IEC 63115-2

Edition 1.0 2021-01

INTERNATIONAL STANDARD

NORME INTERNATIONALE

colour inside

Secondary cells and batteries containing alkaline or other non-acid electrolytes – Sealed nickel-metal hydride cells and batteries for use in industrial applications –
Part 2: Safety

Accumulateurs alcalins et autres accumulateurs à électrolyte non acide – Accumulateurs étanches au nickel-métal hydrure destinés à l'utilisation dans les applications industrielles –
Partie 2: Sécurité

IEC 63115-2:2021-01(en-fr)

IEC Central Office
3, rue de Varembé
CH-1211 Geneva 20
Switzerland

Tel.: +41 22 919 02 11
info@iec.ch
www.iec.ch

IEC 63115-2

Edition 1.0 2021-01

INTERNATIONAL STANDARD

NORME INTERNATIONALE

colour inside

Secondary cells and batteries containing alkaline or other non-acid electrolytes – Sealed nickel-metal hydride cells and batteries for use in industrial applications –
Part 2: Safety

Accumulateurs alcalins et autres accumulateurs à électrolyte non acide – Accumulateurs étanches au nickel-métal hydrure destinés à l'utilisation dans les applications industrielles –
Partie 2: Sécurité

INTERNATIONAL ELECTROTECHNICAL COMMISSION

COMMISSION ELECTROTECHNIQUE INTERNATIONALE

ICS 29.220.30

ISBN 978-2-8322-9132-0

CONTENTS

INTERNATIONAL ELECTROTECHNICAL COMMISSION

____

SECONDARY CELLS AND BATTERIES CONTAINING ALKALINE OR OTHER NON-ACID ELECTROLYTES – SEALED NICKEL-METAL HYDRIDE CELLS AND BATTERIES FOR USE IN INDUSTRIAL APPLICATIONS –

Part 2: Safety

FOREWORD

1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as "IEC Publication(s)"). Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.

2) The formal decisions or agreements of IEC on technical matters express, as nearly as possible, an international consensus of opinion on the relevant subjects since each technical committee has representation from all interested IEC National Committees.

3) IEC Publications have the form of recommendations for international use and are accepted by IEC National Committees in that sense. While all reasonable efforts are made to ensure that the technical content of IEC Publications is accurate, IEC cannot be held responsible for the way in which they are used or for any misinterpretation by any end user.

4) In order to promote international uniformity, IEC National Committees undertake to apply IEC Publications transparently to the maximum extent possible in their national and regional publications. Any divergence between any IEC Publication and the corresponding national or regional publication shall be clearly indicated in the latter.

5) IEC itself does not provide any attestation of conformity. Independent certification bodies provide conformity assessment services and, in some areas, access to IEC marks of conformity. IEC is not responsible for any services carried out by independent certification bodies.

6) All users should ensure that they have the latest edition of this publication.

7) No liability shall attach to IEC or its directors, employees, servants or agents including individual experts and members of its technical committees and IEC National Committees for any personal injury, property damage or other damage of any nature whatsoever, whether direct or indirect, or for costs (including legal fees) and expenses arising out of the publication, use of, or reliance upon, this IEC Publication or any other IEC Publications.

8) Attention is drawn to the Normative references cited in this publication. Use of the referenced publications is indispensable for the correct application of this publication.

9) Attention is drawn to the possibility that some of the elements of this IEC Publication may be the subject of patent rights. IEC shall not be held responsible for identifying any or all such patent rights.

International Standard IEC 63115-2 has been prepared by subcommittee 21A: Secondary cells and batteries containing alkaline or other non-acid electrolytes, of IEC technical committee 21: Secondary cells and batteries.

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

FDIS	Report on voting
21A/735/FDIS	21A/743/RVD

Full information on the voting for the approval of this International Standard 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 63115 series, published under the general title *Secondary cells and batteries containing alkaline or other non-acid electrolytes – Sealed nickel-metal hydride cells and batteries for use in industrial applications*, 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.

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.

SECONDARY CELLS AND BATTERIES CONTAINING ALKALINE OR OTHER NON-ACID ELECTROLYTES – SEALED NICKEL-METAL HYDRIDE CELLS AND BATTERIES FOR USE IN INDUSTRIAL APPLICATIONS –

Part 2: Safety

1 Scope

This document specifies designations, tests and requirements for the safe operation of sealed nickel-metal hydride cells and batteries used in industrial applications excluding road vehicles.

When an IEC International Standard specifying test conditions and requirements for cells used in special applications is in conflict with this document, the former takes precedence (e.g. IEC 62675).

Since this document covers batteries for various industrial applications, it includes those requirements which are common and minimum to the various applications.

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* (available at www.electropedia.org)

IEC 63115-1:2020, *Secondary cells and batteries containing alkaline or other non-acid electrolytes – Sealed nickel-metal hydride cells and batteries for use in industrial applications – Part 1: Performance*

ISO/IEC Guide 51, *Safety aspects – Guidelines for their inclusion in standards*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 60050-482, IEC 63115-1, ISO/IEC Guide 51, 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
safety
freedom from unacceptable risk

[SOURCE: IEC 60050-903:2013, 903-01-19]

3.2
risk
combination of the probability of occurrence of harm and the severity of that harm

[SOURCE: IEC 60050-903:2013, 903-01-07, modified – The note has been omitted.]

3.3
harm
physical injury or damage to the health of people, or damage to property or the environment

[SOURCE: IEC 60050-351:2013, 351-57-02]

3.4
hazard
potential source of harm

[SOURCE: IEC 60050-351:2013, 351-57-01, modified – The note has been omitted.]

3.5
intended use
use of a product, process or service in accordance with the specifications, instructions and information provided by the supplier

[SOURCE: IEC 60050-903:2013, 903-01-13, modified – The words "specifications" and "instructions" have been added and "for use" omitted.]

3.6
reasonably foreseeable misuse
use of a product, process or service in a way not intended by the supplier, but which may result from readily predictable human behaviour

[SOURCE: IEC 60050-903:2013, 903-01-14]

3.7
cell
sealed nickel-metal hydride cell
cell containing a nickel hydroxide compound for the positive electrode, a hydrogen absorbing alloy for the negative electrode, and potassium hydroxide or other alkaline solution as electrolyte, and not releasing either gas or liquid when operated within the limits specified by the manufacturer

Note 1 to entry: A sealed cell may be equipped with a safety device to prevent a dangerously high internal pressure and is designed to operate during its life in its original sealed state. See IEC 60050-482:2004, 482-05-17.

3.8
cell block
group of cells connected together in parallel configuration with or without protective devices (e.g. fuse or PTC (positive temperature coefficient)) and monitoring circuitry

3.9
monobloc
battery with multiple separate but electrically connected cell compartments each of which is designed to house an assembly of electrodes, electrolyte, terminals or interconnections and possible separators

[SOURCE: IEC 60050-482:2004, 482-02-17, modified – "battery" has been omitted from the term and the note to entry deleted.]

3.10
module
group of cells connected together either in series and/or parallel configuration with or without protective devices (e.g. fuse or PTC) and monitoring circuitry

3.11
battery pack
energy storage device comprised of one or more cells, monoblocs or modules electrically connected

Note 1 to entry: A battery pack may have a monitoring circuitry which provides information (e.g. cell voltage) to a battery system.

3.12
battery system
battery
system which comprises one or more cells, cell blocks, monoblocs, modules or battery packs

Note 1 to entry: The battery system has a battery management system to cut off current in case of overcharge, overcurrent, overdischarge, or overheating.

Note 2 to entry: Overdischarge cut off is not mandatory if there is an agreement on this between the cell manufacturer and the customer.

Note 3 to entry: The battery system may have cooling or heating units.

Note 4 to entry: The battery system may be enclosed in a battery box.

3.13
battery enclosure
enclosure
physical construction which separates the battery or battery system from its external environment

3.14
battery management system
BMS
electronic system associated with a battery which has functions to cut off in case of overcharge, overcurrent, overdischarge, and overheating

Note 1 to entry: The BMS monitors and/or manages its state, calculates secondary data, reports that data and/or controls its environment to influence the battery's safety, performance and/or service life.

Note 2 to entry: The function of the BMS can be assigned to the battery pack or to equipment that uses the battery (see Figure 2).

Note 3 to entry: The BMS can be divided and it can be found partially in the battery pack and partially on the equipment that uses the battery (see Figure 2).

Note 4 to entry: The BMS is sometimes also referred to as a BMU (battery management unit).

3.15
final voltage
specified voltage of a battery at which the battery discharge is terminated

[SOURCE: IEC 60050-482:2004, 482-03-30, modified – The synonyms "end-of-discharge voltage", "cut-off voltage" and "end-point voltage" have been omitted.]

3.16
nominal voltage
suitable approximate value of the voltage used to designate or identify the voltage of a cell or battery

Note 1 to entry: The nominal voltage of a sealed nickel-metal hydride rechargeable single cell is 1,2 V.

Note 2 to entry: The nominal voltage of a battery of n series connected cells is equal to n times the nominal voltage of a single cell.

[SOURCE: IEC 60050-482:2004, 482-03-31, modified – The words "the voltage of" have been added; the notes to entry have been added and the reference to electrochemical systems has been omitted.]

3.17
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 is the quantity of electricity in C_5 Ah (ampere-hours) declared by the manufacturer which a single cell can deliver when discharged at the reference test current of 0,2 I_tA to a specified final voltage, after charging, storing and discharging under specified conditions.

[SOURCE: IEC 60050-482:2004, 482-03-15, modified – "cell" has been added to the definition, along with a note to entry.]

3.18
explosion
failure that occurs when a cell, module, or monobloc container opens violently as a result of a sudden increase of pressure and temperature in cell due to exothermic reaction and major components are forcibly expelled

3.19
rupture
mechanical failure of a cell, monobloc or battery induced by an internal or external cause, resulting in exposure or spillage but not ejection of materials

3.20
leakage
unplanned, visible escape of liquid electrolyte

[SOURCE: IEC 62133-1:2017, 3.9]

3.21
venting
release of excessive internal pressure from a cell, monobloc or battery in a manner intended by design to preclude rupture or explosion

4 Parameter measurement tolerances

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

a) ± 1 % for voltage;

b) ± 1 % for current;

c) ± 1 % for capacity;

d) ± 2 °C for temperature;

e) ± 0,1 % for time;

f) ± 1 % for dimension.

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

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

5 General safety considerations

5.1 General

The safety of sealed nickel-metal hydride cells or batteries requires the consideration of two sets of applied conditions:

a) intended use;

b) reasonably foreseeable misuse.

The manufacturer can use "cell block(s) or monobloc(s)" instead of "cell(s)" for any test that specifies "cell(s)". The manufacturer can use "battery pack" instead of "battery" as the test unit in this document. The cell manufacturer shall clearly declare the test unit for each test.

Cells or batteries shall be so designed and constructed that they are safe under conditions of both intended use and reasonably foreseeable misuse. It may also be expected that cells or batteries subjected to intended use shall not only be safe but shall continue to be functional in all respects.

It is expected that cells or batteries subjected to misuse may fail to function. However, even if such a situation occurs, they shall not present any significant hazards.

Potential hazards which are the subject of this document are:

a) fire,

b) explosion,

c) electrical shock hazards,

d) venting (such as H_2 gas),

e) rupture of the casing of a cell or battery with exposure of internal components,

f) leakage.

5.2 Insulation and wiring

The insulation resistance between the positive terminal and externally exposed electrically active surfaces of the battery shall protect against shock hazard.

Internal wiring and insulation should be sufficient to withstand the maximum anticipated current, voltage and temperature requirements. The orientation of wiring should be such that adequate clearances and creepage distances are maintained between conductors as per the intended application standard (or if unknown, as per IEC 60664-1). The mechanical integrity of internal connections should be sufficient to accommodate conditions of reasonably foreseeable misuse (i.e. solder alone is not considered a reliable means of connection). Adequate clearances and creepage distances as noted above shall also be maintained on control boards and other areas within the battery.

5.3 Venting

Battery cases and cells shall incorporate a pressure relief mechanism or shall be so constructed that they will relieve excessive internal pressure at a value and rate that will preclude rupture, explosion and self-ignition. If encapsulation is used to support cells within an outer case, the type of encapsulating and the method of encapsulation shall neither cause the battery to overheat during normal operation nor inhibit pressure relief.

5.4 Temperature, voltage and current management

The design of batteries shall be such that abnormal temperature-rise conditions are prevented. 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 so that associated chargers are designed to maintain charging within the temperature, voltage and current limits specified. Where necessary, applicable means can be provided to limit current and temperature to safe levels during charge and discharge.

The battery manufacturer shall declare the cell design type as per IEC 63115-1:2020, Table 1.

5.5 Terminal connectors

The size and shape of the terminal connectors shall be such to ensure that they can carry the maximum anticipated current. External terminal contact surfaces shall be formed from conductive materials with good mechanical strength and corrosion resistance (see appropriate corrosion tests, e.g. IEC 60068-2-60 and IEC 60068-2-11). Terminal connectors shall be arranged so as to minimize the risk of short circuits. Terminal connectors shall be marked to indicate polarity.

5.6 Assembly of cells into batteries

If there is more than one battery housed in a single battery enclosure, cells used in the assembly of each battery shall be of the same design, be of the same chemistry and be from the same manufacturer.

Manufacturers of cells shall specify current, voltage and temperature limits so that the battery manufacturer and/or designer may ensure proper design and assembly.

Batteries that are designed for the selective discharge of a portion of their series connected cells shall incorporate circuitry to prevent operation of cells outside the limits specified by the cell manufacturer.

5.7 Quality plan

The manufacturer shall prepare and implement a quality plan that defines procedures for the inspection of materials, components, cells and batteries and which covers the whole process of producing each type of cell or battery. Manufacturers should understand their process capabilities and should institute the necessary process controls as they relate to product safety.

5.8 Type test conditions

A battery system that is used outside of its operating region may exhibit hazards originating from the cells or batteries. Such risks shall be taken into consideration in order to prepare a safe test plan.

The test facility should have a sufficient structural integrity and a fire suppression system to contain the conditions of overpressure and fire that may occur as a result of testing. The facility should have a ventilation system to dilute gas which might be produced during the tests. Consideration should be given to high voltage hazards when applicable.

5.9 Test items

Tests items are specified in Table 1, using cells or batteries that are not more than six months old. Unless otherwise specified, tests are carried out in an ambient temperature of 20 °C ± 5 °C. Test conditions are for type tests only and do not imply that intended use includes operation under these conditions. Similarly, the limit of six months is introduced for consistency and does not imply that cell and battery system safety is reduced after six months.

Table 1 – Sample size for type tests

Test items		Test unit (see 6.1)	
Test		Cell	Battery
		(see b)	(see a and c)
6.4.1	Vibration	R	R
6.4.2	Enclosure stress at high ambient temperature	-	R
6.4.3	Temperature cycling	R	-
6.5.1	External short-circuit test	R	R
6.5.2	Drop test	R	R
6.5.3	Mechanical shock (crash hazard)	R	R
6.5.4	Thermal abuse test	R	-
6.5.5	Crush	R	-
6.5.6	Low pressure	R	-
6.5.7	Overcharge test (see d)	R	R
6.5.8	Reverse charge test	R	-

"R" = required (minimum of 1)

"-" = unnecessary or not applicable

a The manufacturer can use "battery" instead of "cell" at any test that specifies "cell(s)" as the test unit in this document if the test can be conducted for both battery and cell. The manufacturer clearly declares the test unit for each test. If it is difficult to divide the small parts in the battery, the battery can be tested as a representative of the cell. The manufacturer can add functions which are present in the final battery system to the tested unit. The manufacturer shall clearly declare the tested unit.

b The manufacturer can use "cell block or monobloc" instead of "cell" at any test that specifies "cell(s)" as the test unit in this document. The tested unit is declared clearly by the manufacturer.

c If a battery system is divided into smaller units the unit can be tested as a representative of the battery system. The manufacturer can add functions which are present in the final battery system to the tested unit. The tested unit is declared clearly by the manufacturer.

d The test is performed with those batteries that are provided with only a single control or protection for charging voltage control.

6 Specific requirements and tests

6.1 General

If tests have already been performed on a battery, their results can be accepted as equivalent for batteries of the same type.

An equivalent battery means that it is the same battery type.

The type of change that might be considered to differ from a tested type, such that it might lead to failure of any of the test results, may include, but is not limited to:

1) a change in the material of the anode, the cathode, the separator or electrolyte;
2) a change of protective devices, including hardware and software;
3) a change of safety design in cells or batteries, such as a venting valve;
4) a change in the number of cells in the battery;
5) a change in the connecting mode of cells.

6.2 Preliminary preparation for test purposes

Prior to charging, the cells or batteries shall be fully discharged in an ambient temperature of 20 °C ± 5 °C, at a constant current of 0,2 I_tA, down to 1,0 V per cell.

Unless otherwise stated in this document, cells or batteries shall be fully charged in an ambient temperature of 20 °C ± 5 °C, using the method as specified in IEC 63115-1:2020, 7.2 for the cell design type as declared by the manufacturer.

Charge and discharge currents for the tests shall be based on the rated capacity, (C_5 Ah). These currents are expressed as multiples of I_tA, where I_tA = C_5 Ah/1 h.

6.3 Insulation

The insulation resistance between the positive terminal and externally exposed metal surfaces of the battery excluding electrical contact surfaces shall be not less than 100 kΩ at 500 V DC when measured 60 s after applying the voltage.

For evaluating limits for accessibility to electrically active surfaces, the applicable access probe test as shown in Table 2 is conducted. Refer to IEC 61032 and IEC 60529 for details, including type of access probe to use, and how to evaluate for the various IP levels noted in Table 2.

Table 2 – Level of accessibility test

IPXX	Level of protection	DC Voltage
1	Not > 50 mm, prevent access by hand	< 60 V
2	Not > 12,5 mm, prevent access by finger	> 60 V
3	Not > 2,5 mm, prevent access by screwdriver	> 160 V
4	Not > 1 mm, prevent access by wire	> 500 V
5	Dust protected	
6	Dust tight	

6.4 Intended use

6.4.1 Vibration

a) Purpose

Vibration encountered during transportation shall not cause leakage, fire or explosion.

b) Test

Fully charged cells or batteries according to 6.2 are firmly secured to the platform of the vibration machine in such a manner as to faithfully transmit the vibration, without distorting the cells. The vibration shall be a sinusoidal waveform with a logarithmic sweep between 7 Hz and 200 Hz and back to 7 Hz within 15 min. This cycle shall be repeated 12 times for a total of 3 h for each of three mutually perpendicular mounting positions of the cell. One of the directions of vibration shall be perpendicular to the terminal face.

A peak acceleration of 1 g_n is to be maintained from 7 Hz to 18 Hz. The amplitude is then maintained at 0,8 mm (1,6 mm total excursion) and the frequency increased until a peak acceleration of 1,4 g_n occurs (at approximately 20 Hz). A peak acceleration of 1,4 g_n is then maintained until the frequency is increased to 200 Hz.

c) Requirements

No fire, no explosion, no leakage.