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**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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CONTENTS

FOREWORD.....	5
INTRODUCTION.....	7
1 Scope.....	8
2 Normative references	8
3 Terms, definitions and abbreviated terms	9
3.1 Terms and definitions.....	9
3.2 Abbreviated terms.....	11
4 General requirements	12
4.1 Definitions of components of a battery system, see Figure 1 (images are examples).....	12
4.2 Definitions of battery type	12
4.3 Environmental conditions	12
4.4 System requirements	13
4.4.1 System voltage.....	13
4.4.2 Charging requirements	15
4.4.3 Discharging requirements	16
4.4.4 Charge retention (self-discharge).....	18
4.4.5 Requirements for battery capacity sizing.....	18
4.5 Safety and protection requirements.....	19
4.5.1 General	19
4.5.2 Deep discharge of batteries	19
4.5.3 Temperature compensation during charging	19
4.6 Fire protection.....	20
4.7 Maintenance	20
4.8 Charging characteristics	20
5 Mechanical design of battery system	20
5.1 General.....	20
5.2 Interface mechanism.....	20
5.2.1 General	20
5.2.2 Fixed type.....	20
5.2.3 Roller type.....	21
5.2.4 Slide type	23
5.3 Location of battery system on the vehicle.....	24
5.4 Accessibility to the battery	24
5.5 Ventilation of battery box	24
6 Electrical interface.....	25
6.1 General.....	25
6.2 External electrical connections interface	25
7 Markings.....	26
7.1 Safety signs	26
7.1.1 Outside the box	26
7.1.2 Tray, crate or other places inside the box	26
7.1.3 Cells or monoblocs	26
7.2 Nameplate	26
7.2.1 Battery box	26
7.2.2 Nameplates on tray, crate, module or other nameplates inside the box.....	27

7.2.3	Cells or monoblocs	27
8	Storage and transportation conditions.....	27
8.1	Transportation	27
8.2	Storage of batteries	27
9	Testing	27
9.1	General.....	27
9.2	Type test.....	28
9.2.1	General	28
9.2.2	Electrical characteristic tests	28
9.2.3	Dielectric test	28
9.2.4	Load profile test.....	28
9.2.5	Shock and vibration test	28
9.3	Routine test	29
9.3.1	General	29
9.3.2	Visual checks	29
9.3.3	Dielectric test	29
9.3.4	Electrical characteristics tests	29
Annex A (informative)	Examples of typical load profiles for emergency operation.....	30
A.1	Example of load profile – High speed train (Figure A.1)	30
A.2	Example of load profile – Regional train / EMU (Figure A.2).....	30
Annex B (normative)	Load profile verification	31
B.1	General.....	31
B.2	General methodology.....	31
B.3	Battery sizing documentation IEC 62973-1:2018	32
B.4	Operational verification (load profile test).....	32
B.5	Test report	32
Annex C (informative)	Example of functions during load profile.....	34
Bibliography	35
Figure 1	– Definition of cell(s), monobloc battery, crate, tray, and box	12
Figure 2	– Example of discharge curves at various constant discharge currents based on percentage of capacity	14
Figure 3	– Examples of charge curves	14
Figure 4	– Interfaces between battery and battery charging system	15
Figure 5	– Example of load profile for emergency back-up for auxiliaries (train not moving).....	17
Figure 6	– Example of load profile during normal operation such as rail gaps (driving without battery charging).....	17
Figure 7	– Example of fixed solution without tray	21
Figure 8	– Example of fixed solution with tray	21
Figure 9	– Example of roller solution with folding beams	22
Figure 10	– Example of roller solution with roller bearings	23
Figure 11	– Example of slide solution.....	24
Figure 12	– Typical schematic of an electrical interface of a battery system	25
Figure A.1	– Example of load profile for high speed train (without starting up segment)	30
Figure A.2	– Example of load profile for regional train / EMU (without starting up segment)	30

Table 1 – Operating range of the equipment supplied by the battery system 13
Table 2 – Requirements of the charging characteristics 15
Table 3 – Parameters and responsibility for battery capacity sizing 19
Table C.1 – Examples of functions during different steps of load profile 34

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

Part 1: General requirements

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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

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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.

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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

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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

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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

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4 General requirements

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

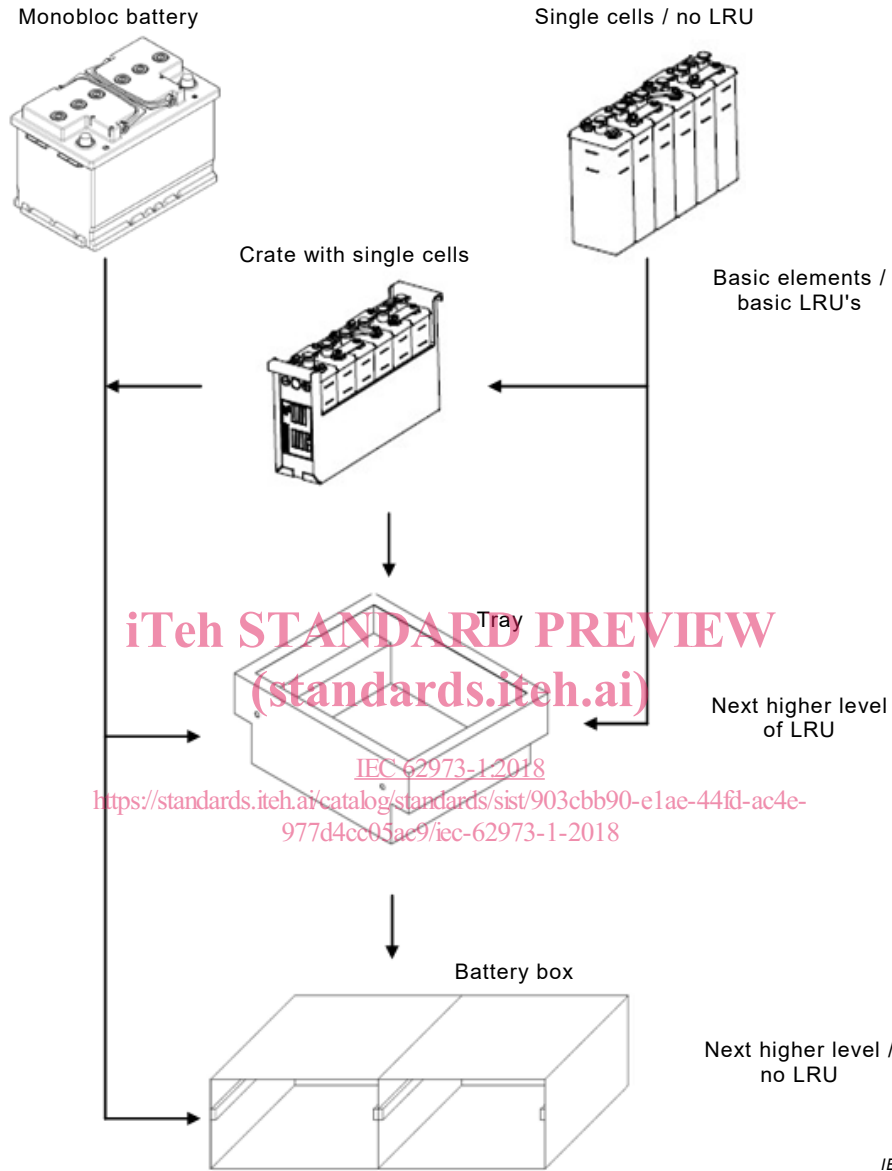


Figure 1 – Definition of cell(s), monobloc battery, crate, tray, and box

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