BAHAMAS NATIONAL STANDARD

BAHAMAS BUREAU OF STANDARDS AND QUALITY

DRAFT BAHAMAS NATIONAL STANDARD

ELECTRIC VEHICLES SAFETY REQUIREMENTS

DBNS GB 18384-2020

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BBSQ Foreword

This national standard is identical with the English version of National Standard of the People's Republic of China GB 18384-2020, **Electric Vehicles Safety requirement**. The national committee responsible for reviewing this standard is Technical Committee 12 *Road Vehicles*. This standard contains requirements that are relevant for The Bahamas.

BBSQ Committee Representation

This National Standard was adopted as a National Standard under the supervision of the CATARC (China Automotive Technology & Research Center Co., LTd) hosted by the Bahamas Bureau of Standards and Quality and the National Technical Committee for Road Vehicles which at the time comprised the following members:

Member	Representing
Mrs. Pia Farmer (**Interim Chairwoman**)	Easy Car Sales
Mr. Kevin Hanna (**Interim Vice Chairman**)	Lucayan Car Rental & Auto Sales
Mr. Trevor Williams	Out Island Water Company
Mrs. Sharmaine Smith-Farah	The Bahamas Ministry of Tourism
Ms. Veronique Martin	Crocasack Tings
Mr. Martin Gibson	Fresh Auto Centre
Mr. Ian Johnson	Easy Car Sales
Ms. Felecia D. Blair	Royal Bahamas Police Force

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GB 18384-2020

Supercede GB/T 18384.1-2015, GB/T18384.2-2015, GB/T 18384.3-2015

Electric vehicles safety requirements

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Table of Contents

Foreword 3
Introduct ion 5
1 Scope 6
2 Normat ive References 6
3 Terms and Definit ions 7
4 Voltage Classes 7
5 Safety Requirements 8
5.1 Requirements on protect ion of persons against electric shock 8
5.2 Requirements on protect ion of funct ional safety 15
5.3 Requirements on tract ion battery 16
5.4 Requirements on vehicle collision protect ion 17
5.5 Requirements on fire resistance of inner materials 17
5.6 Requirements on charging interface 17
5.7 Requirements on vehicle alarming and indicat ion 17
5.8 Requirements on event data recording system 17
5.9 Requirements on electromagnet ic compat ibility 18
6 Test Methods 18
6.1 Protect ion against direct contact 18
6.2 Protect ion against indirect contact 18
6.3 Complete vehicle waterproof 25
6.4 Funct ional safety protect ion 26
7 Implementat ion Date 26
Annex A (Normat ive) Waterproof Performance Verificat ion Method of Voltage Class B Components / Parts 27
Bibliography 29

Foreword

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.

This standard superceds 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/T18384.3-2015 Electrically propelled road vehicles—Safety specifications—Part 3:Protection of persons against electric shock, the main technical changes comparing with GB.T 18384.1-2015 , GB.T 18384.2-2015 and GB/T18384.3-2015:

- 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 complete vehicle waterproof requirement, namely waterproof requirement for parts and components (see 5.1.5)
- Add warning requirements for REESSS 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 by and was prepared by Ministry of Industry and Information Technology of the People's Republic of China.

The responsible drafting entities of this standard: BYD Automobile Industry Co., Ltd., China Automotive Technology and Research Center Co., Ltd., BAIC BJEV Automobile Co., Ltd. and China FAW Group Co., Ltd., SAIC MAXUS Motor Co., Ltd., Shanghai NEXT EV Co., Ltd., National Automobile Quality Supervision and Inspection Center (Xiangyang) , Chongqing Vehicle Test Research Institute Co., Ltd., SAIC Motor Technical Center, Guangzhou

Automobile Group Co., Ltd., Ningde Contemporary Amperex Technology Co., Limited, Zhejiang Geely New Energy Commercial Vehicle Co., Ltd., Changchun Automotive Test Center Co., Ltd., Zhejiang Geely Holding Group Co., Ltd., Hunan CRRC Times Electric Vehicle Co., Ltd., CATARC Motor Vehicle Quality Inspection Center (Ningbo) Co., Ltd. , Chongqing Changan New Energy Automobile Technology Co., Ltd., Chery New Energy Automotive Technology Co., Ltd., FAW-Volkswagen Co., Ltd., Pan Asia Technical Automotive Center Co., Ltd., Zhengzhou Yutong Bus Co., Ltd., Anhui Jianghuai Automobile Group Co., Ltd., Haima New Energy Vehicle Co., Ltd. , Huawei Technologies Co., Ltd., Chongqing Jinkang New Energy Vehicle Co., Ltd., Technical Center of Dongfeng Motor Group Co., Ltd. , Shenzhen Denza New Energy Vehicle Co., Ltd., Suzhou Huichuan United Power System Co., Ltd. and SAIC GM Wuling Automotive Co., Ltd..

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This standard superceds 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 ante test methods of electric vehicles, to protection passenger 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 personal electric shock protection requirements, functional safety protection requirements and test methods for electric vehicles under normal use situations.

This standard is applicable to voltage class B electric vehicles on the maximum working voltage of on-board drive system.

This standard is not applicable to road vehicles which are continuously connected with power grid during travel process.

2 Normative References

The following referenced documents are indispensable for the application of this document. For dated references, only the edition citied 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 road

GB 8410 Flammability of Automotive Interior Materials

GB/T 4208-2017 *Degrees ofprotection provided by enclosure (IP code)*

GB 11551 The protection of the occupants in the event of a frontal collision for passenger car

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 collision

GB 34660 Road vehicles - Requirements and test

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 V

Voltage classes	Maximum working voltage U	
	DC	AC (rms)
A	0<U≤60	0<U≤30
B	60<U≤1,500	30<U≤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 provisions

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 30V a.c. (rms) and not more than 60V 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 provisions

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.

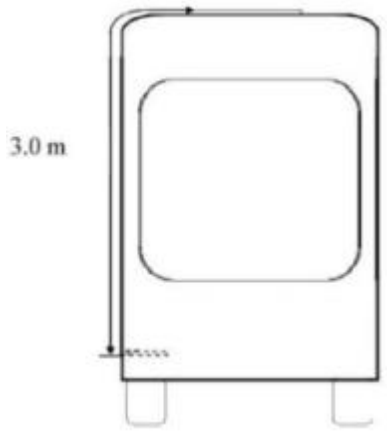


Figure 2 Schematic Diagram of the Shortest Route Measurement

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 a.c.; or

-- 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; or

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; or

c) After disconnection of high-voltage connector, the voltage drop of live part in connector shall be not 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 be not 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 at least meet one of the following requirements:

a) Within 1s after disconnection, the charging inlet voltage class B live part voltage drop shall be not 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; or

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 be not 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

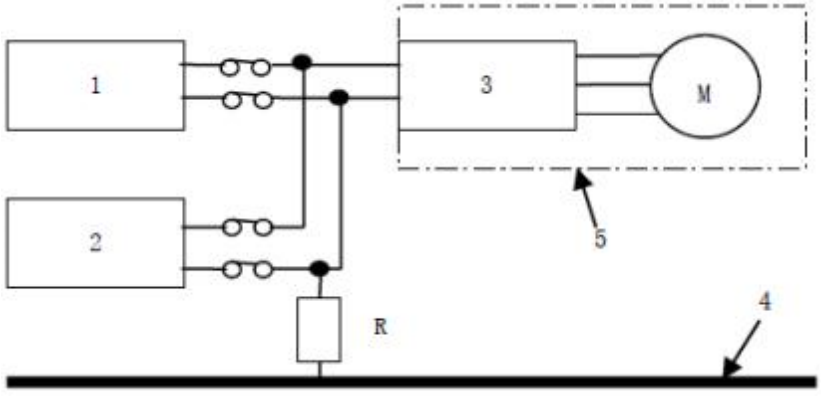
5.1.4.1 Requirements on insulation resistance

Under the maximum working voltage, the value of insulation resistance of DC circuit shall be not less than 100Ω/V; for AC circuit, the value shall be not less than 500Ω/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 500Ω/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 100Ω/V at least.

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

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

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.



Explain:
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

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 be no 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 be not more than 0.1Ω;

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 be not more than 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 circuit, the energy stored in the total capacitor between any voltage class B live part and electrical chassis at its maximum work voltage shall be not 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 form 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 be not less than 1MΩ 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 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 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 protection of functional safety

5.2.1 Power-on/power-off of drive system procedure

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

Only one action is required from the “drivable mode” to the power off state of the drive system.

It is necessary to continuously or intermittently indicate that vehicle is already under “drivable mode” to driver. When the driver leaves vehicle, if the drive system is still in “drivable 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 drive system is automatically or manually closed, it is only possible to re-enter the “drivable mode” through the above-mentioned procedure.

5.2.2 Travel

5.2.2.1 Reminding for power decrease

If electric drive 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 travel.

5.2.2.2 Reminding for low electric quantity of REESS

If the low electric quantity of REESS influences vehicle travel , it is necessary to 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 Switch shifts

5.2.3.1 Switch driving shift

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

5.2.3.2 Reverse travel

If vehicles realize transformation between two travel 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 travel 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 travel directions of forward and reverse is not realized through change of electric motor rotation direction , then reversing travel requirement does not apply.

5.2.4 Parking

The vehicle shall not generate undesirable travel caused by its own electric drive 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 drive system.

5.3 Requirements on traction battery

Safety of electric vehicle traction battery should comply with requirements in GB38031.

5.4 Requirements on vehicle collision protection

Frontal collision protection of electric vehicles should comply with requirements in GB11551, side collision protection should comply with GB 20071, anti-collision of frontal and rear protective devices should comply with GB 17354, roof anti-press strength should comply with GB 26134, post-collision safety of electric vehicle should comply with GB/T31498 .

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 should 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 interface

Charging interface of electric vehicle should 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 should 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 M1 should be equipped with event data recording system (EDR) or onboard video travelling recording device.

5.9 Requirements on electromagnetic compatibility

Electromagnetic compatibility of electric vehicle should comply with requirements in GB34660 and GB/T 18387.

Note: the scope of this clause is consistent with the scope of GB34660 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 complete 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 complete vehicle

6.2.1.1 Test preparation

The internal resistance of voltage testing tool shall be not less than $10M\Omega$. If the insulation monitoring function will influence test of complete 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 is recommended to be 1 MΩ. 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';

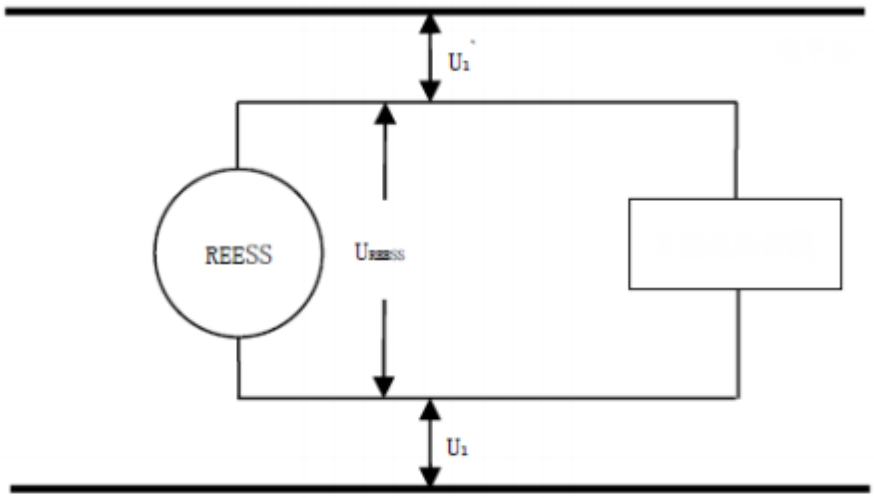


Figure 4 Insulation Resistance Measurement Step b

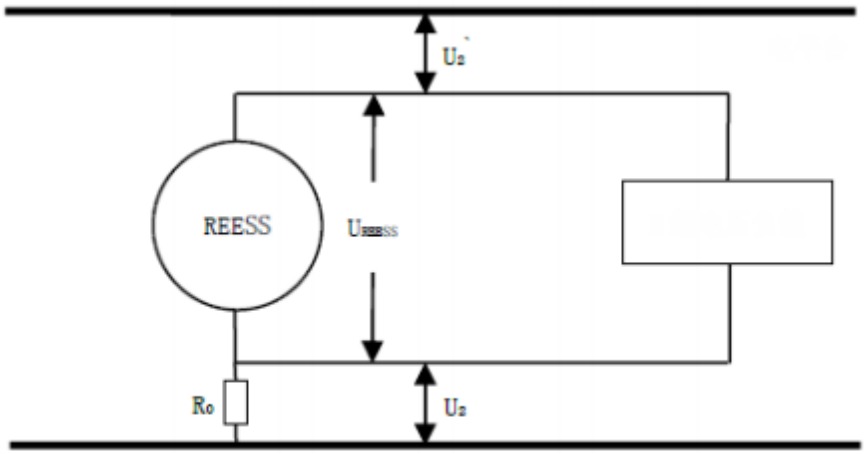


Figure 5 Insulation Resistance Measurement Step c

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):

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

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

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, then the insulation resistance of these components may be measured separately by the maximum working voltage of disconnecting their.

6.2.1.4 Calculation of complete vehicle insulation resistance

For vehicles of which all voltage class B loads are able to work at the sametime, it is permitted to directly measure complete 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 complete vehicle.

If complete 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 complete 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.

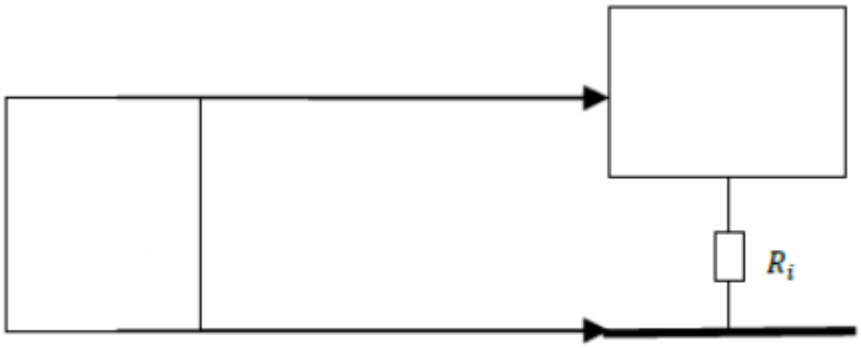


Figure 6 Charging Port Insulation Resistance Measurement Step c

Furthermore, it is also permitted to respectively test the insulation resistance between 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 closed, and insulation monitoring function or equipment shall be activated. Use adjustable resistor (for example: rheostat) in test, and the maximum resistance of adjustable resistor ≥10MΩ .

The measurement steps are as follows:

a) Under normal temperature, in accordance with the test method of 6.2.1, measure the current complete vehicle insulation resistance value R_i and make record for high-voltage side of REESS where smaller measurement voltage U_1' is in test Step b) in 6.2.1.2;

b) Enable vehicle to enter “drivable mode” as per the normal operation procedure of vehicle under test;

c) If U_1' 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_1' 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 100Ω/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:

$$1/\left[1/(95U_{REESS})-1/R_1\right] \le R_x < 1/\left[1/(100U_{REESS})-1/R_1\right] \quad \text{..... (3)}$$

As per the requirements of 5.1.4.1, if the minimum insulation resistance is required to be 500Ω/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:

$$1/\left[1/(475U_{REESS})-1/R_1\right] \le R_x < 1/\left[1/(500U_{REESS})-1/R_1\right] \quad \text{..... (4)}$$

Where:

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

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

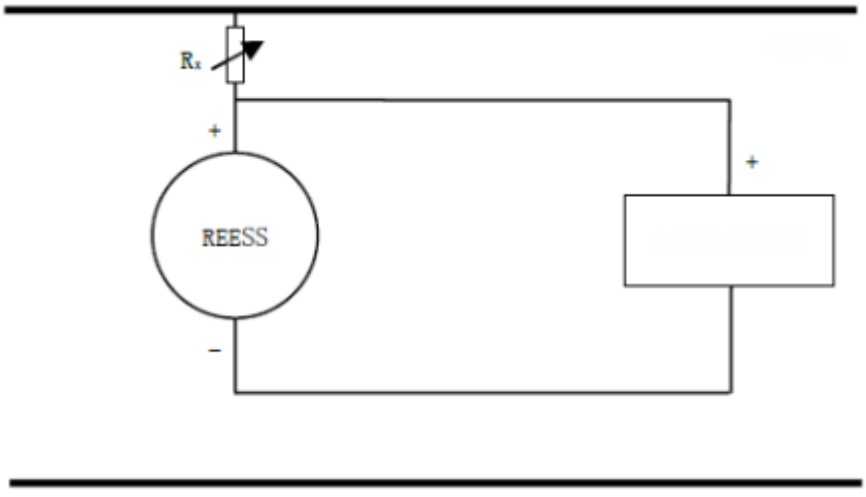


Figure 7 Insulation Monitoring Verification Test

6.2.4 Potential equalization

Balance of potential can 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 0.01Ω. The independent DC supply voltage is also adjustable.

The resistance between two exposed conductive enclosures or barriers can 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.

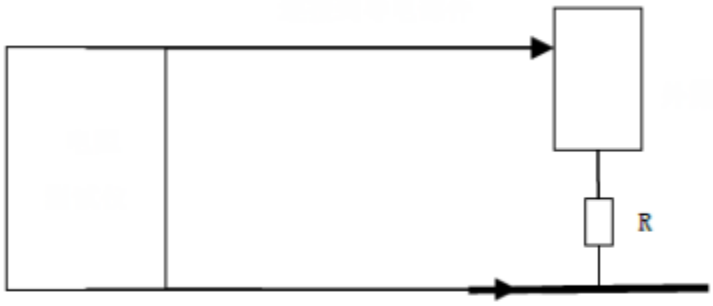


Figure 8 Test the Resistance between Conductive Part and Electrical Chassis by Using Resistance Tester

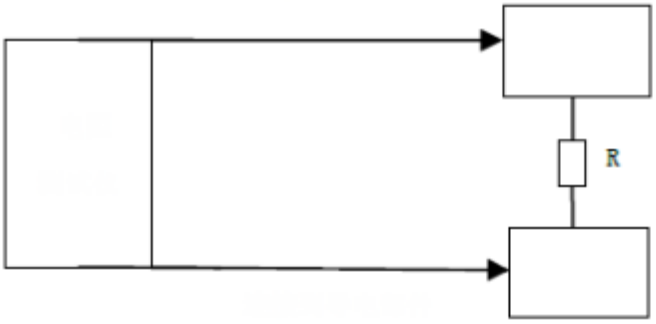


Figure 9 Test the Resistance between Two Conducting Parts by Using Resistance Tester

6.2.5 Capacitance coupling

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

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

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 Complete vehicle waterproof

6.3.1 Simulation of washing

The test scope of this test is the complete 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 12.5L/min±0.5L/min (0.10m/s±0.05m/s), sprinkle water to all boundary lines in all possible directions, the distance between nozzle and boundary line is 3.0m±0.5m.

6.3.2 Simulation of wading

Vehicle shall travel at least for 500m and approximately 1.5min with speed 20km/h±2km/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 Functional safety 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 13th 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 category M1 should be equipped with event data recording system or onboard video travelling 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 repair 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 300mm, 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 300mm 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 complete 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)