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The Swapping Battery Pack Rack of Electric Vehicle

电动汽车快换电池箱架

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The Swapping Battery Pack Rack of Electric Vehicle

1 Scope

This Document specifies the operating conditions, general requirements, interchangeability requirements, structure types, mechanical requirements, inspection rules, and marking, packaging, transportation, and storage requirements for battery pack racks used in electric vehicle battery swap stations. It also describes the corresponding test methods.

This Document applies to the design, production, testing, and use of battery pack racks used in battery swap stations for M1, N2, and N3 electric vehicles with rear-mounted battery swapping.

NOTE: For electric vehicle classifications, refer to GB/T 15089-2001.

2 Normative References

The provisions in following documents become the essential provisions of this Document through reference in this Document. For the dated documents, only the versions with the dates indicated are applicable to this Document; for the undated documents, only the latest version (including all the amendments) is applicable to this Document.

GB/T 1231 High strength bolts with large hexagon head assemblies for steel structures

GB/T 1804-2000 General tolerances - Tolerances for linear and angular dimensions without individual tolerance indications

GB/T 13306-2011 Plate

GB/T 16935.1-2023 Insulation coordination for equipment within low-voltage supply systems - Part 1: Principles, requirements and tests

GB/T 18487.1-2023 Electric vehicle conductive charging system - Part 1: General requirements

GB/T 19596-2017 Terminology of electric vehicles

GB/T 19666-2019 General rules for flame retardant and fire resistant electric wires and cables or optical fiber cables

GB/T 19804-2005 Welding - General tolerances for welded constructions - Dimensions for lengths and angles - Shape and position

GB/T 29317-2021 Terminology of electric vehicle charging/battery swap infrastructure

GB/T 32879-2025 Swappable battery pack connector of electric vehicle

GB 38031-2025 Electric vehicles traction battery safety requirements

QC/T 29106-2014 Technical Specification of Automobile Wire Harness

3 Terms and Definitions

For the purposes of this Document, the terms and definitions given in GB/T 19596-2017, GB/T 29317-2021 and the following apply.

3.1 Swappable battery systems; SBS

A device that consists of several cells or power battery modules, a pack, a battery information collection unit, and related electrical and mechanical accessories, etc.

NOTE: Referred to as a battery pack.

[SOURCE: GB/T 29317-2021, 8.1.1]

3.2 Battery pack rack

A mechanical device that is used to carry a swapping battery pack.

NOTE: This typically includes a swapping battery pack connector, guides, and other positioning mechanisms. It provides charging, storage, and monitoring functions.

4 Use Conditions

The use conditions of battery pack rack shall comply with the following conditions.

a) Ambient temperature: -20°C ~ + 65°C.

b) Relative humidity: Daily average maximum 95%, monthly average maximum 90%, with no condensation on the surface.

c) Altitude: Not exceeding 2,000 m. For above 2,000 m, clearances and creepage distances shall meet the requirements of GB/T 16935.1-2023.

d) The environment shall be free of explosive media, gases that corrode metals or damage insulation, and conductive media.

5 General Requirements

5.1 General requirements

5.1.1 The battery pack rack shall have battery pack position limiting and guiding functions.

5.1.2 The battery pack rack shall be able to automatically and accurately connect to the battery pack and prevent incorrect insertion.

5.1.3 The battery pack rack shall have electrical and communication connection functions with the battery pack charger.

5.1.4 The battery pack rack shall have the function of detecting the battery pack's position and storage status and may have a temperature detection function.

5.1.5 The battery pack rack should have drainage functions to prevent water from accumulating inside the battery pack rack or flowing into electrical equipment.

5.1.6 The battery pack rack may be equipped with an automatic dust cover that automatically closes when no battery box is present.

5.1.7 The battery pack rack should have the load capacity to safely transfer and transport the battery pack.

5.2 Connectors for battery pack rack

The battery pack rack shall have electric connectors and may have liquid connectors. The structure and performance shall comply with the provisions of Clause 7 of GB/T 32879-2025.

5.3 Wiring harness

5.3.1 The low-voltage wiring harness for the battery pack rack shall comply with the provisions of Clause 4 in QC/T 29106-2014.

5.3.2 The power cables for the battery pack rack shall be able to withstand the dielectric strength test in 9.8; and no insulation breakdown or flashover shall occur during the test.

5.3.3 The flame retardancy and fire resistance of the cables for the battery pack rack shall comply with the provisions of GB/T 19666-2019 and shall be heat-resistant, waterproof, corrosion-resistant, and anti-oxidation.

5.3.4 Power cables and low-voltage wiring harnesses shall be bundled and isolated separately, and routed smoothly.

5.3.5 Signal cables shall be shielded and twisted in pairs to prevent interference.

5.4 Grounding

5.4.1 The battery pack rack's frame, electrical components, and connector metal casings shall be effectively grounded, with a connection impedance of no greater than 0.1 Ω.

5.4.2 The battery pack rack's metal frame shall be equipped with grounding bolts with a diameter of no less than 8 mm and marked with a grounding mark.

6 Interchangeability Requirements

6.1 Battery pack racks of the same type shall be interchangeable.

6.2 The interface signal definitions of electric connectors shall be consistent.

6.3 The cooling medium of the liquid connector shall consist of 50% ethylene glycol and 50% water, and other specifications shall be consistent.

6.4 The load-bearing surface of battery pack rack for commercial vehicle s shall be flat.

7 Structure Type

7.1 The surface of the battery pack rack must be free of obvious burrs, flash, or similar sharp edges. Components shall be complete and clearly labeled.

7.2 Mechanical interfaces of the battery pack rack, where dimensional deviations are not indicated, shall comply with tolerance Grade-m in GB/T 1804-2000 for metal cutting or general

stamping dimension. Welded structural dimensions shall comply with the provisions of tolerance Grade-A in Tables 1 and 2 of GB/T 19804-2005.

7.3 Battery pack racks for commercial vehicle using connectors specified in Appendix A of GB/T 32879-2025 shall meet the following requirements:

a) They shall be equipped with four electric connectors;

b) The layout and dimensions of the electric connectors, limiters, and guides shall comply with the provisions of Appendix A.

NOTE: Limiters and guides include both coarse and fine guides.

c) After coarse guide positioning is completed, the fine guide shall be within the positioning range. After fine guide positioning is completed, the guide positioning device of the electric connector shall be within the positioning range.

8 Mechanical Requirements

8.1 Mechanical requirements for battery pack rack for commercial vehicle

8.1.1 After the battery pack rack and battery pack are coupled completely, the matching clearance between the guide mechanism and the battery pack shall be no greater than 5 mm.

8.1.2 The vertical height of the guide mechanism of the battery pack rack shall match the battery pack.

8.1.3 After undergoing the mechanical impact test in accordance with 9.11.1, the battery pack rack shall meet the following requirements:

a) The battery pack rack shall show no visible cracks;

b) The connector shall show no visible cracks, no apparent looseness during installation, and no visible deformation of the connector terminals;

c) The insulation resistance shall meet the requirements of 5.6.

8.2 Mechanical requirements battery pack rack for passenger car

8.2.1 After the battery pack rack and battery pack for passenger car are coupled completely, the matching clearance between the guide mechanism and the battery pack shall be no greater than 5 mm.

8.2.2 When high-strength bolts are used to connect load-bearing components, the high-strength bolts, nuts, and washers shall comply with the provisions of GB/T 1231.

9 Test Methods

9.1 Test conditions

9.1.1 Unless otherwise specified, specimens shall be tested at an ambient temperature of (25±5)°C and a relative humidity of 5% ~ 95%.

9.1.2 The accuracy of all test instruments and equipment shall be at least one magnitude higher than the accuracy of the parameter being measured, or the error shall be less than 1/3 of the allowable error of the parameter being measured.

9.2 General test

Visually inspect whether the battery pack rack has position limiting and guiding devices, whether has anti-incorrect insertion devices for connection to the battery pack; whether has electrical connections and communication junction interfaces with the battery pack charger; whether has battery pack status monitoring devices; whether has temperature detection devices, drainage devices, and dust covers; and whether is capable of safely supporting the battery pack.

9.3 Battery pack rack connector test

Battery pack rack connector tests shall be conducted in accordance with the provisions of Clause 8 of GB/T 32879-2025.

9.4 Wiring harness test

9.4.1 Low-voltage wiring harness test shall be conducted in accordance with the provisions of Clause 5 in QC/T 29106-2014.

9.4.2 Flame retardancy and fire resistance tests for battery pack rack cables shall be conducted in accordance with the provisions of GB/T 19666-2019.

9.5 Grounding test

Perform the grounding test in the following steps.

a) Use a gauge or vernier caliper to measure the diameter of the grounding bolt and check the grounding mark.

b) Use an electric bridge, ground resistance tester, or digital low-resistance tester to measure the resistance between any conductive part within the battery pack rack and the main grounding point. The number of measurement points shall be at least 3 (including the furthest point).

9.6 Clearance and creepage distance tests

Clearance and creepage distance tests shall be conducted in accordance with the provisions of 6.8 in GB/T 16935.1-2023.

9.7 Insulation resistance test

It shall be conducted in accordance with the provisions of 12.2 in GB/T 18487.1-2023.

9.8 Dielectric strength test

It shall be conducted in accordance with the provisions of 12.3 in GB/T 18487.1-2023.

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