fixation device.

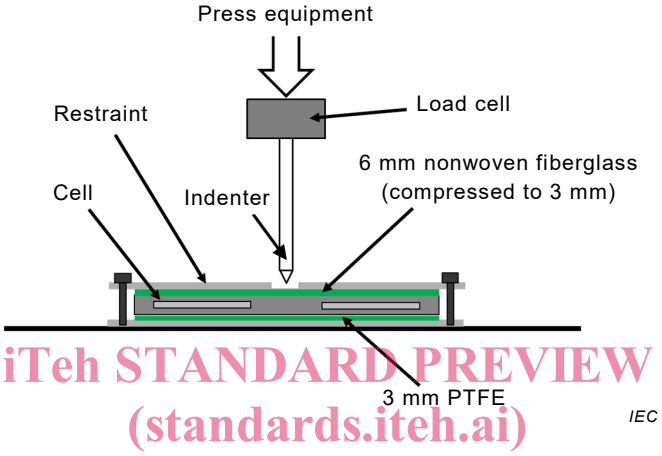

Figure 1 – Example of test setup 1

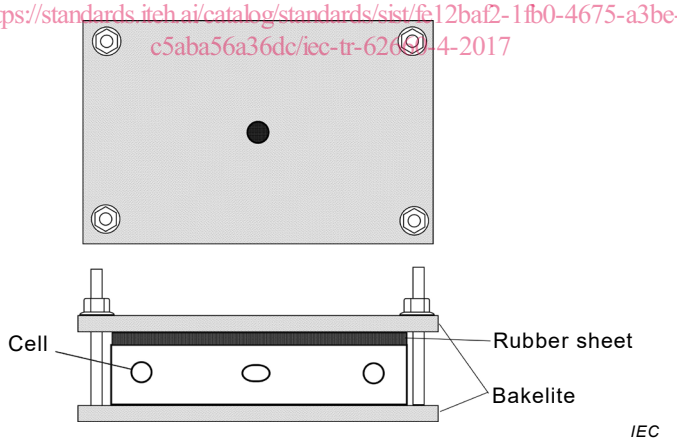

Figure 2 – Example of test setup 2

5.1.2.3 Indenter device

5.1.2.3.1 General

Two types of indenter device, as defined in 5.1.2.3.2 and 5.1.2.3.3 are proposed in this alternative test method.

5.1.2.3.2 Type 1: 3 mm ceramic nail

Type 1 indenter is a ceramic nail having a diameter of 3 mm ± 0,2 mm. The angle of the nail tip should be 45° ± 3°. Figure 1 shows an example of the ceramic nail's orientation to the cell electrode layers during the press.

5.1.2.3.3 Type 2: 1 mm ceramic nail with Ni tip

Type 2 indenter is a ceramic nail having a diameter of 1 mm ± 0,1 mm with a nickel (Ni) tip of 0,35 mm in height. The angle of the Ni nail tip should be between 28° and 45°. See Figure 3 and Figure 4.

A ceramic nail with a Ni tip is suitable for a prismatic cell with a hard casing and a flat or pouch cell.

The test using the Type 1 indenter is not applicable to the cells of which the casing is used as a part of the electrodes. If the casing is removed, this test may be applicable.

Dimensions in millimetres

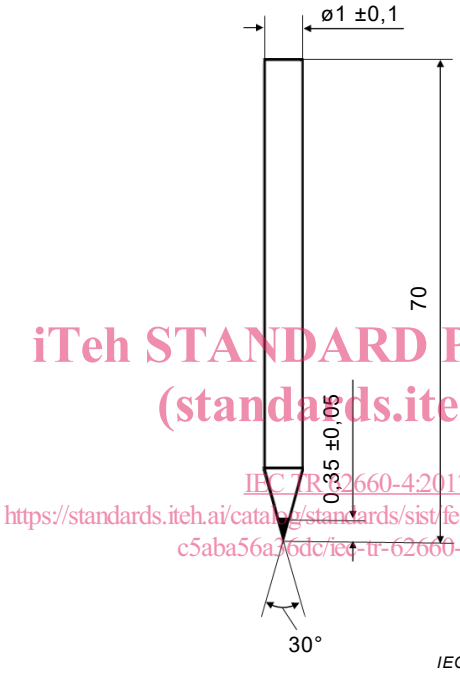

Figure 3 – Example of ceramic nail with Ni tip

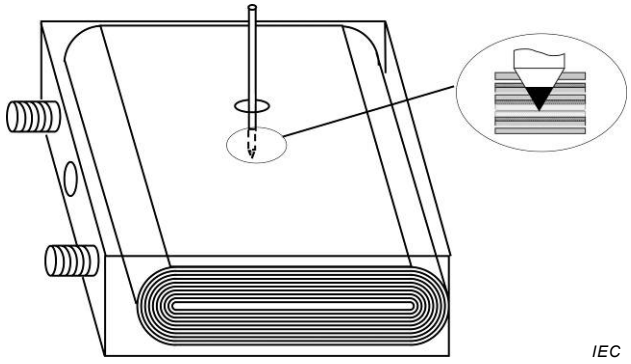

Figure 4 – Example of ceramic nail with Ni tip test

5.1.3 Test execution

The test should be conducted as follows:

a) Prepare the cell in accordance with 5.1.2.1.