



National Standard of the People's Republic of China

GB 18384—2025
Replace GB 18384—2020

Electric vehicles safety requirements

电动汽车安全要求

(English Translation)

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Foreword

SAC/TC114 is in charge of this English translation. In case of any doubt about the contents of English translation, the Chinese original shall be considered authoritative.

This document is drafted in accordance with the rules given in the GB/T 1.1—2020 *Directives for standardization—Part 1: Rules for structure and drafting of standardization documents*.

GB 18384—2020 *Electric Vehicles Safety Requirements* is replaced by this document in whole.

In addition to structural and editorial changes, the main technical changes compared with GB 18384—2020 are as follows:

- The scope has been modified (see Chapter 1, Chapter 1 of the 2020 edition);
- The terms "high voltage service disconnect," "low voltage service disconnect," "high-voltage connector," "cut off the power of propulsion system," and "touch current" have been added (see 3.2, 3.3, 3.5, 3.7, 3.8);
- The requirements for high-voltage warning markings have been modified (see 5.1.2.1, 5.1.2.1 of the 2020 edition);
- The requirements for electrical protection barriers and enclosures have been modified (see 5.1.3.2, 5.1.3.2 of the 2020 edition);
- The requirements for high-voltage connector have been modified (see 5.1.3.3, 5.1.3.3 of the 2020 edition);
- The requirements for service disconnect have been modified (see 5.1.3.4, 5.1.3.4 of the 2020 edition);
- The requirements for vehicle inlet have been modified (see 5.1.3.5, 5.1.3.5 of the 2020 edition);
- The insulation monitoring requirements and verification methods have been modified (see 5.1.4.2 and 6.2.3; 5.1.4.2 and 6.2.3 of the 2020 edition);
- The capacitive coupling requirements and test methods have been modified (see 5.1.4.4 and 6.2.5; 5.1.4.4 and 6.2.5 of the 2020 edition);
- The waterproof requirements and testing methods have been modified (see 5.1.5, 6.2.8.2; 5.1.5, 6.3.2 of the 2020 edition);
- Requirements and verification methods for under-body protection of the vehicle have been added (see 5.2 and 6.3);
- The safety function protection requirements have been modified (see 5.3, 5.2 of the 2020 edition);
- The requirements for vehicle collision protection have been modified (see 5.5, 5.4 of the 2020 edition);
- The requirements for vehicle event data recording have been modified (see 5.9, 5.8 of the 2020 edition);
- User manual requirements have been added (see 5.11);
- The vehicle insulation resistance test has been modified (see 6.2.1.2, 6.2.1.3; 6.2.1.2, 6.2.1.3 of the 2020 edition);

- Barrier and enclosure pressure testing methods have been added (see 6.2.6);
- A steady-state touch current test method has been added (see 6.2.7);
- The same-type determination has been added (see Chapter 7).

Attention is drawn to the possibility that some of the elements of this standard maybe the subject of patent rights. The issuing body of this document shall not be held responsible for identifying any or all such patent rights.

This document was proposed and prepared by the Ministry of Industry and Information Technology of the People's Republic of China.

This document replaces the previous editions as below:

- GB/T 18384.1—2001, GB/T 18384.1—2015
- GB/T 18384.2—2001, GB/T 18384.2—2015
- GB/T 18384.3—2001, GB/T 18384.3—2015
- GB 18384—2020
- This is the third revision.

Introduction

This document has been prepared specifically to effectively ensure the safety of personnel under normal operating conditions of electric vehicles and to clearly define the relevant safety requirements and testing methods. For other safety risks arising from the failure behavior of electronic and electrical safety-related systems, electric vehicles—on top of meeting the conventional safety requirements for automotive electronic and electrical systems—may refer to other standards (such as GB/T 34590 and GB/T 28046) when designing and specifying the safety of their electronic and electrical systems.

The revisions to this document have fully taken into account the technical requirements of UN GTR No. 20, UN R100, and ISO 6469-3, and have been modified based on the technical levels of domestic products, application scenarios, and testing experience.

After issuance, this standard will become an important basic standard for electric vehicle safety performance test of China and one of important technical criteria for mandatory inspection for type approval of new electric vehicle and inspection for imported power-driven vehicle.

Electric vehicles safety requirements

1 Scope

This document specifies the safety requirements and test methods for electric vehicles.

This document is applicable to electric vehicles with a maximum operating voltage of Class B.

This document is not applicable to road vehicles that remain continuously connected to the power grid during operation.

2 Normative references

The contents in the following documents constitute essential provisions of this document through normative references in the text. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

GB/T 4094.2 *Electric vehicles -- Symbols for controls, indicators and tell-tales*

GB/T 4208—2017 *Degrees of protection provided by enclosure (IP Code)*

GB 8410 *Flammability of automotive interior materials*

GB 11551 *The protection of the occupants in the event of a frontal collision for motor vehicle*

GB/T 12113—2023 *Methods of measurement of touch current and protective conductor current*

GB 17354 *Front and rear protective devices for passenger cars*

GB/T 18385—2024 *Battery electric vehicles—Power performance—Test method*

GB/T 18387 *Limits and test method of magnetic and electric field strength from electric vehicles*

GB/T 19596 *Terminology of electric vehicles*

GB/T 19752—2024 *Hybrid electric vehicles—Power performance—Test method*

GB/T 19836 *Instrumentation for electric vehicles*

GB 20071 *The protection of the occupants in the event of a lateral collision*

GB 20072 *The requirements of safety in the event of rear-end collision for passenger car*

GB/T 20234.1 *Connection set for conductive charging of electric vehicles—Part 1: General requirements*

GB 26134 *Roof crush resistance of passenger cars*

GB/T 31498 *Post crash safety requirement for electric vehicle*

GB 34660 *Road vehicles—Requirements and test methods of electromagnetic compatibility*

GB 38031 *Electric vehicles traction battery safety requirements*

GB/T 38892 *On-board driving video recording system*

GB 39732 *Vehicle event data recorder system*

3 Terms and definitions

For the purpose of this document, the terms and definitions given in GB/T 19596 and listed in the following apply.

3.1

rechargeable electrical energy storage system (REESS)

energy storage system that is rechargeable and can provide electrical energy

3.2

high voltage service disconnect

device used to disconnect the high-voltage circuit when inspecting or servicing Class B voltage components, as it itself contains Class B voltage sections

3.3

low voltage service disconnect

device used to disconnect the high-voltage circuit when inspecting or servicing Class B voltage components, and which itself does not carry Class B voltage

3.4

conductive connection

perform conductive connection by using conductor

3.5

high voltage connector

component consisting of one or more sets of conductor terminals and insulating jackets, designed to provide electrical connection and disconnection functions between high-voltage cables in electric vehicles and between high-voltage cables and high-voltage components

[SOURCE: GB/T 37133—2025, 3.2]

3.6

direct driving

driver controls the vehicle by means of steering wheel, braking pedal, shifting device, accelerating pedal and etc

3.7

cut off the power of the propulsion system

high-voltage circuit of the vehicle is disconnected, and at least the high-voltage circuit between the drive system and the rechargeable energy storage system is also disconnected. For fuel cell vehicles, the circuit between the fuel cell system and the drive system must be disconnected simultaneously

3.8

touch current

electric current that flows through a person's or animal's body when they come into contact with one or more accessible parts of a device or equipment

[SOURCE: GB/T 12113—2023, 3.1]

4 Voltage classes

4.1 Electric components or circuits are classified according to Table 1 based on the maximum working voltage.

Table 1 Voltage classes

Unit: Volts

Voltage classes	Maximum working voltage U	
	DC	AC (rms)
A	$0 < U \leq 60$	$0 < U \leq 30$
B	$60 < U \leq 1,500$	$30 < U \leq 1,000$

4.2 For voltage class A circuit and voltage class B circuit of mutually conductive connection, when one pole of DC live part in the circuit is connected with electrical chassis, and the maximum voltage value between any other live part and the pole is not more than 30V a.c. (rms) and not more than 60V d.c., then the conductive connection circuit does not completely belong to voltage class B circuit, and only the part operating at voltage class B is deemed as voltage class B circuit.

5 Safety requirements

5.1 Requirements on protection of persons against electric shock

5.1.1 General

5.1.1.1 Requirements on protection of persons against electric shock shall include the following four parts:

- Requirements on high voltage mark;
- Requirements on protection against direct contact;
- Requirements on protection against indirect contact;
- Requirements on waterproof.

5.1.1.2 For voltage class A circuit and voltage class B circuit of mutually conductive connection, when one pole of DC live part in the circuit is connected with electrical chassis, and the maximum voltage value between any other live part and the pole is not more than 30V a.c. (rms) and not more than 60V d.c., then the requirements in 5.1.4.1, 5.1.4.2, 5.1.4.3 and 5.1.5 do not apply to the circuit (including DC part and AC part).

5.1.2 Requirements on high voltage mark

5.1.2.1 Requirements on high voltage warning mark

For electrical energy storage system or generating device of voltage class B, such as REESS and fuel cell stack, as well as Class B voltage circuit systems and components (such as drive motors, high-voltage distribution boxes, on-board chargers, etc.), the symbol as shown

in Figure 1 shall be marked. For voltage class A circuit and voltage class B circuit of mutually conductive connection, when one pole of DC live part in the circuit is connected with electrical chassis, and it satisfies the condition that the maximum voltage value between any other live part and the pole is not more than 30 V a. c. (rms) and not more than 60 V d. c., then the REESS is permitted not to mark the symbol shown in Figure 1. Symbol is yellow background, border and arrow is black.



Figure 1 High voltage warning mark

If the live part of voltage class B can be exposed when the barrier or enclosure is removed, the same symbol shall also be marked clearly on the barrier and enclosure. When the necessary for this symbol is assessed, enter and removable case of the barrier or enclosure shall be considered.

5.1.2.2 Requirements on mark of voltage class B wire

The sheath of cable and wire harness in voltage class B circuit shall be orange color for distinction, with the exception of the parts inside enclosure or behind barrier that meets the requirements of 5.1.3.2.

5.1.3 Requirements on protection against direct contact

5.1.3.1 General

Protection against direct contact is to realize physical isolation of human body from voltage class B live part through insulation material, enclosure or barrier, the enclosure or barrier can be conductor or insulator. The requirements on protection against direct contact for specific parts shall be in compliance with 5.1.3.2 to 5.1.3.5.

For categories M_2 and M_3 of vehicle types, if roof charging device is arranged on vehicle roof, as shown in Figure 2, if the shortest route length from the lowest step at vehicle entrance to the exposed voltage class B live part of roof charging device is at least 3m, then the exposed voltage class B live part of roof charging device is not required to meet the requirements on protection against direct contact.

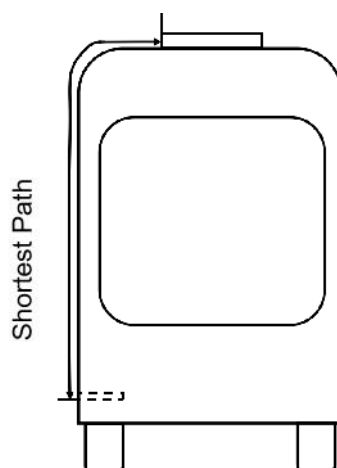


Figure 2 Schematic diagram of the shortest route measurement

5.1.3.2 Requirements on barrier or enclosure

If electric shock protection is provided through enclosure or barrier, then class B live part shall be arranged in enclosure or behind barrier so as to prevent access to live part along any direction.

Barriers and enclosures shall meet the following requirements:

- a) The barrier and enclosure inside passenger compartment and goods compartment shall meet the IPXXD protection degree requirements in GB/T 4208 – 2017, the barrier and enclosure outside passenger compartment and goods compartment shall meet the IPXXB protection degree requirements;
- b) Barriers and enclosures shall be opened or removed by tools; if the barriers and enclosures can be opened or removed without tools, then voltage class B live parts shall meet at least one of the two requirements as follows within 1s after opening of the barriers and enclosures:
 - The AC circuit voltage shall be reduced to not exceed 30V a.c. (rms), the DC circuit voltage shall be reduced to not exceed 60V d.c.;
 - The total energy stored in class B circuit shall be less than 0.2J.

5.1.3.3 High voltage connector requirements

It shall be impossible to open high-voltage connectors without tools; otherwise, at least one of the following conditions shall be met:

- a) After disconnection of high voltage connector, it shall meet the IPXXB protection degree requirements specified in GB/T 4208—2017;
- b) It takes at least two different actions to disconnect the high voltage connector from its mating end, and it shall feature a mechanical locking relationship;
- c) After disconnection of high voltage connector, the voltage of live part in connector shall be reduced to not exceed 30V a.c. (rms) and not exceed 60V d.c. within 1s.

5.1.3.4 Requirements on service disconnect

The vehicle shall be equipped with a service disconnect and meet one of the following conditions.

- a) The high voltage service disconnect shall be impossible to open or remove without the use of tools. However, the following two situations are exceptions:
 - The live parts in the class B voltage range meet the IPXXB protection level requirements specified in GB/T 4208—2017.
 - After disconnection of high voltage service disconnect, the voltage of live parts in the class B voltage range shall be reduced to not exceed 30V a.c. (rms) and not exceed 60V d.c. within 1s.
- b) The low voltage service disconnect shall be clearly labeled to distinguish it from other components. Within 10 s after the low voltage service disconnect is opened, the voltage of the live parts of the Class B voltage circuit outside the REESS shall be reduced to not exceed 30 V a.c. (rms) and 60 V d.c.

5.1.3.5 Requirements on vehicle inlet

When vehicle charging inlet is disconnected from vehicle charging connector, the vehicle charging inlet shall at least meet one of the following requirements:

- a) Within 1s after disconnection, the voltage between the contacts and any other contacts, as well as between the contacts and the electrical chassis, shall be reduced to not exceed 30V a.c. (rms) and not exceed 60V d.c., or the total energy stored in the circuit shall be less than 0.2J;
- b) The vehicle charging inlet shall meet the protective level requirements of IPXXB specified in GB/T 4208—2017; within 1min after disconnection, the voltage between the contacts and any other contacts, as well as between the contacts and the electrical chassis, shall be reduced to not exceed 30V a.c. (rms) and not exceed 60V d.c., or the total energy stored in the circuit shall be less than 0.2J;
- c) Within 1s after disconnection, the steady-state touch current between the contacts and any other contacts, as well as the steady-state touch current between the contacts and the electrical chassis, shall be less than 0.5 mA (a.c.) and 2 mA (d.c.).

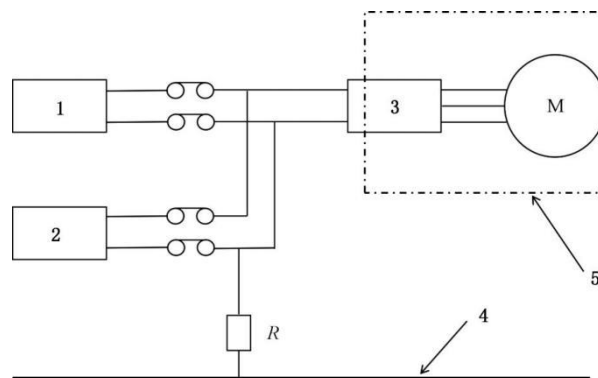
5.1.4 Requirements on protection against indirect contact

5.1.4.1 Requirements on insulation resistance

Under the maximum working voltage, the value of insulation resistance of DC circuit shall be not less than 100 Ω/V ; for AC circuit, the value shall be not less than 500 Ω/V . If DC and AC class B voltage circuits are conductively connected, the insulation resistance shall be at least 500 Ω/V . For fuel cell electric vehicles, as shown in Figure 3, if the AC circuit is provided with additional protection, the insulation resistance of the combined circuit shall be at least 100 Ω/V .

Additional protection method shall at least meet one of following requirements:

- a) Shall feature at least barrier, enclosure or two insulation layers;
- b) Shall be arranged in enclosure or behind barrier, and these enclosures or barriers shall be able to withstand pressure intensity not less than 10kPa and shall be free from prominent plastic deformation.



Explanation of indexing numbers:

- 1 — Fuel cell system;
- 2 — Traction battery;
- 3 — Inverter;
- 4 — Electrical chassis;
- 5 — AC circuit.

Figure 3 Requirements on insulation resistance of fuel cell vehicle

5.1.4.2 Requirements on insulation resistance monitoring

5.1.4.2.1 The vehicle shall be equipped with an insulation resistance monitoring function. When either of the following two conditions is present, the vehicle shall activate the insulation resistance monitoring function. After conducting the insulation monitoring function verification test according to 6.2.3, the vehicle shall meet the requirements specified in 5.1.4.2.2.

— The vehicle's Class B voltage circuit is energized and not electrically connected to an external power source;

— The vehicle uses the vehicle-to-load (V2L) function for AC power supply.

Note: V2L refers to an operational mode in which the traction battery of an electric vehicle is connected to a load via a charge-discharge device, serving as an energy storage unit to supply power to the load.

5.1.4.2.2 The insulation resistance monitoring function shall be capable of continuously or intermittently detecting the vehicle's insulation status. When the insulation resistance value falls below the threshold specified by the manufacturer, the driver shall be alerted by a conspicuous audible or visual signaling device. Moreover, the threshold specified by the manufacturer shall not be lower than the requirement set forth in 5.1.4.1.

5.1.4.3 Requirements on potential equalization

Exposed conductive part which is used for protection against direct contact with voltage class B circuit, such as conductive enclosure and barrier, shall feature conductive connection to electrical chassis and meet the following requirements:

- a) The resistance between all exposed conductive parts and the electrical chassis shall be lower than 0.1Ω ;
- b) In circuit featuring balance of potential, the resistance between any two simultaneously reachable exposed conductive parts that are less than 2.5 m from each other shall not exceed 0.2Ω .

If welding connection mode is adopted, then it is deemed as satisfaction of the above mentioned requirements.

5.1.4.4 Requirements on capacitive coupling

Capacitive coupling shall at least meet one of the following requirements:

- a) In voltage class B circuits, the energy stored in the total capacitance between any voltage class B live part and the electrical chassis at its maximum working voltage shall be less than 0.2J, and after the stored energy is discharged, the steady-state touch current shall not exceed 5 mA a.c. and 25 mA d.c. Furthermore, if there are voltage class B circuits isolated from each other, each isolated circuit shall individually meet the requirement of being less than 0.2J.
- b) Voltage class B circuits shall have at least barriers, enclosures, or two layers of insulation. The enclosures or barriers shall be able to withstand a pressure not less than 10kPa and shall not undergo significant plastic deformation.

Note: 0.2J refers to the maximum energy storage requirement of the Y capacitor on the positive side or the negative side of a Class B voltage circuit.

5.1.4.5 Requirements on charging inlet

5.1.4.5.1 Vehicle AC charging inlet

Vehicle AC charging inlet shall have a terminal to connect the electrical chassis with the grounding part of the grid.

The insulation resistance of vehicle AC charging inlet, including the circuit of conductively connected to power grid during charging, shall be not less than $1\text{ M}\Omega$ when the charging coupler is disconnected.

5.1.4.5.2 Vehicle DC charging inlet

Vehicle DC charging inlet shall have terminals to connect the vehicle electrical chassis with the Protective Earthing (PE) of external power.

Insulation resistance of vehicle DC charging inlet including the circuit that is conductively connected with vehicle DC charging inlet during charging process shall meet the requirements of 5.1.4.1 when the charging coupler is disconnected.

5.1.5 Requirements on waterproof

Vehicles of categories M_2 and M_3 can be exempted from the waterproof requirements of this chapter. For other vehicle types, vehicle shall still be able to meet the insulation resistance requirements in 5.1.4.1 after washing and wading test.

The manufacturer or vehicle shall meet at least one of the following requirements:

- a) Manufacturer shall provide documentary evidence required in Annex A to inspection institution. If the parts protection level is higher than the requirements of Annex A, it is also deemed as satisfaction of requirements. If the provided documentary evidence does not meet requirements, then the manufacturer shall perform test as per the requirements in A.2 of Annex A;
- b) Perform washing and wading test of vehicle as per the test method of 6.2.8 and measure insulation resistance as per the test method in 6.2.1 under condition that vehicle is still wet after waterproof test, insulation resistance shall meet the requirements of 5.1.4.1. Furthermore, after vehicle is let stand for 24h, measure insulation resistance again as per the test method in 6.2.1, insulation resistance shall meet the requirements of 5.1.4.1.

Note: The waterproof requirements for vehicle of categories M_2 and M_3 are specified in GB 38032.

5.2 Requirements for underbody protection of the vehicle

Vehicles with REESS located in a non-underbody position, M_2 vehicles, M_3 vehicles and N-category vehicles with a minimum ground clearance (when fully laden) of not less than 200 mm are exempt from the requirements of this clause. All other vehicles shall undergo underbody protection testing in accordance with 6.3 and shall meet the following requirements:

- a) After the test, inspect the exterior of the vehicle's underbody. The REESS and its high-voltage connectors shall meet the IPXXB protection level requirements specified in GB/T 4208—2017.
- b) After the test, the vehicle's insulation resistance shall be tested according to 6.2.1, and the vehicle's insulation resistance shall meet the requirements specified in 5.1.4.1.
- c) Within 30 min after the test, no electrolyte shall leak from the REESS.
- d) Within 2 h after the test, the REESS shall neither catch fire nor explode.

5.3 Requirements on safety function protection

5.3.1 Procedure for power-on and power-off of the propulsion system

When the driver is direct driving the vehicle, the vehicle's transition from a power-off state of the propulsion system to "driving-enabled mode" must involve at least two distinct, conscious actions, with at least one of these actions being the act of pressing the brake pedal. The vehicle shall be equipped with a physical power-off device located in a position that is easy for the driver to operate. When the vehicle is stationary and not charging or discharging,

the driver can cut off the power supply to the propulsion system with just one action using this power-off device.

The vehicle shall continuously or intermittently indicate to the driver that it is in “driving-enabled mode” When the driver leaves the vehicle, if the propulsion system is still in “driving-enabled mode” the driver shall be alerted by a conspicuous audible or visual signaling device.

When the vehicle comes to a stop and the propulsion system is automatically or manually deactivated, the driver can only re-enter “driving-enabled mode” by following the procedure described above when resuming direct driving of the vehicle..

5.3.2 Driving

5.3.2.1 Reminding for power decrease

The vehicle shall be equipped with a function that alerts the driver when the propulsion power is reduced. When the limitation and reduction of propulsion power affect the vehicle’s driving performance, the vehicle shall notify the driver via a conspicuous audible or visual signaling device.

5.3.2.2 Reminding for low state of charge of REESS

The vehicle shall be equipped with a REESS low state of charge warning function. If a low state of charge (SOC) in the REESS has a relevant impact on the vehicle driving performance, the driver shall be alerted by a conspicuous audible or visual signaling device.

5.3.2.3 Alarm for thermal event of REESS

The vehicle shall be equipped with a REESS thermal event alarm function. When the REESS emits a thermal event alarm signal as specified in GB 38031, the vehicle shall also alert the driver via conspicuous visual and audible signaling devices.

5.3.2.4 Braking priority

When the vehicle braking signal and the acceleration signal occur simultaneously, the vehicle shall prioritize responding to the vehicle braking signal.

5.3.3 Gear shifting

5.3.3.1 Switch driving shift

When the driver is direct driving the vehicle, in a stationary state, the brake pedal or clutch pedal must be depressed before shifting from a non-driving gear to a driving gear.

5.3.3.2 Driving backwards

When the driver is direct driving the vehicle, if vehicles realize transformation between two drive directions of forward and backward through changing of rotary direction of the motor, one of the following two requirements shall be met:

- a) Transformation between two travel directions of forward and backward shall be completed by two separate actions of driver;
- b) In case it is completed by one operation action of driver, one safety measure shall be used so that mode shift can only be finished under static or low-speed conditions. Vehicle speed judgment is subject to vehicle instrument display.

If transformation between two drive directions of forward and backward is not realized through change of electric motor rotation direction, then driving backwards requirement does not apply.

5.3.4 Parking

After the power is disconnected, the vehicle shall no longer be able to generate motion driven by its own electric propulsion system.

5.3.5 Locking of conductive connection between vehicle and the outside

When vehicle is connected with stationary external power source or load through charging cable, vehicle shall be unable to move through its own propulsion system.

5.4 Requirements on traction battery

Safety of electric vehicle traction battery shall comply with requirements in GB 38031.

5.5 Requirements on vehicle collision protection

Frontal collision protection of electric vehicles shall comply with requirements in GB 11551, lateral collision protection shall comply with GB 20071, the rear-end collision protection shall comply with GB 20072, anti-collision of front and rear protective devices shall comply with GB 17354, roof crush resistance shall comply with GB 26134, post-crash safety of electric vehicle shall comply with GB/T 31498.

Note: the scope of this clause is consistent with the scope of GB 11551, GB 20071, GB 20072, GB 17354, GB 26134 and GB/T 31498.

5.6 Requirements on fire resistance of vehicle

Flammability of electric vehicle interior materials shall comply with requirements in GB 8410.

Note: the scope of this clause is consistent with the scope of GB 8410.

5.7 Requirements on charging coupler

Charging coupler of electric vehicle shall comply with requirements in GB/T 20234.1.

Note: the scope of this clause is consistent with the scope of GB/T 20234.1.

5.8 Requirements on vehicle alarming and indication

Alarming and indication of electric vehicle shall comply with requirements in GB/T 19836 and GB/T 4094.2.

Note: the scope of this clause is consistent with the scope of GB/T 19836 and GB/T 4094.2.

5.9 Requirements on vehicle event data recording

The electric vehicle event data recorder system; (EDR) or On-board driving video recording device shall comply with the requirements of GB 39732 or GB/T 38892.

Note: The scope of this clause is consistent with GB 39732 and GB/T 38892.

5.10 Requirements on electromagnetic compatibility

Electromagnetic compatibility of electric vehicle shall comply with requirements in GB 34660 and GB/T 18387.

Note: the scope of this clause is consistent with the scope of GB 34660 and GB/T 18387

5.11 User manual

The user manual shall specifically note the requirements for using the service disconnect, as well as other relevant safety instructions and operational guidelines.

6 Test methods

6.1 Protection against direct contact

During the direct contact protection test, all barriers and enclosures of the vehicle shall be intact.

During the IP degree test procedure, the vehicle shall be in a fully de-energized state. Without using any other tools, the testing personnel shall conduct IP degree tests on external and internal openings and connectors—using only probes or test fingers—according to the test methods specified in GB/T 4208—2017 for IPXXD and IPXXB degrees.

In addition, the compliance of connectors, service disconnect, and vehicle charging inlet with the requirements for protection against direct contact may be verified by visual inspection in combination with the manufacturer's instructions.

6.2 Protection against indirect contact

6.2.1 Insulation resistance test of vehicle

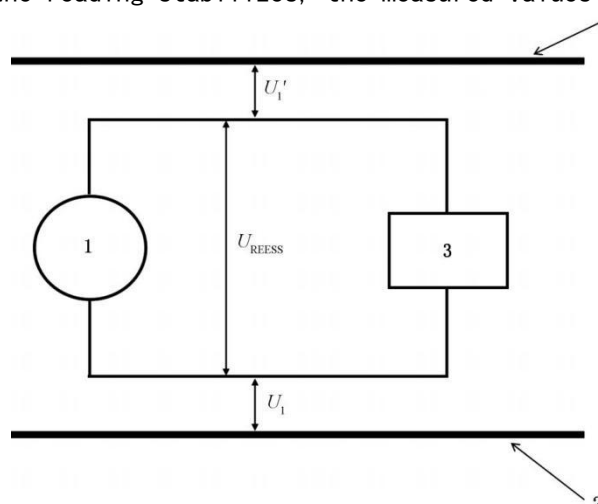
6.2.1.1 Test preparation

The internal resistance of voltage testing tool shall be not less than 10 M Ω . If the insulation monitoring function will influence test of vehicle insulation resistance during measurement, then it shall deactivate insulation monitoring function of vehicle or disconnect insulation resistance monitoring unit from voltage class B circuit, so as to avoid influence upon measured value, otherwise manufacturer may select whether to deactivate insulation monitoring function or disconnect insulation monitoring unit from voltage class B circuit.

6.2.1.2 Measurement method of insulation resistance of circuit containing voltage class B power source

The specific measurement steps are as follows:

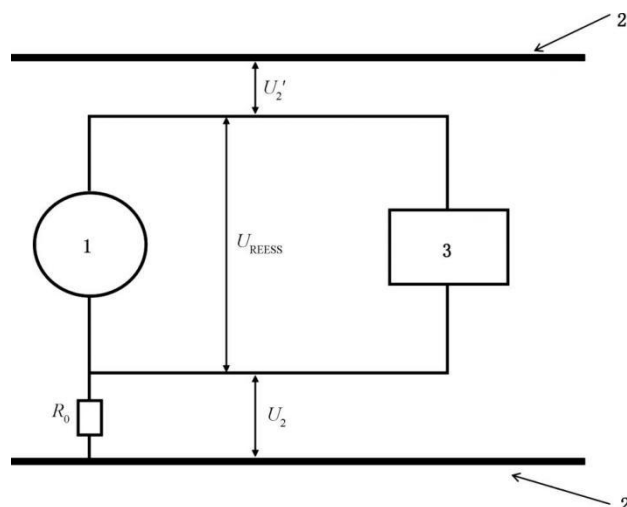
- a) Energize vehicle, to ensure that all electric power and electronic switches on the vehicle are active;
- b) Measure the internal resistance r of the voltage detection device used for measurement.
- c) The manufacturer shall provide a suitable voltage measurement interface, and then use the same two voltage detection tools simultaneously to measure the voltage between the two terminals of the REESS and the electrical chassis, as shown in Figure 4. Once the reading stabilizes, the higher value is U_1 , and the lower value is U_1' ;
- d) Add a known resistor R_0 , with a resistance value preferably set at $1\text{ M}\Omega$, and connect it in parallel between the U_1 terminal measured in step c) and the electrical chassis. Then, use the two voltage detection tools from step c) simultaneously to measure the voltage difference between the two terminals of the REESS and the electrical chassis, as shown in Figure 5. After the reading stabilizes, the measured values are U_2 and U_2' .



Explanation of indexing numbers:

- 1 — REESS;
- 2 — Electric chassis;
- 3 — Class B voltage load;

Figure 4 Schematic diagram of U_1 and U_1' voltage measurement



Explanation of indexing numbers:

- 1 — REESS;
- 2 — Electric chassis;
- 3 — Class B voltage load;

Figure 5 Schematic diagram of U_2 and U_2' voltage measurement

- e) Calculate the insulation resistance R_i by substituting R_0 and four voltage values of U_1 , U_1' , U_2 and U_2' and voltage test equipment internal resistance r into formula (1) or (2).

$$\frac{R_i \times r}{R_i + r} = R_0 \left(\frac{U_2'}{U_2} - \frac{U_1'}{U_1} \right) \dots\dots\dots (1)$$

$$R_i = \frac{1}{\frac{1}{R_0 \left(\frac{U_2'}{U_2} - \frac{U_1'}{U_1} \right)} - \frac{1}{r}} \dots\dots\dots (2)$$

6.2.1.3 Measurement method of insulation resistance of voltage class B load containing no power source

The specific measurement steps are as follows:

- a) Disconnect all power supply (including voltage class A power supply) of voltage class B load to be tested;
- b) Complete mutually conductive connection between all voltage class B live parts of voltage class B load;
- c) Complete conductive connection between all exposed conductive parts of voltage class B load, class A voltage part and electrical chassis;
- d) Connect insulation resistance test equipment between live part and electrical chassis, the equipment may select megohmmeter;

- e) Set the test voltage of insulation resistance test equipment as not less than the maximum working voltage of voltage class B circuit;
- f) The reading of insulation resistance of voltage class B load is R_x .

If there are a number of voltage classes in the conductively connected circuit in the system (for example: voltage boost converter in the system), and some components cannot withstand the maximum working voltage of the whole circuit, their insulation resistance can be measured separately at their own maximum working voltage by disconnecting them.

In addition, an insulation resistance tester can be used to separately measure the insulation resistance between each high-voltage terminal of the Class B voltage load (without a power supply) and the vehicle's electrical chassis. The test equipment must have a test voltage higher than the system's maximum operating voltage. After obtaining these individual measurements, the parallel combination of these values will yield the insulation resistance of the Class B voltage load without a power supply.

6.2.1.4 Calculation of vehicle insulation resistance

For vehicles of which all voltage class B loads are able to work at the same time, the vehicle insulation resistance may be measured directly using the method in 6.2.1.2.

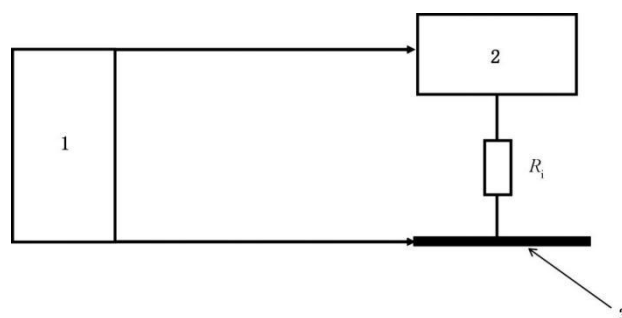
Otherwise, it is also necessary to measure the insulation resistance of voltage class B loads (for which testing cannot be completed in 6.2.1.2) in accordance with 6.2.1.3. The parallel connection result derived from the measurement value R_i obtained in 6.2.1.2 and the insulation resistance values R_x of the voltage class B loads measured in 6.2.1.3 shall be taken as the vehicle insulation resistance.

If a vehicle has two or more mutually isolated voltage class B circuits, the insulation resistance of each circuit may be measured and calculated separately in accordance with this clause. The lowest value shall be taken as the vehicle insulation resistance.

6.2.2 Vehicle inlet insulation resistance

After test of 6.2.1, proceed with charging inlet insulation resistance test, the test method is as follows:

- a) Power off the vehicle, to ensure that all electric power and electronic switches on the vehicle are inactive;
- b) Short the charging inlet high-voltage terminals (i.e., the positive/negative pole terminals of DC charging inlet or AC charging inlet phase terminals) by electric wire;
- c) Respectively connect two probes of insulation resistance test equipment with charging inlet high-voltage terminal and electrical chassis, see Figure 6;
- d) The measuring voltage of test equipment shall be set as more than the maximum charging voltage;
- e) Take reading of charging inlet insulation resistance value R_i .



Explanation of indexing numbers:

- 1 — Resistance tester;
- 2 — High-voltage terminal of the charging inlet;
- 3 — Electric chassis.

Figure 6 Schematic diagram of charging inlet insulation resistance measurement

Furthermore, the insulation resistance between the high-voltage terminals of the charging inlet and the vehicle's electrical chassis may also be tested using insulation resistance test equipment. The test voltage shall be higher than the maximum charging voltage. The resultant value from the parallel calculation shall be taken as the charging inlet insulation resistance.

6.2.3 Insulation monitoring function verification test

During testing, the vehicle's Class B voltage circuit must be energized, and the insulation monitoring function or device shall be activated. Use adjustable resistor (for example: rheostat) in test, and the maximum resistance value of the adjustable resistor shall be no less than 10 MΩ.

The measurement steps are as follows:

- a) Under normal temperature, in accordance with the test method of 6.2.1, measure the current vehicle insulation resistance value R_i and make record for high-voltage side of REESS where smaller measurement voltage U_i' is in test Step c) in 6.2.1.2;
- b) Enable vehicle to enter "driving-enabled mode" as per the normal operation procedure of vehicle under test;
- c) If U_i' is at positive pole terminal of REESS in Step a), then as shown in Figure 7, connect the adjustable resistor in parallel between positive pole terminal of REESS and vehicle electrical chassis. On the contrary, if U_i' is at negative pole terminal of REESS, then connect the adjustable resistor in parallel between negative pole terminal of REESS and vehicle electrical chassis. When starting measurement, set the resistance value of the adjustable resistor at the maximum value;
- d) As per the requirements of 5.1.4.1, if the minimum insulation resistance is required to be 100 Ω/V, then reduce the resistance value of the adjustable resistor to target value R_x , which can be obtained through calculation as per formula (3) as follows:

$$1/[1/(95U_{\max}) - 1/R_i] \leq R_x < 1/[1/(100U_{\max}) - 1/R_i] \dots\dots\dots (3)$$

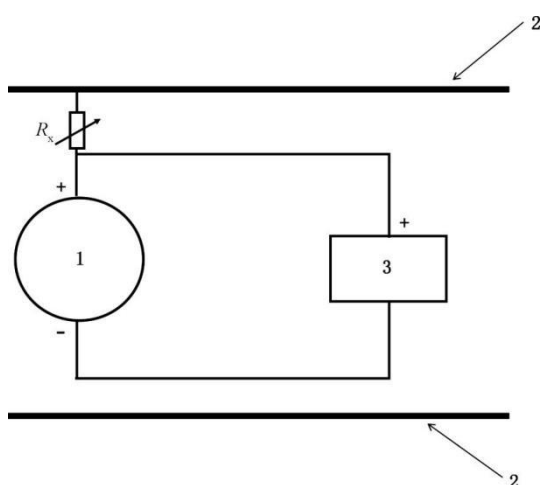
As per the requirements of 5.1.4.1, if the minimum insulation resistance is required to be $500\Omega / V$, then reduce the resistance value of the adjustable resistor to target value R_x , which can be obtained through calculation as per formula (4) as follows:

$$1/[1/(475U_{\max}) - 1/R_i] \leq R_x < 1/[1/(500U_{\max}) - 1/R_i] \dots\dots\dots (4)$$

Where:

$U_{\max}$ — Maximum working voltage of the system, unit is V.

- e) Observe whether vehicle has prominent acoustic or optical alarm.



Explanation of indexing numbers:

1 — REESS;

2 — Electric chassis;

3 — Class B voltage load.

Figure 7 Schematic diagram of the insulation monitoring verification test

6.2.4 Potential equalization

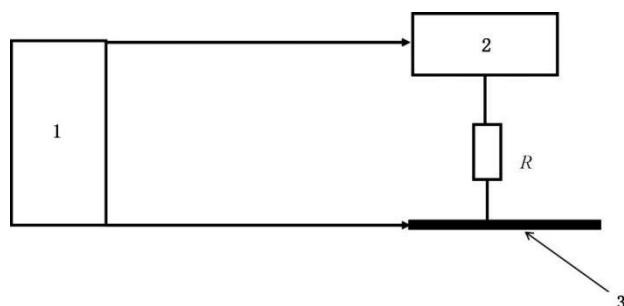
Potential equalization may be directly measured by resistance tester or by independent DC power supply in combination with voltage measurement equipments. In which, the measurement current of resistance tester is adjustable, resistance test resolution is more than 0.01Ω . The independent DC supply voltage is also adjustable.

The resistance between two exposed conductive enclosures or barriers may also be obtained through calculation of connection resistance value between exposed conductive enclosure or barrier and electrical chassis.

The test method is as follows:

- Respectively connect two probes of resistance tester with the exposed conductive enclosure or barrier and electrical chassis, as shown in Figure 8;
- Increase test current so that the test current reaches 0.2A at least;

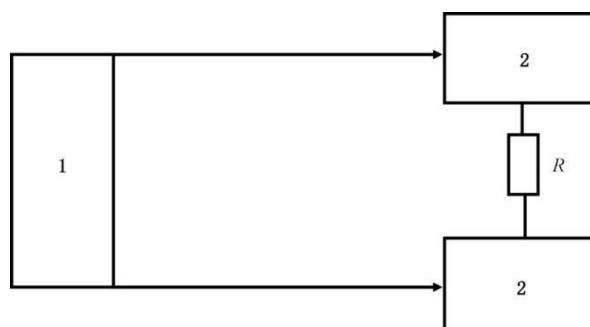
- c) Respectively connect two probes of resistance tester with the two exposed conductive enclosures or barriers, as shown in Figure 9;
- d) Repeat Step b.



Explanation of indexing numbers:

- 1 — Resistance tester;
- 2 — Exposed conductive parts;
- 3 — Electric chassis.

Figure 8 Schematic diagram of resistance measurement between exposed conductive components and the electrical chassis



Explanation of indexing numbers:

- 1 — Resistance tester;
- 2 — Exposed conductive parts.

Figure 9 Schematic diagram of resistance measurement between two exposed conductive components

6.2.5 Capacitive coupling

Capacitive coupling test is to obtain the maximum energy stored in Y capacitor in all voltage class B circuits in vehicle through calculation. The specific calculation formula is shown in formula (5):

$$Q = \sum_{x=1}^n \frac{C_x}{2} U_{\max}^2 \dots\dots\dots (5)$$

Where:

- Q — The maximum energy stored in the Y-capacitor in a Class B voltage circuit, unit is joules (J);
- n — Number of voltage class B units equipped with Y capacitor;

C_x — Capacitance value of Y capacitor of a voltage class B unit, unit is farads (F);

U_{max} — The maximum working voltage of the voltage class B unit, unit is volts (V).

6.2.6 Test method for pressure resistance of barriers and enclosures

During the test, a load of 10 kPa shall be applied slowly to the high-voltage protective component for a duration of 1 second. The contact area between the load and the high-voltage protective component shall be no less than $5\text{ cm} \times 5\text{ cm}$ at minimum. After the test, check whether the high-voltage protective components have any obvious deformation.

6.2.7 Steady-state touch current test

The touch current shall be tested according to 5.4.1 of GB/T 12113—2023. For AC touch currents not exceeding 2 mA (rms), the measurement network specified in Figure 4 of GB/T 12113—2023 shall be used; for AC touch currents exceeding 2 mA (rms), the measurement network specified in Figure 5 of GB/T 12113—2023 shall be used. For DC touch current, any of the measurement networks specified in Figure 3, Figure 4, or Figure 5 of GB/T 12113—2023 shall be used.

6.2.8 vehicle waterproof

6.2.8.1 Simulation of washing

The scope of this test covers the vehicle's boundary lines, such as the seals between two components, glass seals, the outer edges of openable components, the boundaries of the front pillars, and the seals around the lights.

This test adopts hose nozzle of IPX5 of GB/T 4208—2017. Use clean water with flow rate $12.5\text{ L/min} \pm 0.625\text{ L/min}$ ($0.10\text{ m/s} \pm 0.05\text{ m/s}$), sprinkle water to all boundary lines in all possible directions, the distance between nozzle and boundary line is $3.0\text{ m} \pm 0.5\text{ m}$.

6.2.8.2 Vehicle wading

The vehicle shall travel through a pool of water that is 150 mm deep at a speed of $20\text{ km/h} \pm 2\text{ km/h}$ for at least 500 m, taking approximately 1.5 minutes. If the distance to the pool is less than 500 m, the test shall be repeated until the cumulative wading distance reaches at least 500 m. Additionally, the total test time—including the vehicle's time spent outside the pool—should be less than 10 minutes.

6.3 Verification method for underbody protection of the vehicle

6.3.1 Vehicle preparation

6.3.1.1 Vehicle charging

The vehicle shall be charged before the test. Battery electric vehicles shall be fully charged according to 5.1 in GB/T 18385—2024, while off-vehicle-chargeable hybrid electric vehicles shall be fully charged according to 5.1 in GB/T 19752—2024. Non off-vehicle-chargeable hybrid electric vehicles shall be prepared for the test in accordance with the vehicle's normal

operating conditions. The test shall be conducted within 24 hours after the vehicle's charging is completed.

6.3.1.2 Vehicle mass

Perform and record vehicle mass operations in accordance with GB 11551.

6.3.1.3 Cabin adjustment

Adjust the steering wheel, seats, and other components within the passenger compartment in accordance with GB 11551.

6.3.1.4 Dummy placement

Place two Hybrid III 50th percentile male dummies or equivalent-weight counterweights in the front seats as ballast, and secure them using seat belts or other appropriate restraint methods.

6.3.2 Test preparation

6.3.2.1 Site requirements

The test site shall be large enough to accommodate the runway, barriers, and the technical facilities necessary for the tests. The runway section at least 5 m in front of the barrier shall be level, flat, and smooth.

6.3.2.2 Barrier requirements

The impactor of the barrier used for underbody protection verification is a solid hemisphere with a diameter of $\varnothing 150^{+2}_{-2}$ mm, made of #45 steel. A schematic diagram of the barrier is shown in Figure 10.

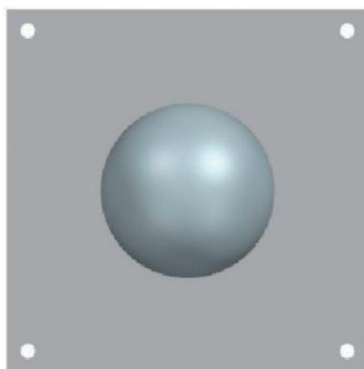


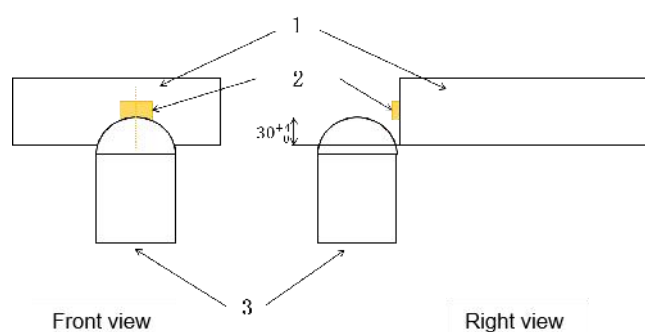
Figure 10: Schematic diagram of the barrier

6.3.2.3 Positioning requirements for barriers

Adjust the lateral relative position between the vehicle and the barrier so that the barrier's centerline coincides with a weak point located within ± 150 mm of the REESS centerline. If no such weak point exists, select the REESS centerline as the impact location. (If this location is in a non-cell area such as a longitudinal beam, adjust the barrier position to coincide with the cell area closest to the REESS centerline.)

Select three measurement points—front, middle, and rear—along the X-direction at equal intervals on the flat surface of the REESS, and measure the ground clearance at each of these points. Take the minimum of the three measured values as the ground clearance of the REESS. Adjust the relative Z-axis position between the vehicle and the barrier so that, in the vehicle coordinate system, the barrier's Z-axis height is 30^{+4}_0 mm greater than the REESS. ground clearance. The schematic diagram of barrier positioning is shown in Figure 11.

Unit: millimeters



Explanation of indexing numbers:

- 1 — REESS;
- 2 — REESS weak points;
- 3 — Barrier.

Figure 11: Schematic diagram of barrier localization

6.3.2.4 Collision offset

The lateral deviation between the centerline of the spherical barrier and the impact point shall not exceed 25 mm.

6.3.3 Vehicle drive

The vehicle shall not be driven by its own power. At the moment of collision, the vehicle shall no longer be subjected to any additional steering or driving forces.

6.3.4 Test speed

The vehicle's traction acceleration shall not exceed 0.3g. The vehicle shall pass the barrier traveling at a speed of 35^{+1}_0 km/h in the forward direction, and this speed must remain stable for at least 1 meter prior to the collision. The schematic diagram of the experiment is shown in Figure 12.

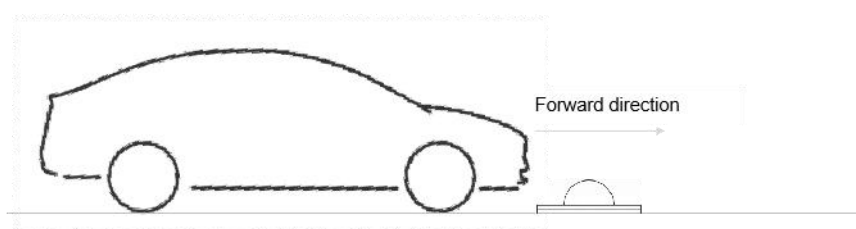


Figure 12 Schematic diagram of the vehicle underbody protection verification test

6.4 Safety function protection

In accordance with all safety function protection requirements specified in 5.3, manufacturer shall provide detailed program description, including triggering condition of protection action, operation instruction and alarm indication signal description, inspection institution shall perform test verification on vehicle as per the instruction and perform compliance determination in comparison with the requirements in 5.3.

7 Same-type determination

7.1 If a vehicle complies with all the provisions of 7.2 and 7.3, it shall be considered to be of the same type.

7.2 If the vehicle fails to meet any of the following requirements, it must once again satisfy the requirements specified in 5.1.

- a) The vehicle types (Category M, Category N) are the same. For modified vehicles, if the modification results in a change of vehicle category but does not involve any alterations to the Class B high-voltage circuit layout or Class B high-voltage components, the vehicle shall once again meet the requirements specified in 5.1.3.1 and 5.1.5; other clauses shall be deemed identical to the original vehicle type.
- b) The high-voltage markings are located in the same position (which can be considered identical if they are on the surface of the corresponding Class B high-voltage components).
- c) The direct-contact protective devices (such as barriers/enclosures, connectors, high voltage service disconnect, and other protective devices) and their arrangement shall be identical or of the same or higher IP degrees.
- d) For Class B high-voltage components (such as the energy storage system assembly, drive motor, drive motor controller, high-voltage distribution box, DC/DC converter, on-board charger, electric heater, air-conditioning compressor, steering motor controller, etc.), if their model specifications and manufacturer are identical, their layout is the same or reduced in number, their IP degrees is the same or higher, and their connection structure and method to the vehicle body are identical (when the aforementioned components—excluding the energy storage system, drive motor, and drive motor controller—offer

multiple optional configurations, a full-coverage approach may be adopted provided that all such components installed in the vehicle (from the same manufacturer and same brand model) have passed inspection; in this case, combined inspections are not required).

- e) The categories (such as lithium iron phosphate batteries, ternary lithium batteries, etc.), types (such as energy-type, power-type, etc.), model specifications, and manufacturing enterprises of the energy storage system assembly and individual cells shall be identical. Their arrangement, IP degrees (identical or higher), and connection structure and method with the vehicle body shall also be the same. (Note: If the number of battery cells or modules connected in series is reduced while the internal structure remains unchanged, and the overall reduction in REESS battery energy does not exceed 20%, such a change in the battery assembly model may be considered equivalent.)
- f) The types of drive motors are the same (e.g., DC motors, AC motors, permanent magnet synchronous motors, switched reluctance motors, etc.).
- g) The number and arrangement of drive motors are the same or reduced (e.g., front-mounted, mid-mounted, rear-mounted, wheel-side, in-wheel, etc.).
- h) The model specifications, manufacturer, and software version numbers of the vehicle controller and the on-board energy management system (hardware) must be identical [a change in software version number resulting from over-the-air (OTA) updates to the vehicle software shall be treated as equivalent].
- i) Safety function protection requirements (with the remaining clauses being treated as equivalent, only the content related to 5.3 shall be inspected).
- j) The arrangement locations of charging inlet (AC charging inlet and DC charging inlet) are the same, or their number has been reduced; the rated voltage and current of the charging inlet are the same or have increased.

7.3 If the vehicle fails to meet any of the following requirements, it must again satisfy the requirements specified in 5.2.

- a) The vehicle types (Category M, Category N) are the same. For modified vehicles, if the modification results in a change of vehicle category but does not involve any alterations to the Class B high-voltage circuit layout or Class B high-voltage components, the vehicle shall once again meet the requirements specified in 5.2; other clauses shall be deemed identical to the original vehicle type.
- b) The direct-contact protective devices (barriers/enclosures, connectors) and their arrangement shall be identical or of the same or higher IP degrees .
- c) Class B high-voltage components (such as energy storage system assemblies and drive motors) shall have the same model specifications and manufacturer, be arranged in the same manner or with a reduced number, and have the same or higher IP degrees .
- d) The categories (such as lithium iron phosphate batteries, ternary lithium batteries, etc.), types (such as energy-type, power-type, etc.), model specifications, and manufacturing enterprises of the energy storage system assembly and individual cells shall be identical. Their arrangement, IP degrees (identical or higher), and connection structure and method

with the vehicle body shall also be the same. (Note: If the number of battery cells or modules connected in series is reduced while the internal structure remains unchanged, and the overall reduction in REESS battery energy does not exceed 20%, such a change in the battery assembly model may be considered equivalent.)

- e) The types of drive motors are the same (e.g., DC motors, AC motors, permanent magnet synchronous motors, switched reluctance motors, etc.).
- f) The relative positions of the vehicle's anti-collision bar and the sub-frame crossbeam to the REESS are essentially consistent (with a variation of no more than 50 mm in the x-direction and no more than 5 mm in the z-direction).
- g) The materials and structures of the vehicle's anti-collision bars, subframe, and underbody guard are identical or enhanced.
- h) The change in the vehicle's curb weight shall not exceed 8%.

8 Implementation of the standard

For vehicle models applying for type approval for the first time, this document shall take effect from the date of its implementation. For vehicle models that have already obtained type approval, this document shall take effect starting from the 13th month following the date of its implementation.

Annex A

(annex normative)

Waterproof Performance Verification Method of Voltage Class B Components/Parts

A.1 Requirements on data to be submitted by manufacturer

A.1.1 The manufacturer shall provide, in accordance with Table A.1, a list of all Class B voltage components, along with their corresponding layout positions and installation details.

Table A.1 description list of voltage class B components/parts and their arrangement position and installation situations

No.	Name of high-voltage parts	Height of lower surface of parts from ground	Is there barrier underneath parts
	Traction battery		
	Drive motor		
	Steering motor		
	AC compressor		
	DC/DC converter		
	Drive motor controller		
	Steering motor controller		
	Air conditioner compressor controller		
	High voltage power distribution cabinet		
	high voltage service disconnect		
	High-voltage wire and connector		
	On-board charger		
	Others		

If the test vehicle has voltage class B components/parts in Table A.1, then it is necessary to feed back as per Table A.1. If the test vehicle does not have one or several of these items, these items are not required. Furthermore, voltage class B components/parts are not limited to the list enumerated in Table A.1, and shall be provided by manufacturer as per specific vehicle.

A.1.2 Manufacturer shall provide waterproof level test report of voltage class B components/parts, and the report shall be issued by third party inspection institution. The waterproof requirements for all Class B voltage components are determined based on their installation height when the vehicle is unloaded, as follows:

- a) If the height of lower surface of parts from ground is less than 300 mm, then high-voltage parts shall meet the IPX7 requirement in GB/T 4208-2017;

- b) If the height of lower surface of parts from ground is not less than 300 mm and there is no barrier underneath parts, then high-voltage parts shall meet the IPX5 requirement in GB/T 4208-2017;
- c) If the height of lower surface of parts from ground is not less than 300mm and there is barrier underneath parts, then high-voltage parts shall meet the IPX4 requirement in GB/T 4208-2017.

A.1.3 Manufacturer shall provide insulation resistance of all voltage class B components/parts in Table A.1 after completion of test in A.2, and the vehicle insulation resistance obtained through parallel connection calculation shall meet the requirements of 5.1.4.1.

A.2 Waterproof test method of voltage class B components/parts

A.2.1 IPX7, IPX5 and IPX4 tests shall be carried out in accordance with GB/T 4208-2017.

A.2.2 In the test process of IPX7, IPX5 and IPX4, prior to inspection of ingress of water into voltage class B components/parts, it is necessary to test its insulation resistance firstly by adopting the test method of 6.2.1.

Bibliography

- [1]GB/T 28046 Road vehicles—Environmental conditions and testing for electrical and electronic equipment
 - [2]GB/T 29317 Terminology of electric vehicle charging/battery swap infrastructure
 - [3]GB/T 34590 Road vehicles - Functional safety
 - [4]GB/T 37133—2025 High voltage connection system for electric vehicle
 - [5]GB 38032 Electric buses safety requirements
 - [6]ISO 6469-3 Electrically propelled road vehicles—Safety specifications—Part 3: Electrical safety
 - [7]UN GTR No.20 Electric Vehicle Safety (EVS) (ECE/TRANS/180/Add.20)
 - [8]UN R100 Uniform provisions concerning the approval of vehicles with regard to specific requirements for the electric powertrain
-