



National Standard of the People's Republic of China

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Replace GB/T 18384.1-2015, GB/T 18384.2-2015, GB/T 18384.3-2015

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Electric vehicles safety requirements

电动汽车安全要求

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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.

The entire context of this standard is mandatory.

This standard is drafted in accordance with the rules given in the GB/T 1.1—2009 *Directives for standardization—Part 1: Structure and drafting of standards*.

This standard replaces the GB/T 18384.1—2015 *Electrically propelled road vehicles—Safety specifications—Part 1: On-board rechargeable energy storage system (REESS)*, GB/T 18384.2—2015 *Electrically propelled road vehicles—Safety specifications—Part 2: Vehicle operational safety means and protection against failures* and GB/T 18384.3—2015 *Electrically propelled road vehicles—Safety specifications—Part 3: Protection of persons against electric shock* in whole, the following technical deviations have been made with respect to the GB/T 18384.1—2015, GB/T 18384.2—2015 and GB/T 18384.3—2015:

- Modify high voltage warning symbol in Figure 1 (see 5.1.2.1, see Figure 1 in GB/T 18384.1—2015 and Figure 1 in GB/T 18384.3—2015)
- Add exemption requirements for roof charging device (see 5.1.3.1)
- Amend the optional requirement for insulation resistance supervision requirement into mandatory requirement (see 5.1.4.2, see 8.1 in GB/T 18384.3—2015)
- Modify partial content of capacity coupling requirements (see 5.1.4.4, see 6.3.3 in GB/T 18384.3—2015)
- Add the identical requirement with whole vehicle waterproof requirement, namely waterproof requirement for parts and components (see 5.1.5)
- Add warning requirements for REESS heating (see 5.2.2.3)
- Modify the measuring method for insulation resistance (see 6.2.1 and 6.2.2, see 7.2 in GB/T 18384.3—2015)
- Add verification test for insulation supervision function (see 6.2.3)
- Add the formula for Y capacitor (see 6.2.5)

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

This standard 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

## Introduction

This standard lays out the safety requirements and test methods of electric vehicles, to protect passengers as the vehicle runs normally. For other safety risks caused by system failures related to electronic and electrical systems, it could take references to other standards (such as GB/T 34590, GB/T 28046) for safety design and requirements for electronic and electrical systems, on basis that electric vehicles meet the safety requirements of electronic and electrical systems of conventional vehicles.

The formulation of this standard has made sufficient reference to the technical requirements of UN GTR 20 *Global Technical Regulation for Electric Vehicle Safety*, and has been modified in combination with the technical level, application scenario and test experience of domestic products.

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 standard specifies the safety requirements and test methods for electric vehicles. .  
 This standard is applicable to voltage class B electric vehicles on the maximum working voltage of on-board propulsion system.  
 This standard is not applicable to road vehicles which are continuously connected with power grid during driving process.

## 2 Normative references

The following referenced documents are indispensable for the application 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.

GB/T 4094.2 *Electric vehicles—Symbols for controls, indicators and tell-tales*  
 GB 7258—2017 *Technical specifications for safety of power-driven vehicles operating on roads*  
 GB 8410 *Flammability of automotive interior materials*  
 GB/T 4208—2017 *Degrees of protection provide by enclosure (IP code)*  
 GB 11551 *The protection of the occupants in the event of a frontal collision for motor vehicle*  
 GB 17354 *Front and rear protective devices for passenger cars*  
 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 19836 *Instrumentation for electric vehicles*  
 GB 20071 *The protection of the occupants in the event of a lateral collision*  
 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 *The safety requirement of electric vehicle post crash*  
 GB 34660 *Road vehicles—Requirements and test methods of electromagnetic compatibility*  
 GB 38031 *Electric vehicles traction battery safety requirements*

## 3 Terms and definitions

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

### 3.1

rechargeable electrical energy storage system (REESS)

an energy storage system that is rechargeable and can provide electrical energy

## 3.2

service disconnect

a device that is used to disconnect high voltage circuit while checking or repairing battery pack or fuel cell stack

## 3.3

conductive connection

perform conductive connection by using conductor

## 3.4

direct driving

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

## 4 Voltage classes

Electric components or circuits are divided into the following classes according to the maximum working voltage, see Table 1.

Table 1 Voltage classes

Unit is Volt

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

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

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.

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, 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 symbol as shown in Figure 1 shall not be marked for REESS; otherwise, regardless whether voltage class B exists in REESS, it is necessary to mark with 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.

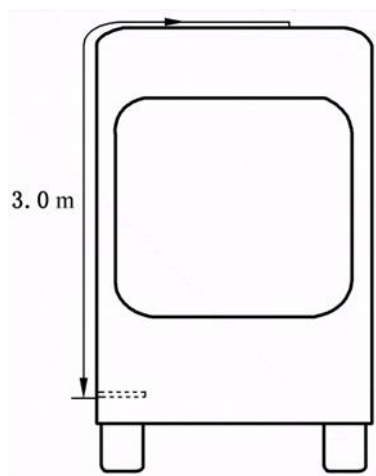


Figure 2 Schematic diagram of the shortest route measurement

#### 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.

Barrier and enclosure shall meet two requirements as follows:

- 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) Generally, barrier and enclosure can only be opened or removed by tools; if the barrier and enclosure can be opened or removed without tools, then there shall be a method to enable voltage class B live part to meet at least one of two requirements as follows within 1s after opening of barrier and enclosure:

— AC circuit voltage drop shall not exceed 30V a.c. (rms), DC circuit voltage drop shall not



exceed 60V d.c. ;

— The total energy stored in class B circuit shall be less than 0.2J.

#### 5.1.3.3 Requirements on connector

It shall be impossible to open high-voltage connector without tools, but with the exception of three scenarios as follows:

- a) After disconnection of high-voltage connector, shall meet the IPXXB protection degree requirements;
- b) It takes at least two different actions to disconnect high-voltage connector from mutual abutting end, and high-voltage connector shall feature mechanical locking relation with some other mechanism, before opening of high-voltage connector, the locking mechanism can only be opened by using tools;
- c) After disconnection of high-voltage connector, the voltage drop of live part in connector shall not be more than 30V a.c. (rms) and not more than 60V d.c. within 1s.

#### 5.1.3.4 Requirements on high-voltage service disconnect

For vehicle installed with high-voltage service disconnect, it shall be impossible to open or remove high-voltage service disconnect without tools, but with the exception of two scenarios as follows:

- a) After opening or removal of high-voltage service disconnect, in which the voltage class B live part shall meet the IPXXB protection degree requirement specified in GB/T 4208-2017;
- b) After disconnection of high-voltage service disconnect, the voltage drop of its voltage class B live part shall not be more than 30V a.c. (rms) and not more than 60V d.c. within 1s.

#### 5.1.3.5 Requirements on charging inlet

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

- a) Within 1s after disconnection, the charging inlet voltage class B live part voltage drop shall not be more than 30V a.c. (rms) and not more than 60V d.c. or total energy stored in electric circuit shall be less than 0.2J;
- b) Shall meet the protective level requirements of IPXXB specified in GB/T 4208-2017, and within time duration of 1min, the charging inlet voltage class B live part voltage drop shall not be more than 30V a.c. (rms) and not more than 60V d.c. or total energy stored in electric circuit shall be less than 0.2J.

#### 5.1.4 Requirements on protection against indirect contact

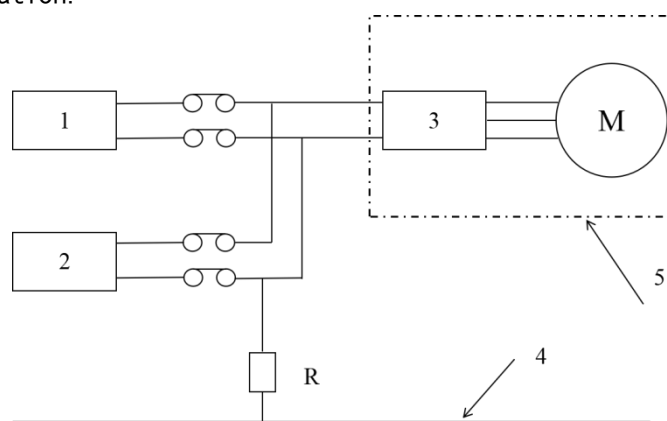
##### 5.1.4.1 Requirements on insulation resistance

Under the maximum working voltage, the value of insulation resistance for DC circuit shall not be less than 100  $\Omega/V$ ; for AC circuit, the value shall not be less than 500

$\Omega / V$ . If DC and AC voltage class B electric circuits are conductively connected together, then shall meet the requirement that insulation resistance is not less than  $500 \Omega / V$ . For fuel cell electric vehicle, as shown in Figure 3, if AC circuit has added additional protection, then combination circuit shall meet the requirement of  $100 \Omega / V$  at least.

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

- a) Shall feature at least two insulation layers, barrier or enclosure.
- 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.



Key:

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

Figure 3 Requirements on insulation resistance of fuel cell electric vehicle

#### 5.1.4.2 Requirements on insulation resistance monitoring

Vehicle shall feature insulation resistance monitoring function, and shall be able to pass the insulation monitoring function verification test of 6.2.3. The device is able to measure the insulation resistance value of vehicle continuously or intermittently when vehicle's voltage class B circuit is closed but conductive connection with external power supply is not made, and it is necessary to remind driver through a prominent signaling device (for example: acoustic or optical signal) when the insulation resistance is less than the threshold value specified by manufacturer, and the threshold value specified by manufacturer shall not be lower than the requirements of 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 impedance of connection between exposed conductive part and electrical chassis shall not be more than  $0.1\Omega$ ;
- b) In circuit featuring balance of potential, the resistance between two exposed conductive parts that can be touched by human being at the same time i.e., two conductive parts between which the distance is not more than 2.5m shall not be more than  $0.2\Omega$ .

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 meet at least one of the following requirements:

- a) In voltage class B circuit, the energy stored in the total capacitor between any voltage class B live part and electrical chassis at its maximum work voltage shall not be more than 0.2J, which is the requirements on the maximum electrical energy stored in Y capacity at positive pole side of voltage class B circuit or Y capacity at negative pole side. Furthermore, if voltage class B circuits are isolated from each other, then 0.2J is the separated requirement on circuits that are isolated from each other.
- b) Voltage class B circuit shall feature at least two insulation layers, barrier or enclosure, after arrangement 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.

#### 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 not be less than  $1\text{ M}\Omega$  when the charge 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 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 simulated washing and simulated wading test. The manufacturer or vehicle shall meet at least one of the following requirements:

- a) Manufacturer provides 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 simulated washing and simulated wading test of vehicle as per the test method of 6.3, and measure insulation resistance as per the test method in 6.2.1 under condition that vehicle is still wet after each 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.

## 5.2 Requirements on safety function protection

### 5.2.1 Power-on/power-off of propulsion system procedure

The vehicle shall have at least two consciously different actions from the power off state of the propulsion system to the “driving-enabled mode”, and at least one of these actions is stepping on the brake pedal.

Only one action is required from the “driving-enabled mode” to the power off state of the propulsion system.

It is necessary to continuously or intermittently indicate that vehicle is already under “driving-enabled mode” to driver. When the driver leaves vehicle, if the propulsion system is still in “driving-enabled mode”, then it is necessary to remind driver through a prominent signaling device (for example: acoustic or optical signal).

When the vehicle is stopped, after the propulsion system is automatically or manually closed, it is only possible to re-enter the “driving-enabled mode” through the above-mentioned procedure.

### 5.2.2 Driving

#### 5.2.2.1 Reminding for power decrease

If electric propulsion system adopts measure to automatically restrict and decrease vehicle driving power, it is necessary to remind driver through a prominent signaling device (for example: acoustic or optical signal) when the driving power restriction and decrease influence vehicle driving.

#### 5.2.2.2 Reminding for low electric quantity of REESS

If the low electric quantity of REESS influences vehicle driving, it shall remind driver through a prominent signaling device (for example: acoustic or optical signal).

#### 5.2.2.3 Alarm for thermal event of REESS

If safety issue of thermal runaway will occur in REESS, it is necessary to remind driver through a prominent signaling device (for example: acoustic or optical signal).

#### 5.2.2.4 Braking priority

Control system of the whole vehicle makes response to braking signal first as braking signal and accelerating signal are sent simultaneously.

### 5.2.3 Gear shifts

#### 5.2.3.1 Switch driving shift

As driving the vehicle, the driver shall step on the brake pedal when the vehicle under static status is switched from non-driving gear to driving gear.

#### 5.2.3.2 Reverse driving

If vehicles realize transformation between two driving directions of forward and reverse through changing of rotary direction of the motor, one of the following two requirements shall be met:

- a) Transformation between two driving directions of forward and reverse shall be completed by two operation actions of different directions of driver; or
- 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 driving directions of forward and reverse is not realized through change of electric motor rotation direction, then reversing driving requirement does not apply.

#### 5.2.4 Parking

The vehicle shall not generate undesirable driving caused by its own electric propulsion system after power off.

#### 5.2.5 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.

### 5.3 Requirements on traction battery

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

#### 5.4 Requirements on vehicle collision protection

Frontal collision protection of electric vehicles shall comply with requirements in GB 11551, side collision protection shall comply with GB 20071, anti-collision of frontal and rear protective devices shall comply with GB 17354, roof anti-press strength shall comply with GB 26134, post-collision safety of electric vehicle shall comply with GB/T 31498.

Note: the scope of this clause is consistent with the scope of GB11551, GB 20071, GB 26134 and GB/T 31498.

#### 5.5 Requirements on fire resistance of inner materials

Fire resistance of inner materials of electric vehicle shall comply with requirements in GB 8410.

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

#### 5.6 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.

#### 5.7 Requirements on vehicle alarming and indication

Vehicle 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.

#### 5.8 Requirements on event data recording system

Electric vehicle of category M<sub>1</sub> shall be equipped with event data recording system (EDR) or onboard video driving recording device.

#### 5.9 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

### 6 Test methods

#### 6.1 Protection against direct contact

In the process of test of protection against direct contact, vehicle shall be under whole vehicle power off condition, and all barriers and enclosures of vehicle shall be intact. In the test process, inspector shall perform IP degree test for opening and connector outside vehicle and inside vehicle by using probe or test finger only as per the test

method of IPXXD and IPXXB in GB/T 4208-2017 under the precondition that no other tool is used.

Furthermore, it is permitted to verify compliance of connector, high-voltage service disconnect and vehicle charging inlet with requirement on protection against direct contact through visual inspection in combination with manufacturer's instruction.

## 6.2 Protection against indirect contact

### 6.2.1 Insulation resistance test of whole vehicle

#### 6.2.1.1 Test preparation

The internal resistance of voltage testing tool shall not be less than 10 M $\Omega$ . If the insulation monitoring function will influence test of whole vehicle insulation resistance during measurement, then it is necessary to 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 voltage between two terminals of REESS and electrical chassis by using two identical voltage testing tools at the same time, as shown in Figure 4. When the reading gets stable, the higher one is  $U_1$  and the lower one is  $U_1'$ ;
- c) Add one known resistor  $R_0$ , and the resistance value should be 1 M $\Omega$ . Connect in parallel between  $U_1$  side terminal of REESS and electrical chassis as shown in Figure 5. Then measure the voltage between two terminals of REESS and electrical chassis by using two voltage testing tools in Step b at the same time, after the reading gets stable, the measured values are  $U_2$  and  $U_2'$ ;

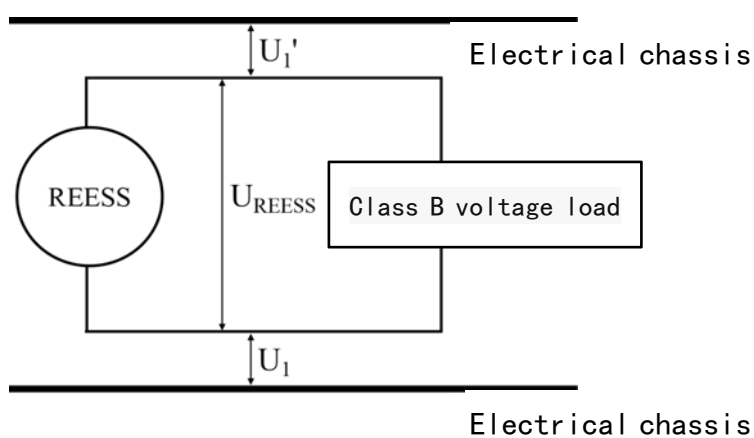


Figure 4 Insulation resistance measurement step b

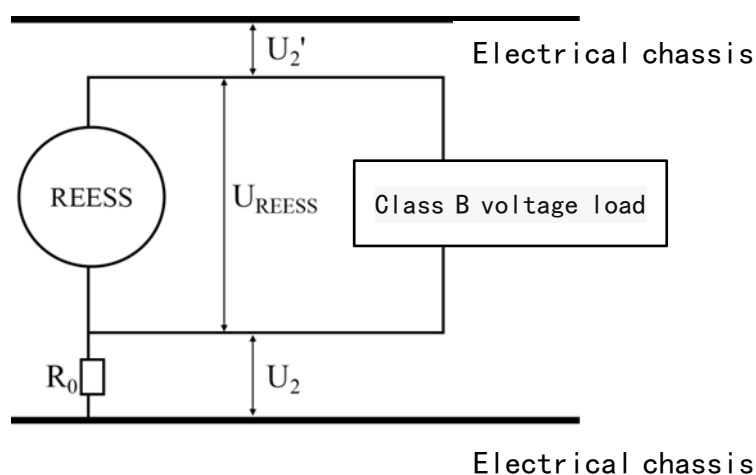


Figure 5 Insulation resistance measurement step c

d) Calculate the insulation resistance  $R_i$ , methods are as follows:

$R_i$  can be calculated 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 megger meter;
- 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.

#### 6.2.1.4 Calculation of whole vehicle insulation resistance

For vehicles of which all voltage class B loads are able to work at the same time, it is permitted to directly measure whole vehicle insulation resistance as per the test method of 6.2.1.2. Otherwise, it is also necessary to measure as per 6.2.1.3 the insulation resistance of voltage class B load for which it is impossible to complete test in 6.2.1.2. Calculate the parallel connection result as per the measurement result  $R_i$  in 6.2.1.2 and the insulation resistance  $R_x$  of voltage class B loads measured in 6.2.1.3 and take it as the insulation resistance of whole vehicle.

If whole vehicle has two or more voltage class B circuits that are isolated from each other, then it is permitted to respectively measure and calculate insulation resistance of voltage class B circuits respectively as per the method in this section, and take the minimum value as the whole vehicle insulation resistance.

#### 6.2.2 Charging 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 port insulation resistance value  $R_i$ .

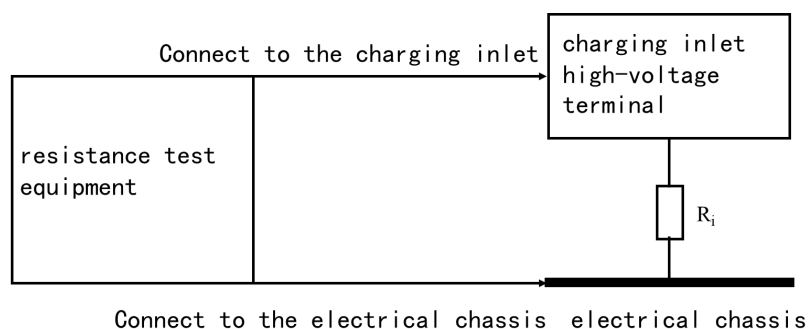


Figure 6 Charging port insulation resistance measurement step c

Furthermore, it is also permitted to respectively test the insulation resistance between each high-voltage terminal of charging inlet and vehicle electrical chassis by using insulation resistance test equipment, the measuring voltage of test equipment is required to be higher than the maximum charging voltage, then calculate parallel connection results, i.e., the charging inlet insulation resistance.

### 6.2.3 Insulation monitoring function verification test

In the test process, vehicle voltage class B circuit shall be in the on state, and insulation monitoring function or equipment shall be activated. Use adjustable resistor (for example: rheostat) in test, and the maximum resistance of adjustable resistor  $\geq 10\text{M}\Omega$ . The measurement steps are as follows:

- a) Under normal temperature, in accordance with the test method of 6.2.1, measure the current whole 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 b) 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  $100\ \Omega/\text{V}$ , 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:

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

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:

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

Where:

$U_{REESS}$  — The present total voltage of battery pack, unit is V.

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

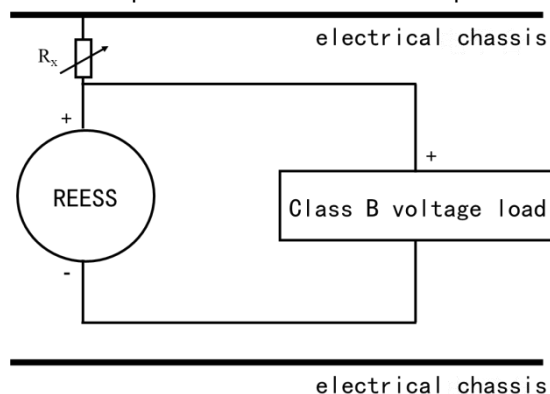


Figure 7 Insulation monitoring verification test

#### 6.2.4 Potential equalization

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

- a) Respectively connect two probes of resistance tester with the exposed conductive enclosure or barrier and electrical chassis, as shown in Figure 8;
- b) 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.

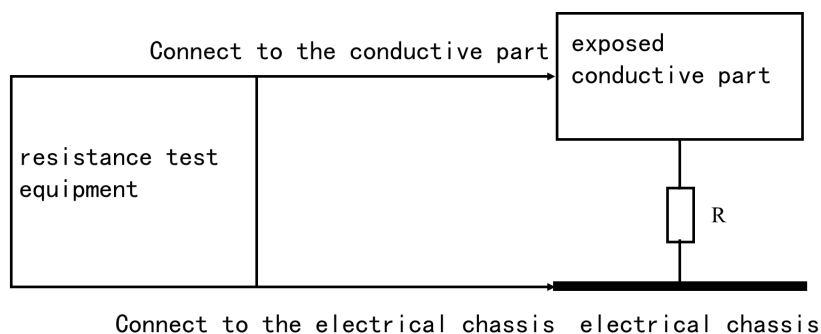


Figure 8 Test the resistance between conductive part and electrical chassis by using resistance tester

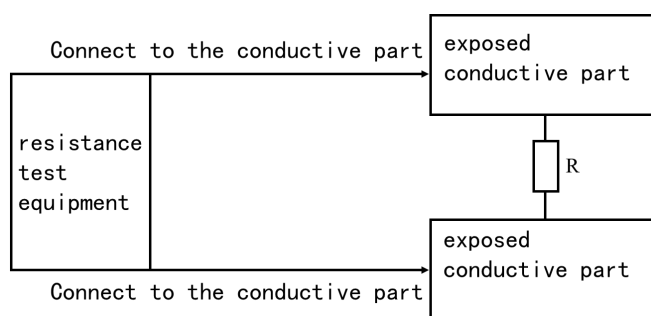


Figure 9 Test the resistance between two conducting parts by using resistance tester

### 6.2.5 Capacitive coupling

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

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

Where:

$n$  — 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 F;

$U_x$  — The maximum working voltage of Y capacitor of the voltage class B unit, unit is V.

## 6.3 Whole vehicle waterproof

### 6.3.1 Simulation of washing

The test scope of this test is the whole vehicle boundary line, for example, sealing between two parts, glass sealing ring, outer edge of opening parts, boundary of A-post and sealing ring of lamp.

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

#### 6.3.2 Simulation of wading

Vehicle shall driving at least for 500m and approximately 1.5min with speed  $20\text{km}/\text{h} \pm 2\text{km}/\text{h}$  in pool of depth 100mm. If water pool distance is less than 500m, it is necessary to repeat test so that the wading distance is not less than 500m accumulatively, and the total test time of vehicle outside water pool shall be less than 10min.

#### 6.4 Safety function protection

In accordance with all function protection requirements specified in 5.2, 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 real vehicle as per the instruction and perform compliance determination in comparison with the requirements in 5.2.

### 7 Implementation date

This standard shall be implemented starting on the date of implementation of standard for vehicle type applying for new type approval, and shall be implemented starting in the 13<sup>th</sup> month since the date of implementation of standard for vehicle type granted with type approval.

The effective date for the requirement that electric vehicles of  $M_1$  shall be equipped with event data recording system or onboard video driving recording device, complies with 15.4 in GB 7258-2017.

Annex A  
(normative)

Waterproof performance verification method of voltage class B components/parts

A.1 Requirements on data to be submitted by manufacturer

A.1.1 Manufacturer shall provide list of all voltage class B components/parts and relevant arrangement position and installation situations, see Table A.1.

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 compressor controller		
	High voltage power distribution cabinet		
	High-voltage service switch		
	High-voltage wire and connector		
	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 one or several items are not listed in the table, then 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 level requirements on all voltage class B components/parts are 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 whole 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 34590 Road vehicles—Functional safety
  - [3] UN GTR No.20 Electric Vehicle Safety (EVS) (ECE/TRANS/180/Add.20)
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