IEC 61982-4

Edition 1.0 2015-10

INTERNATIONAL STANDARD

NORME INTERNATIONALE

Secondary batteries (except lithium) for the propulsion of electric road vehicles – Part 4: Safety requirements of nickel-metal hydride cells and modules

Accumulateurs (excepté lithium) pour la propulsion des véhicules routiers électriques – Partie 4: Exigences de sécurité pour les éléments et modules d'accumulateurs nickel métal-hydrure

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International Standard IEC 61982-4 has been prepared by IEC technical committee 21: Secondary cells and batteries.

The text of this standard is based on the following documents:

CDV	Report on voting
21/852/CDV	21/866/RVC

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

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

A list of all parts in the IEC 61982 series, published under the general title *Secondary batteries (except lithium) for the propulsion of electric road vehicles*, can be found on the IEC website.

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

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- withdrawn,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

INTRODUCTION

The electric road vehicles (EV) including hybrid electric vehicles (HEV) begin to diffuse in the global market with backing from global concerns on CO_2 reduction and clean energy, as well as from relevant technology advancement and cost reduction. Nickel-metal hydride (Ni-MH) batteries have advantages in cost and balanced performance, and have been used extensively for EV application, especially for the propulsion of HEV.

This standard provides the safety test procedures and acceptance criteria of Ni-MH batteries (cells and modules) for EV application in order to evaluate their basic safety performance. For automobile application, it is important to note the designing diversity of battery packs and systems, and specific requirements for cells 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 cells or modules to be used in a variety of battery systems.

For specific requirements for the safety of cell differ depending on the system designs of battery pack or vehicle, final pass-fail criteria of cell are to be based on the agreement between the cell manufacturers and the customers.

SECONDARY BATTERIES (EXCEPT LITHIUM) FOR THE PROPULSION OF ELECTRIC ROAD VEHICLES –

Part 4: Safety requirements of nickel-metal hydride cells and modules

1 Scope

This Part of IEC 61982 specifies test procedures and acceptance criteria for safety performance of nickel-metal hydride (Ni-MH) secondary cells and modules used for the propulsion of electric vehicles (EV) including battery electric vehicles (BEV) and hybrid electric vehicles (HEV).

This standard intends to secure the basic safety performance of the cell as used in a battery system under intended use and reasonably foreseeable misuse, during the normal operation of EV. The safety requirements of the cell in this standard are based on the premise that the cells and modules are properly used in a battery pack and system within the limit of voltage, current and temperature as specified by the cell manufacturer.

The evaluation of the safety of batteries during transport and storage is not covered by this standard.

NOTE 1 In this standard, Ni-MH cells mean the sealed nickel-metal hydride cells: these are sealed cells that use nickel hydroxide at the positive electrode, a hydrogen absorbing alloy at the negative electrode, and alkaline aqueous solution such as potassium hydroxide as the electrolyte. Sealed-type cells are those that can maintain their sealed condition and do not release gas or liquid when electrically charged and discharged within the temperature range specified by the cell manufacturer. These cells are equipped with a gas release mechanism to prevent explosion.

NOTE 2 In this standard, all the description on the cell are applicable to the module under the test.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 60050-482:2004, *International Electrotechnical Vocabulary (IEV) – Part 482: Primary and secondary cells and batteries*

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

3 Terms and definitions

For the purposes of this document, the terms and definitions and those given in IEC 60050-482, as well as the following apply.

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

3.2
explosion
failure that occurs when a cell container opens violently and major components are forcibly expelled

3.3
fire
emission of flames from a cell

3.4
hybrid electric vehicle
HEV
vehicle with both a rechargeable energy storage system and a fuelled power source for propulsion

3.5
module
group of cells connected together in a series and/or parallel configuration with or without protective devices, e.g. fuse or positive temperature coefficient (PTC), not yet fitted with its final housing, terminal arrangement and electronic control device

3.6
rated capacity
capacity value of a cell or battery determined under specified conditions and declared by the manufacturer

Note 1 to entry: The rated capacity C_n of a cell or battery is declared by the cell manufacturer.

[SOURCE: IEC 60050-482:2004, 482-03-15, modified – Addition of Note to entry.]

3.7
ambient temperature
temperature of 25 °C ± 2 K

3.8
state of charge
SOC
available capacity in a battery expressed as a percentage of the rated capacity

4 General test requirements

4.1 Accuracy of measuring instruments

4.1.1 Electrical measuring instruments

4.1.1.1 Range of measuring devices

The instruments used shall enable the values of voltage and current to be correctly 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.

4.1.1.2 Voltage measurement

The instruments used for voltage measurement shall be voltmeters of an accuracy class equal to 0,5 or better. The resistance of the voltmeters used shall be at least 1 000 Ω/V (see IEC 60051 series).

4.1.1.3 Current measurement

The instruments used for current measurement shall be ammeters of an accuracy class equal to 0,5 or better. The entire assembly of ammeter, shunt and leads shall be of an accuracy class of 0,5 or better (see IEC 60051 series or refer to IEC 60359).

4.1.2 Tolerance

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

a) ± 1 % for voltage;

b) ± 1 % for current;

c) ± 2 K for temperature;

d) ± 0,1 % for time;

e) ± 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.

4.2 General test conditions

4.2.1 Test temperature

If not otherwise defined, before each test, the cell shall be stabilised at the ambient temperature for a period between 1 h and 4 h.

Unless otherwise stated in this standard, the cell shall be tested at the ambient temperature.

4.2.2 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 4.1.2. The temperature should be measured at a location which most closely reflects the cell 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.

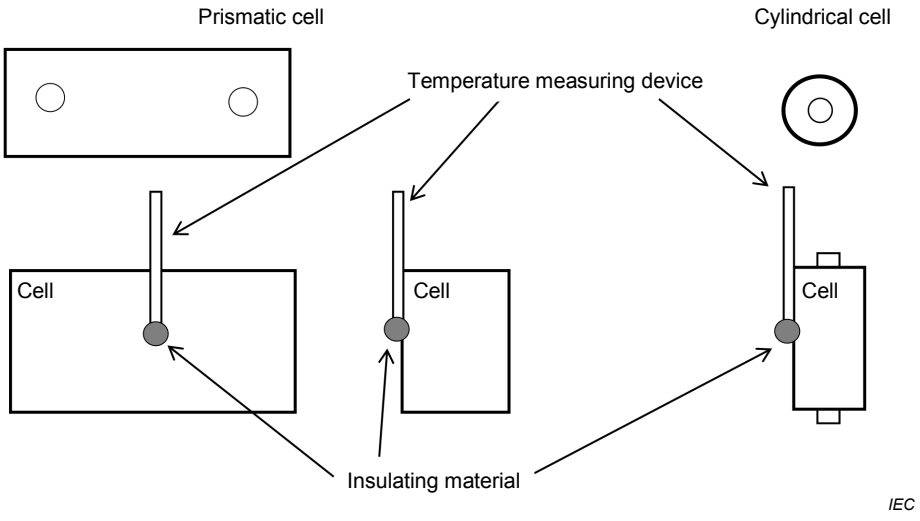

Figure 1 – Example of temperature measurement of cell

4.2.3 Dimension measurement

The maximum dimension of the total width, thickness or diameter, and length of a cell shall be measured up to three significant figures in accordance with the tolerances in 4.1.2.

The examples of maximum dimension are shown in Figures 2a) to 2d).

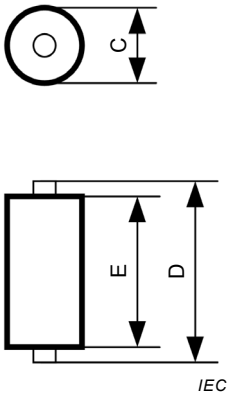

Figure 2a) – Cylindrical cell (type a)

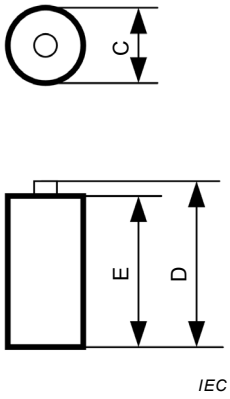

Figure 2b) – Cylindrical cell (type b)

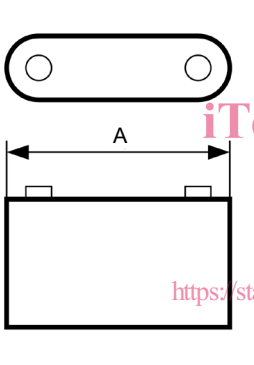

Figure 2c) – Prismatic cell (type a)

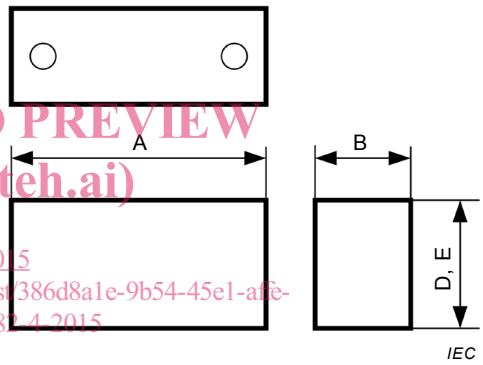

Figure 2d) – Prismatic cell (type b)

Key

A total width

B total thickness

C diameter

D total length (including terminals)

E total length (excluding terminals)

Figure 2 – Examples of maximum dimension of cell

5 Electrical measurement

5.1 General charge conditions

Unless otherwise stated in this standard, prior to electrical measurement, the cell shall be charged as follows.

Step 1 Prior to charging, the cell shall be discharged at the ambient temperature at a constant current of 1/3 I_t A down to a final voltage specified by the cell manufacturer.

Step 2 Then, the cell shall be charged, at the ambient temperature, according to the charging method declared by the cell manufacturer.

5.2 Capacity

Before the SOC adjustment in 5.3, the capacity of test cell shall be confirmed to be the rated value in accordance with the following steps.

Step 1 The cell shall be charged in accordance with 5.1. After the charge, the cell temperature shall be stabilized in accordance with 4.2.1.

Step 2 The cell shall be discharged at 1 I_t A down to 0,9 V at the ambient temperature. The upper limit of the discharge current shall be 200 A. When testing modules, the final voltage is the product of the final voltage of a cell and the number of cells connected in series in the module.

The method of designation of test current I_t A is defined in IEC 61434.

Step 3 Measure the discharge duration until the specified final voltage is reached, and calculate the capacity of the cell, expressed in Ah to three significant figures.

5.3 State of charge (SOC) adjustment

The test cells shall be charged as specified below. The SOC adjustment is the procedure to be followed for preparing cells to the various SOCs for the tests.

Step 1 The cell shall be charged in accordance with 5.1.

Step 2 The cell shall be left at rest at ambient temperature in accordance with 4.2.1.

Step 3 The cell shall be discharged at a constant current of 1/3 I_t (A) at ambient temperature for $(100 - n)/100 \times 3$ h, where n is SOC (% Cn Ah) to be adjusted for each test.

6 Safety tests

6.1 General

The safety tests in this clause shall be performed on a cell or module that is not more than six months old under the conditions specified by the cell manufacturer.

The number of cells under each test can be determined according to the agreement between the cell manufacturer and the customer.

For all the tests specified in this clause, the test installation shall be reported including the securement and wiring of the cell or module.

NOTE If necessary, to prevent deformation, the cell can be maintained during the test in a manner that does not violate the test purpose.

6.2 Mechanical test

6.2.1 Mechanical shock

6.2.1.1 General

This test is to verify the safety performance of the cell under inertial loads which may occur during a vehicle crash.

6.2.1.2 Test

The test shall be performed as follows.

Step 1 Adjust the SOC of the cell to 100 % Cn Ah for BEV application and 80 % Cn Ah for HEV application in accordance with 5.3.

Step 2 The cell shall be secured to the testing machine by means of a rigid mount which will support all mounting surfaces of the cell.