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INTERNATIONAL STANDARD

NORME INTERNATIONALE

colour inside

Railway applications – Rolling stock – Batteries for auxiliary power supply systems – Part 1: General requirements

Applications ferroviaires – Matériel roulant – Batteries pour systèmes d'alimentation auxiliaire – Partie 1: Exigences générales

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RAILWAY APPLICATIONS – ROLLING STOCK – BATTERIES FOR AUXILIARY POWER SUPPLY SYSTEMS –

Part 1: General requirements

FOREWORD

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

FDIS	Report on voting
9/2362/FDIS	9/2386/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 62973 series, published under the general title *Railway applications – Rolling stock – Batteries for auxiliary power supply systems*, 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- withdrawn,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.

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INTRODUCTION

This document considers general requirements for all rechargeable battery technologies.

Details of each battery technology are described in other parts as follows:

Part 2: Nickel Cadmium (NiCd) batteries

Part 3: Lead Acid (LA) batteries

Future parts: Other battery technologies, such as Nickel metal hydride (NiMH), Lithium ion (Li-ion), etc.

In this document the interface with a battery charger is specified and the battery charger itself is out of scope.

RAILWAY APPLICATIONS – ROLLING STOCK – BATTERIES FOR AUXILIARY POWER SUPPLY SYSTEMS –

Part 1: General requirements

1 Scope

This part of IEC 62973 applies to various rechargeable battery technologies for auxiliary power supply systems used on rolling stock.

This document applies to any rolling stock types (e.g. light rail vehicles, tramways, streetcars, metros, commuter trains, regional trains, high speed trains, locomotives, etc.).

This document focuses on:

– the description of electrical interfaces for the following battery nominal voltages: 24 V, 32 V, 36 V, 48 V, 64 V, 72 V, 87 V, 96 V, 110 V;

– the description of electrical interfaces: considering battery load profile and battery capacity sizing parameters (e.g. operating voltage range and charging characteristics).

This document with the other parts of the standard is used in conjunction with other related IEC standards for auxiliary equipment used for railway rolling stock applications.

The main objective of this document is to achieve standardization of the electrical interfaces by considering various battery parameters in order to allow for calculating the battery capacity required for a specific load profile for the various battery technologies as detailed in the other parts of the standard.

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 60077-1, *Railway applications – Electric equipment for rolling stock – Part 1: General service conditions and general rules*

IEC 61373:2010, *Railway applications – Rolling stock equipment – Shock and vibration test*

IEC 62485-2, *Safety requirements for secondary batteries and battery installations – Part 2: Stationary batteries*

IEC 62498-1:2010, *Railway applications – Environmental conditions for equipment – Part 1: Equipment on board rolling stock*

IEC 62847, *Railway applications – Rolling stock – Electrical connectors – Requirements and test methods*

ISO 7010, *Graphical symbols – Safety colours and safety signs – Registered safety signs*

3 Terms, definitions and abbreviated terms

3.1 Terms and definitions

For the purposes of this document, the following terms and definitions 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

NOTE All typical battery related descriptions are defined in IEC 60050-482.

3.1.1
battery crate
container with frame walls for holding several cells or batteries

Note 1 to entry: See 4.1 and Clause 5.

[SOURCE: IEC 60050-482:2004/AMD1:2016, 482-05-10, modified – Note 1 to entry has been added.]

3.1.2
battery tray
container with a base and walls for holding several cells or batteries

Note 1 to entry: See 4.1 and Clause 5.

[SOURCE: IEC 60050-482:2004/AMD1:2016, 482-02-35, modified – Note 1 to entry has been added.]

3.1.3
cell
basic functional unit, consisting of an assembly of electrodes, electrolyte, container, terminals and usually separators, that is a source of electric energy obtained by direct conversion of chemical energy

[SOURCE: IEC 60050-482:2004/AMD1:2016, 482-01-01, modified – Note has been deleted.]

3.1.4
monobloc battery
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

Note 1 to entry: The cells in a monobloc battery can be connected in series or in parallel.

Note 2 to entry: See 4.1.

[SOURCE: IEC 60050-482:2004, 482-02-17, modified – Note 2 to entry has been added.]

3.1.5
rated capacity <of the battery>
C_n
capacity value of a battery determined under specified conditions and declared by the battery manufacturer

[SOURCE: IEC 60050-482:2004, 482-03-15]

3.1.6
state of charge
SOC
remaining capacity to be discharged, normally expressed as a percentage of the full battery rated capacity as expressed in relevant standards

Note 1 to entry: Practical definitions of SOC are dependent upon chosen technologies.

3.1.7
depth of discharge
DOD
capacity removed from a battery during discharge in relation to its full rated capacity expressed as a percentage

Note 1 to entry: It is the complement of SOC.

Note 2 to entry: As one increases, the other decreases by the same amount.

Note 3 to entry: Practical definitions of DOD are dependent upon chosen technologies.

3.1.8
ageing factor
quantitative factor expressing the degradation in the ability of the battery, due to usage, to deliver electrical energy under specified operating conditions such as, but not limited to, operating ambient temperature, cycling considering depth of discharge (DOD), and maintenance practices

3.1.9
battery module
group of cells connected together either in a series and/or parallel configuration with or without protective devices (e.g. fuse or temperature sensor) and monitoring circuitry

3.1.10
battery system
battery
system that also includes battery tray(s), battery crate(s), monobloc(s), battery module(s), electronic components and/or equipment and associated electromechanical connections

Note 1 to entry: This is a general definition. A more precise definition can be detailed for each battery technology in the parts of the series if necessary.

3.1.11
end user
organization which operates the battery system

Note 1 to entry: The end user is normally an organization which operates the vehicle equipped with the battery system, unless the responsibility is delegated to a main contractor or consultant.

3.1.12
system integrator
organization which has the technical responsibility of the complete battery system and charging system

Note 1 to entry: The system integrator can be the end user or the train manufacturer, or none of them.

3.1.13
manufacturer
organization which has the technical responsibility for its scope of supply

Note 1 to entry: The manufacturer can be the train builder or the system integrator of a battery system, a cell manufacturer, etc. If necessary to explicitly distinguish, “train manufacturer”, “battery system manufacturer” or “cell manufacturer” is expressed.

3.2 Abbreviated terms

AC	Alternating Current
C_n	Capacity at the n-hour rate
CCTV	Closed-Circuit Television
DC	Direct Current
DOD	Depth Of Discharge
EMU	Electrical Multiple Unit
FEA	Finite Element Analysis
HVAC	Heating, Ventilation, Air Conditioning
LRU	Line Replaceable Unit
NTC	Negative Temperature Coefficient (temperature sensor)
PT 100	Temperature Sensor, Type PT 100
PT 1000	Temperature Sensor, Type PT 1000
SOC	State Of Charge

4 General requirements

4.1 Definitions of components of a battery system, see Figure 1 (images are examples)

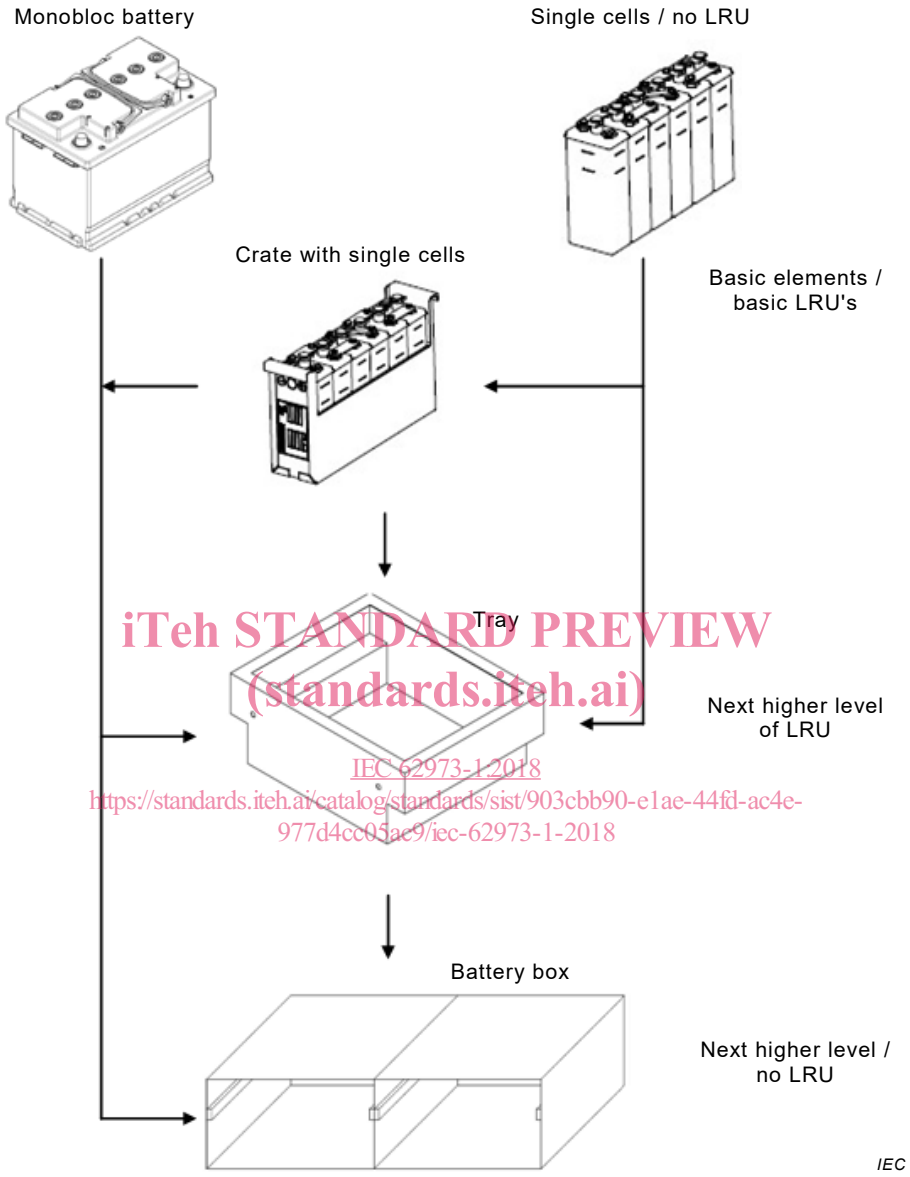

Figure 1 – Definition of cell(s), monobloc battery, crate, tray, and box

Some batteries may not include all of the above components, e.g. single cells may be installed in a tray without crates. Some battery technologies may include further components (e.g. module) in the parts of this standard series if necessary.

4.2 Definitions of battery type

Refer to the relevant part of this standard series for the battery technology.

4.3 Environmental conditions

The battery has to ensure an appropriate function at the given requirements, but with respect to lifetime and chargeability and discharge performance, the battery should not be operated above or below the maximum or minimum operating temperature range of the respective battery technology.

The battery cells/ monoblocs in the battery box shall be protected against direct solar radiation, heat sources, rain, pollution, snow, hail and sandstorm.

- Temperature conditions:
  - ambient battery temperature: according to IEC 62498-1:2010, Table 2
    Deviations may be agreed between end user and / or system integrator and cell / battery manufacturer.
  - transport and storage: –30 °C to 70 °C
    Deviations may be agreed between end user and / or system integrator and cell / battery manufacturer.
- Humidity: according to IEC 62498-1:2010, 4.4
  Deviations may be agreed between end user and / or system integrator and cell / battery manufacturer.
- Shock and vibration: according to IEC 61373:2010,11.3
- Dielectric properties: according to IEC 60077-1
- Altitude: according to IEC 62498-1:2010, 4.2

4.4 System requirements

4.4.1 System voltage

The low voltage supply network has to allow operation of the connected equipment within the minimum and maximum limits of the voltage range according to Table 1.

The battery nominal voltages are given only to identify or classify the system voltage equipment types and should not be considered as equipment operating voltages or off-load battery voltages. The number of cells in a battery can vary depending on the operating conditions and battery load profile as long as the minimum and maximum equipment operating voltage range is respected. The charging voltage for the battery is dependent on the number of cells, temperature, and its technology.

Table 1 – Operating range of the equipment supplied by the battery system

Battery nominal voltage V	Minimum voltage at equipment V	Maximum voltage at equipment V
24	17[a] / 16,8	34[a] / 30
32	23[a]	42,5[a]
48	34[a] / 33,6	68[a] / 60
64	46[a]	85[a]
72	50,4	90
87	60,9[b]	108,8[b]
96	67,2	120
110	77	137,5

NOTE Values are based on IEC 60077-1.

[a] IEEE 1476 (North America) – Refer to Bibliography.

[b] JIS E 5004-1 (Japan) – Refer to Bibliography.

The battery nominal voltages and the discharge voltages are different. As an example, the following Figure 2 shows typical discharges of a cell at different constant discharging currents (shown in multiples of C_n or multiples of I_n , C_n and I_n are related, e.g. 0,2 C_5 is equivalent to I_5) that vary by battery technology. Typical discharge curves (discharge voltages relative to