
**Cestna vozila – Vozila z električnim pogonom – Sistem zamenljivih akumulatorjev
za vozila kategorije L**

Road vehicles - Electrically propelled vehicles - Swappable battery system applied to L-
category vehicles

Straßenfahrzeuge - Elektrisch angetriebene Straßenfahrzeuge - Technische
Spezifikation für Batteriewechselsysteme für Fahrzeuge der Kategorie L

Sample Document

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Električna cestna vozila

Electric road vehicles

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**Road vehicles - Electrically propelled vehicles - Swappable
battery system applied to L-category vehicles**

Straßenfahrzeuge - Elektrisch angetriebene
Straßenfahrzeuge - Technische Spezifikation für
Batteriewechselsysteme für Fahrzeuge der Kategorie L

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European foreword

This document (FprCEN/TS 18391:2026) has been prepared by Technical Committee CEN/TC 301 “Road vehicles”, the secretariat of which is held by DIN.

This document is currently submitted to the CEN Vote on TS.

This document has been prepared under a standardization request addressed to CEN by the European Commission. The Standing Committee of the EFTA States subsequently approves these requests for its Member States.

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Introduction

For industry and commerce, SME's and the labour within these companies, this document will help in developing and implementing unified solutions for swappable batteries in the context of L-categories of vehicles, that will ensure interoperable and compatible products, which optimized investment and operational costs, maintenance and repairs. This document will be relevant in optimizing secondary life applications as well as end of life of the batteries with dismantling, separating and recycling components, and, thus, contributes to EU circular economy strategy and objectives.

For academic and research bodies this document will help setting and scoping future research in general.

For consumers/users, it will give choice of purchasing different L-cat vehicles models and brands, ensuring utilization of same swappable batteries systems, thanks to compatibility and interoperability from the compliance with this document.

In Figure 1 an example of a battery swapping environment is shown, including electric scooter, swappable battery, charging station and external server interface.

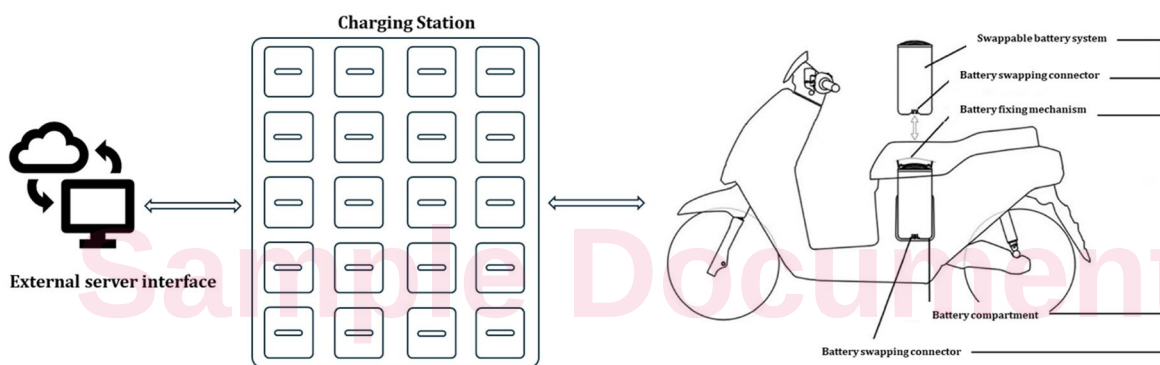


Figure 1 — Battery swapping environment

1 Scope

This document describes main technical specifications to be considered for ensuring interoperability and compatibility of swappable battery systems for small batteries, at battery-system level, vehicle level and charging-station level.

NOTE For specifications at battery system level and charging station level, see also EN IEC 62840-1, IEC 62840-3 and EN 50604-1.

The document is applicable to L-category vehicles, although some vehicles included in that category might not fit in terms of power or energy rating.

This document focuses on the following aspects that are crucial towards interoperability and compatibility:

- electrical specifications;
- mechanical specifications;
- connector specifications;
- BMS and communication protocols;
- safety and security specifications (including cybersecurity).

The document specifies requirements for the following:

- applications with the following numbers and configuration of battery systems;
 - single (1S1P);
 - maximum 2 in series – 1 in parallel (2S1P);
 - maximum 1 in series – 6 in parallel (1S6P);
 - maximum 2 in series – 2 in parallel (2S2P).
- battery-vehicle interface;
- battery-charging station interface;
- charging station.

Interoperability among charging station and operators is not covered in this document.

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.

EN 50604-1:2016¹, *Secondary lithium batteries for light EV (electric vehicle) applications — Part 1: General safety requirements and test method — Amendment 1*

¹ As impacted by EN 50604-1:2016/A1:2021 and EN 50604-1:2016/A2

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EN 60335-1, *Household and similar electrical appliances — Safety — Part 1: General requirements (IEC 60335-1)*

EN ISO 7010:2020, *Graphical symbols — Safety colours and safety signs — Registered safety signs (ISO 7010:2016, Corrected version 2020-06)*

EN ISO 18243:2025, *Electrically propelled mopeds and motorcycles — Test specifications and safety requirements for lithium-ion battery systems (ISO 18243:2025)*

EN IEC 60309-4, *Plugs, fixed or portable socket-outlets and appliance inlets for industrial purposes — Part 4: Switched socket-outlets with or without interlock (IEC 60309-4)*

IEC/TS 61851-3-1, *Electric vehicle conductive charging system — Part 3-1: DC EV supply equipment where protection relies on double or reinforced insulation — General rules and requirements for stationary equipment*

IEC/TS 61851-3-2, *Electric vehicle conductive charging system — Part 3-2: DC EV supply equipment where protection relies on double or reinforced insulation — Particular requirements for portable and mobile equipment*

IEC/TS 61851-3-4, *Electric vehicles conductive charging system — Part 3-4: DC EV supply equipment where protection relies on double or reinforced insulation — General definitions and requirements for CANopen communication*

IEC/TS 61851-3-5, *Electric vehicles conductive charging system — Part 3-5: DC EV supply equipment where protection relies on double or reinforced insulation — Pre-defined communication parameters and general application objects*

IEC/TS 61851-3-6, *Electric vehicles conductive charging system — Part 3-6: DC EV supply equipment where protection relies on double or reinforced insulation — Voltage converter unit communication*

IEC/TS 61851-3-7, *Electric vehicles conductive charging system — Part 3-7: DC EV supply equipment where protection relies on double or reinforced insulation — Battery system communication*

IEC/TS 62196-4, *Plugs, socket-outlets, vehicle connectors and vehicle inlets — Conductive charging of electric vehicles — Part 4: Dimensional compatibility and interchangeability requirements for DC pin and contact-tube accessories for Class II or Class III applications*

EN IEC 62368-1:2024, *Audio/video, information and communication technology equipment — Part 1: Safety requirements (IEC 62368-1:2023)*

EN IEC 62840-1, *Electric vehicle battery swap system — Part 1: General and guidance (IEC 62840-1)*

EN IEC 62840-2, *Electric vehicle battery swap system — Part 2: Safety requirements (IEC 62840-2)*

EN IEC 63066:—², *Low-voltage docking connectors for removable energy storage units (IEC 63066)*

ISO 11451-2, *Road vehicles — Vehicle test methods for electrical disturbances from narrowband radiated electromagnetic energy — Part 2: Off-vehicle radiation sources*

² Under preparation. Stage at the time of preparation: FprEN IEC 63066:2026

ISO 11898-1, *Road vehicles — Controller area network (CAN) — Part 1: Data link layer and physical coding sublayer*

ISO 13063-1, *Electrically propelled mopeds and motorcycles — Safety specifications — Part 1: On-board rechargeable energy storage system (RESS)*

ISO 13063-3, *Electrically propelled mopeds and motorcycles — Safety specifications — Part 3: Electrical safety*

ISO 14229-1, *Road vehicles — Unified diagnostic services (UDS) — Part 1: Application layer*

ISO/SAE 21434, *Road vehicles — Cybersecurity engineering*

CISPR 12, *Vehicles, boats and devices with internal combustion engines or traction batteries – Radio disturbance characteristics – Limits and methods of measurement for the protection of off-board receivers*

3 Terms and definitions

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

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

- ISO Online browsing platform: available at <https://www.iso.org/obp/>
- IEC Electropedia: available at <https://www.electropedia.org/>

3.1 battery system

energy storage device that includes cells or cell assemblies or common-us battery pack(s) as well as electrical circuits and electronics (e.g. BCU (battery control unit), contactors)

Note 1 to entry: For further explanation, see IEC 62840-1 and ISO 12405-4.

[SOURCE: ISO 18243:2025, 3.4]

3.2 charge rate

electric current at which a battery is charged

Note 1 to entry: The charge rate is expressed as the reference current $I_t = \frac{C_r}{n}$ where C_r is the rated capacity declared by the manufacturer and n is the time base in hours for which the rated capacity is declared.

3.3 compatibility

capability of swappable battery systems to meet the requirements of battery swap stations and vehicles to transfer energy and exchange data without appreciable modifications and any undesirable consequences of unpredictable shortage of performance

3.4 discharge rate

electric current at which a battery is discharged

Note 1 to entry: The discharge rate is calculated as the rated capacity divided by the corresponding discharge time which results in an electric current.

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3.5

interface communication

capability of the on-board battery system of exchanging information through electrical/software communication with external interfaces of the swappable battery system and other functions to meet the interoperability and compatibility during life cycle

3.6

interoperability

capability to transfer power and / or data among various swappable battery systems, vehicles and battery swap stations, without requiring modifications, special interfaces or conversion hardware

3.7

live part

conductor or conductive part intended to be electrically energized in normal use

3.8

small battery

battery with a gross mass of not more than 12 kg

[SOURCE: IEC 62281:2019, definition 3.27]

4 Symbols and abbreviated terms

For the purposes of this document, the following symbols and abbreviations apply:

ASIL	automotive safety integrity level
BMS	battery management system
DUT	device under test
EOL	end of life
REESS	rechargeable electric energy storage system
RT	room temperature
SEooC	safety element out of context
SoC	state of charge
SoH	state of health

5 Principle

In operation, for users, this means:

- Any battery which complies with this document can be used in any vehicle which complies with this document.
- Any battery which can be charged within any charging station (independently by the economical energetic operator) or with any charging device which complies with this document. If specific requirements for the charging stations are needed, see applicable standards such as EN IEC 62840-1.
- Any battery which complies with this document can be used in parallel or serial connection within a “vehicle” with any other battery which complies with this document (e.g. with limitations/ranges as expected to be specified in the swappable battery system standard, max. number of batteries connected in serial configuration).

- Any battery which can be recharged “simultaneously” with any other battery which complies with this document, in a multi-battery charging device which complies with this document.

6 Safety and security specifications

6.1 Electrical specifications

6.1.1 Safety

The swappable battery system shall comply with voltage class A safety requirements as defined in ISO 13063-3.

The swappable battery system designed for 2S1P or 2S2P configuration shall comply with voltage class B safety requirements as defined in ISO 13063-3.

6.1.2 Electrical insulation performance

Decrease of performance or personal burns caused by excessive temperature rise shall be avoided. Temperature rise of terminals for external conductors shall be conducted according to EN IEC 60309-4. The other parts of the system shall meet the requirements of EN 60335-1, with 1,06 times rated voltage.

6.1.3 Electrical protection

The swappable battery system shall comply with all electrical protection requirements as defined in EN ISO 18243.

6.1.4 Isolation resistance

Exposed conductive parts of the swappable battery system shall be designed according to ISO 13063-3.

All components forming the equipotential bonding current path (conductors, connections) shall withstand the maximum current in a single fault condition.

The resistance of the equipotential bonding path between any two of these exposed conductive parts of the swappable battery system that can be touched simultaneously by a person shall not exceed 0,1 Ω .

Galvanic isolation is required between the swappable battery system enclosure and the internal live parts.

The creepage distance and clearance shall be according to ISO 13063-3.

The isolation resistance test shall be conducted in accordance with ISO 13063-1 and ISO 13063-3. The test should be conducted between conductors and compartment, or between conductors and shielding layer of the battery swapping connector.

6.1.5 Withstand voltage

The voltage resistance test shall be conducted in accordance with ISO 13063-1 and ISO 13063-3. The test should be conducted between conductors and compartment, or between conductors and shielding layer of the battery swapping connector.

6.1.6 Safety after crash or accident event

Negative events, like accident or crash shall be recorder in the non-volatile memory. The information about the event can also be created by vehicle.

6.2 Functional safety

Appropriate functional safety standards for the swappable battery system shall be considered for the specific project.

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However, it is highly recommended the application of a functional safety process which complies with ISO 26262-12 considering at least ASIL B for the safety relevant BMS functions (as SEooC).

6.3 Cybersecurity

The BMS shall be protected against cyberattacks in accordance with ISO/SAE 21434.

7 Mechanical specifications**7.1 General**

The accuracy of measured values shall be within the tolerances, relative to the specified values stated in Table 1.

Table 1 — Mechanical requirements

Parameter	Value	Unit
Mass	$\pm 1,0 \%$	kg
Length	$\pm 1,0 \%$	m

7.2 Mass

The mass of the battery system shall not exceed 12 kg. This requirement is to ensure easy handling by the user. An LMT battery is defined as a light means of transport battery, a battery that is sealed and weighs 25 kg or less.

NOTE IEC 62281 defines a “large battery” as any battery with a mass exceeding 12 kg.”

7.3 Battery case

The battery case, which may be made of polymer, aluminium or steel, shall include all the components of the battery system. No external components (e.g. external BMS) shall be admitted.

The battery system shall be sealed with minimum IP grade of the swappable battery when the connector is both mated and unmated shall be IP65. This specification shall be guaranteed for the entire life of the battery.

The battery locking mechanism (device to ensure the lock of the battery in place) shall belong to the vehicle.

The battery bay (battery dock) belongs to the vehicle and, during battery insertion, shall guarantee a sufficient reaction force to ensure connector mating without battery dock base bending.

7.4 Shape and dimensions

The swappable battery system shall be a rectangular prism designed for safe and effective manual handling, with a connector installed on the bottom surface. See Figure 2 for the specific dimensions.

The swappable battery system shall include a handle on the top surface for ease of handling, within the limited height dimension.

The shape shall be in accordance with Figure 2.

Shape dimensions shall be in accordance with Annex A, A.1.

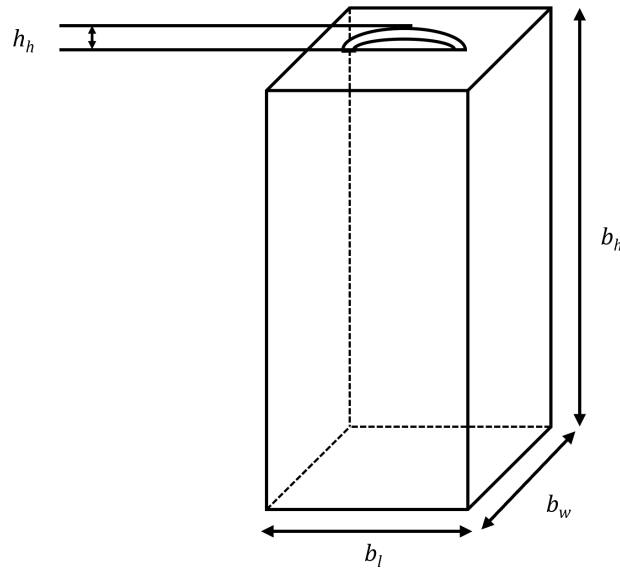


Figure 2 — Overall dimensions

Specific dimensions shall be in accordance with A.1.

The bottom part of the battery (opposite to the handlebar) shall include the female connector in its centre, see Figure 3.

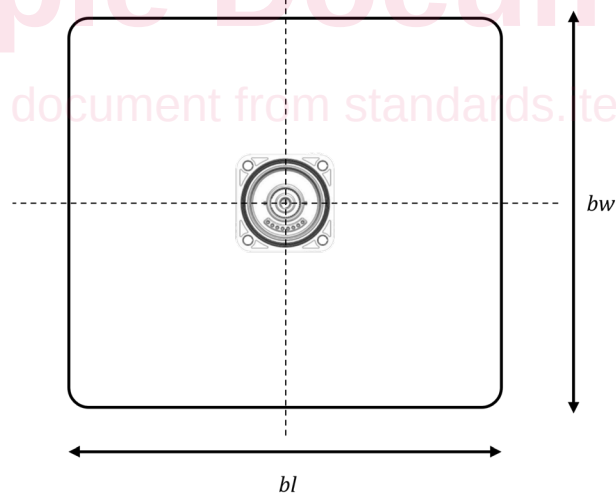


Figure 3 — Battery bottom side with female connector

Specific dimensions shall be in accordance with A.1.

7.5 Handle

Essential features shall include a handle, typically located on the top surface or another surface depending upon the swapping direction, to facilitate easy insertion and removal.

The handle shall withstand a force not less than the product design tension or 3 times the weight of the battery system, as specified in EN IEC 62368-1:2024, 8.8.

The test method shall be carried out in accordance with EN IEC 62368-1:2024.