



National Standard of the People's Republic of China

GB 38032—2020

Electric buses safety requirements

电动客车安全要求

(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.

All technical provisions in this Standard are compulsory.

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 was proposed and administered by the Ministry of Industry and Information Technology (MIIT) of P. R. China.

Introduction

Based on GB 18384 and GB 38031, this standard is established to further enhance the safety technology level of electric buses, perfect safety requirements and test methods for the special water proof, dust proof, fire proof and rechargeable energy storage system and charge of electric buses.

References are made to the existing standards for conventional buses, and relevant standards for the entire electric motors and parts. The main reference standards include GB/T 31467.3-2015, GB/T 18487.1-2015 and UN GTR No.20.

Electric buses safety requirements

1 Scope

This standard specifies the safety requirements and test methods for the electric buses. This standard is applicable to electric buses of category M_2 and category M_3 , including the battery electric buses and hybrid electric buses. This standard is not applicable to fuel cell electric buses.

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 2408-2008 *Plastics – Determination of burning characteristics – Horizontal and vertical test*

GB/T 4208 *Degrees of protection provide by enclosure (IP code)*

GB 8624-2012 *Classification for burning behavior of building materials and products*

GB/T 10295 *Thermal insulation—Determination of steady-state thermal resistance and related properties – Heat flow meter apparatus*

GB 13094 *The safety requirements for bus construction*

GB/T 15089 *Classification of power-driven vehicles and trailers*

GB 17578 *Requirements and test methods of strength for the superstructure of bus*

GB 18384 *Electric vehicles safety requirements*

GB/T 19596 *Terminology of electric vehicles*

GB 20071-2006 *The protection of the occupants in the event of a lateral collision*

GB/T 31498-2015 *The safety requirement of electric vehicle post crash*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in .GB 13094, GB/T 15089 ,GB/T 19596 and the following apply.

3.1

Minimum management unit of battery system

The minimum battery unit which can be monitored by the battery management system.

4 Safety requirements

4.1 General safety requirements

The general safety of electric buses shall meet the requirements of GB 18384.

4.2 Requirements for water proof and dust proof properties

4.2.1 Requirements for vehicle wading

Carry out the vehicle wading test in accordance with test method specified in 5.1.1. The insulation resistance value of vehicle shall be more than $1\text{M}\Omega$ within 10min after the test.

4.2.2 Requirements for Class B voltage component protection level

Carry out the protection level test in accordance with the test method specified in 5.1.2. The insulation resistance value of the vehicle shall exceed $1\text{M}\Omega$. The protection level of the following components shall not be worse than IP67:

- a) Class B voltage electrical equipment with the lowest point under the compartment floor and above the ground less than 500mm as well as the connectors attached to such components;
- b) Class B voltage electrical equipment mounted on the roof without guard (except for the top contact charging system).

4.2.3 Requirements for vehicle water immersion

Carry out the vehicle water immersion test in accordance with the test method specified in 5.1.3. The vehicle shall no fire and explosion within 2h after the test.

4.3 Requirements for fire proof properties

4.3.1 Requirements for Class B voltage component flame retardant properties

Carry out Class B voltage component flame retardant properties test in accordance with the test method specified in 5.2.1. The flame retardant properties of insulating materials used by Class B voltage components shall meet the provisions of Table 1.

Table 1 Requirements for flame retardant properties of insulating materials used by Class B voltage components

S/N	Components assembly	Components name	Standard requirement	
			Horizontal combustion meeting Level HB specified in GB/T 2408-2008	Vertical combustion meeting Level V-0 specified in GB/T 2408-2008
1	Drive motor system	Housing	√	√
2		Cable insulation layer	√	√
3		PCB	√	√
4		Insulating board	√	√
5		Insulating board	√	—
6		Insulation film	√	—
7	Motor compressor	Housing	√	√
8		Cable insulation layer	√	√

S/N	Components assembly	Components name	Standard requirement	
			Horizontal combustion meeting Level HB specified in GB/T 2408-2008	Vertical combustion meeting Level V-0 specified in GB/T 2408-2008
9	Electric heater	Housing	√	√
10		Cable insulation layer	√	√
11	DC/DC convertor	Housing	√	√
12		Cable insulator	√	√
13		PCB	√	√
14	Switch box	Housing	√	√
15		Cable insulation layer	√	√
16	vehicle inlet	Housing	√	√
17		Cable insulation layer	√	√
18	Thermal shrinkage double wall pipe	Thermal shrinkage double wall pipe (all sizes)	√	√
19	Bellow	Bellow (all sizes)	√	√
Note: "-" means this requirement is not applicable to that part.				

4.3.2 Requirements for flame retardant and heat-insulating properties between the rechargeable energy storage system (or mounting compartment body) and passenger compartment

The flame retardant and heat insulating materials shall be used between the rechargeable energy storage system (or mounting compartment body) and passenger compartment. Carry out the flame retardant and heat insulating properties test in accordance with the test method specified in 5.2.2. The combustion properties of such materials shall meet the Class A requirements specified in GB 8624-2012 and the coefficient of heat conductivity at 300°C shall not exceed 0.04W/(m·k).

4.4 Safety requirements for rechargeable energy storage system

4.4.1 Requirements for thermal runaway of minimum management unit of battery system

Carry out the thermal runaway test in accordance with the test method specified in 5.3.1 for the minimum management unit of battery system. The test object shall no fire and explosion.

4.4.2 Flame retardant requirements for materials of parts inside rechargeable energy storage system

Except the battery itself, the other non-metal parts in the rechargeable energy storage system shall be subject to the flame retardant tests in accordance with the test method specified in 5.3.2. The following requirements shall be met:

a) For the parts meeting any of the following conditions, the materials shall meet the requirements for horizontal combustion HB level and vertical combustion V-0 level:

—Mass of individual parts $\geq 50\text{g}$;

—The total mass of parts of the same model in the individual rechargeable energy storage system $> 200\text{g}$.

b) The materials of rest non-metal parts shall meet the requirements of horizontal combustion HB 75 level and vertical combustion V-2 level.

4.4.3 Isolation requirements for mounting compartment body

The rechargeable energy storage system mounting compartment body shall be isolated from the passenger compartment (except the air introduction devices) to prevent the passengers touching the rechargeable energy storage system. Where the air is introduced from the passenger compartment to regulate the temperature of the rechargeable energy storage system, the introduction port shall be provided with smog control device to prevent the noxious gas generated due to the safety issues of energy storage system entering the passenger compartment from the air inlet.

4.4.4 Requirements for disconnecting device

The rechargeable energy storage system shall be provided with fuse and manual service switch.

4.4.5 Requirements for pressure relief and ventilation device

The rechargeable energy storage system shall be provided with directional pressure relief and pressure balance device. The pressure relief intensity shall not exceed 50kPa .

4.4.6 Requirements for abnormality warning

A thermal event warning signal shall be available 5min prior to hazard occurring in the passenger compartment due to the thermal diffusion caused by the individual battery thermal runaway in the rechargeable energy storage system.

4.5 Safety requirements of control system

4.5.1 Requirements for priority of brake signal

In case the brake signal and accelerating signal occur at the same time in the vehicle control system, only the brake signal shall response.

4.5.2 Requirements for assistance system control during driving

With the vehicle running, if the vehicle abnormal condition requiring the Class B high voltage of vehicle to be disconnected occurs, the steering system shall maintain assistance state or at least maintain steering assistance for 30s with the vehicle speed higher than 5km/h .

4.6 Safety requirements of charging

4.6.1 Safety requirements for charging coupler

In the case of several charging coupler, the charging coupler not under working shall not be live.

4.6.2 Requirements for monitoring of vehicle inlet temperature

The vehicle inlet shall be provided with temperature monitoring device which can send the corresponding signal to the vehicle along with the temperature variation to realize the temperature monitoring and excess temperature protection for the charging coupler.

4.7 Safety requirements for vehicle collision and lateral roll-over

4.7.1 Safety requirements for vehicle collision

Where the lowest point of the rechargeable energy storage system is above the ground less than 1m (with vehicle under no load), carry out the impact test in accordance with the test method specified in 5.5.1. After the test, the vehicle shall meet the requirements of 4.2 to 4.4 of GB/T 31498-2015.

4.7.2 Safety requirements for vehicle lateral roll-over

In case the electric bus upper structure strength test shall be made in accordance with the test method specified in 5.5.2, the state of charge (SOC) of the rechargeable energy storage system shall maintain 30% ~ 50%, and the test shall be made under Class B voltage in live state. After the test, it shall meet the requirements of 4.2 to 4.4 in GB/T 31498-2015.

4.7.3 Exemption clauses for vehicle collision and lateral roll-over test

The vehicles of which the collision safety requirements shall be examined can be regarded as meeting the requirements of 4.7.1 when satisfying either of the following conditions.

a) Compared to the vehicles subject to the impact test, all the following 5 conditions are met at the same time:

- The production enterprise and type of the rechargeable energy storage system (individual or assembly) are the same;
- The rechargeable energy storage system energy is the same or less;
- The compartment body frame is the same or reinforced;
- The compartment body mounting frame is the same or reinforced;

The bodywork structure of battery pack mounting area is unchanged or reinforced (the structure opening sizes are the same or less).

b) Compared to vehicles subject to impact test and no mechanical damage on battery pack after the test, the following conditions are met:

- The bodywork structure of battery pack mounting area is unchanged or reinforced (the structure opening sizes are the same or less).

5 Test method

5.1 Water proof and dust proof

5.1.1 vehicel wading test

In a pond of 300mm deep, drive the vehicle at the speed of 5km/h ~ 10km/h for 500m within 3min ~ 6min; if the pond length is less than 500m, repeat the test to ensure the accumulative wading length is not less than 500m while the test duration including the vehicle out of the pond shall be less than 10min.

Carry out the insulation resistance test in accordance with the insulation measurement method specified in GB 18384.

5.1.2 Test for Class B voltage component protection level

Carry out the protection level test in accordance with the provisions of GB/T 4208 and after the test, carry out the insulation resistance test in accordance with the insulation measurement method specified in GB 18348.

5.1.3 vehicel water immersion test

With Class A and Class B volt circuit disconnected, soak the vehicle in the 500mm deep pond for 24h.

5.2 Fire proof properties

5.2.1 Test for Class B voltage component flame retardant property

Test the horizontal combustion and vertical combustion in accordance with the provisions specified in GB/T 2408-2008.

5.2.2 Test for flame retardant and heat-insulating properties between the rechargeable energy storage system (or mounting compartment body) and passenger compartment

Test the combustion property in accordance with GB 8624 - 2012 and coefficient of heat conductivity in accordance with GB/T 10295.

5.3 Safety requirements for rechargeable energy storage system

5.3.1 Test for thermal runaway of minimum management unit of battery system

Carry out the thermal runaway test in accordance with the provisions of Annex A.

5.3.2 Flame retardant test for materials of parts inside rechargeable energy storage system

Test the horizontal combustion and vertical combustion in accordance with the provisions specified in GB/T 2408-2008.

5.4 Safety function protection

The manufacturer shall provide the specific proposal and description according to the functional protection requirements specified in 4.4.3, 4.4.4, 4.4.5, 4.5 and 4.6. The testing body shall verify on the parts or the real vehicle basing on such description and determine the compliance.

5.5 Safety for vehicle collision and lateral roll-over

5.5.1 Vehicle collision safety test

Carry out the vehicle collision safety test in accordance with the provisions of Annex B.

5.5.2 Vehicle lateral roll-over safety test

Carry out the upper structure strength test in accordance with the provisions of GB 17578.

6 Implementation date

For the new type approval application models, it shall be implemented from the date of this standard implementation; for the approved models, it shall be implemented from the 13th month after the date of this standard implementation.

A n n e x A

(normative)

Thermal runaway test method

A.1 Test subject

The test object is the minimum management unit of battery system.

A.2 Test method

A.2.1 The test ambient temperature shall be $22^{\circ}\text{C} \pm 5^{\circ}\text{C}$, the relative humidity shall be 15% ~ 90% and the barometric pressure shall be 86kPa ~ 106kPa.

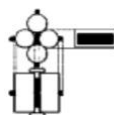
A.2.2 Use the plane or bar heating unit and cover its surface with the ceramics, metal or insulation layer. For the power requirement of heating unit, refer to Table A.1. Set up the test object and heating unit and ensure the heating unit directly contacts the battery cell. The dimensions of heating unit shall not exceed the surface under heating of the test object; install the temperature monitoring device and arrange the monitoring point temperature sensor on the side far from the heat conduction, that is, the offside of heating unit, as shown in Figure A.1. The sampling interval of temperature data shall be less than 1s, the accuracy shall be $\pm 2^{\circ}\text{C}$ and the diameter of the temperature sensor points shall be less than 1mm.

TableA.1 Heating unit power selection

Test object electric energy E_{wh}	Heating unit maximum power W
$E < 100$	30~300
$100 \leq E < 400$	300~1000
$400 \leq E < 800$	300~2000
$E \geq 800$	>600



a) Hard shell and pouch battery



b) Cylindrical battery-I



c) Cylindrical battery-II

Explanation:



—Heating unit



—Heating unit (resistance wire)



—Temperature monitor

FigureA.1 Layout and position sketch of temperature sensor up on heating activation

A.2.3 Charge the test object to 100% SOC, and continue charging for 12min with the 1C charging current. Immediately start the heating unit to heat the test object at the maximum

power. When the thermal runaway occurs or the monitoring point temperature defined in A.2.2 reaches 300°C, stop the activation and shut down the heating unit.

A.2.4 The judgment conditions for thermal runaway test are as follows:

- a) The test object shows voltage drop, exceeding 25% of initial voltage;
 - b) The monitoring point temperature reaches the maximum working temperature specified by the battery manufacturer;
 - c) The monitoring point temperature rise rate $dT/dt \geq 1^\circ \text{C/s}$ for more than 3s continuously.
- The thermal runaway can be determined when a) and c) or b) and c) occur.

A.2.5 During the heating and within 1h after the heating, terminate the test if the fire or explosion occurs.

A n n e x B
(normative)
Collision test method

B.1 Testing ground

The testing ground shall allow the installation of the movable barrier drive system, vehicle under test movement and test equipment after collision. The ground for the vehicle collision and movement shall be horizontal and level, and the road friction coefficient shall not be less than 0.5.

B.2 Vehicle preparation before test

B.2.1 The rechargeable energy storage system SOC shall be regulated to 30% ~ 50%. For pure electric bus, the vehicle shall be powered on; for hybrid bus, the vehicle can be powered under low voltage.

B.2.2 The test vehicle shall be in kerb weight status.

B.2.3 The windows shall be closed while the doors shall be closed without locking.

B.2.4 The transmission shall be in neutral gear and the parking brake shall be released.

B.2.5 The tire pressure shall be adjusted to the value specified by the tire manufacturer.

B.2.6 The axle of test vehicle shall be horizontal.

B.3 Test conditions

B.3.1 The test vehicle shall maintain stationary.

B.3.2 The characteristics of movable and deformable barrier shall meet the requirements of Annex C to GB 20071-2006. The movable and deformable barrier shall be equipped with appropriate device to avoid the secondary collision against the test vehicle.

B.3.3 During the test, the movable and deformable barrier shall impact the weakest position of the vehicle. (The weakest position mainly considers the traction battery installation and vehicle protection conditions. Where the vehicle side is equipped with traction battery, the vehicle side collision is preferred. This shall be determined by the testing body and manufacturer.)

B.3.4 The longitudinal median plane trace of the movable and deformable barrier shall be perpendicular to the longitudinal median plane of vehicle under collision.

B.3.5 At the moment of collision, ensure the up-and-down deviation of position determined by the barrier front surface upper edge and lower edge on the horizontal median plane before and after the test is within $\pm 25\text{mm}$.

B.3.6 At the moment of collision, ensure the lateral deviation of position determined by the barrier front surface left edge and right edge on the vertical median plane before and after the test is within $\pm 25\text{mm}$.

B.4 Test speed

At the moment of collision, the barrier rate shall be $50\text{km/h} \pm 1\text{km/h}$, which shall be stable within 0.5m prior to collision at least. The accuracy of measuring apparatus shall be 1% . It shall be acceptable if the test is made at the higher impact speed while the vehicle meets the requirements of 4.7.1.

References

- [1]GB/T 18487.1-2015 Electric vehicle conductive charging system Part 1: General requirements
 - [2]GB/T 31467.3 - 2015 Lithium-ion traction battery pack and system for electric vehicles - Part 3: Safety performance requirements and test methods
 - [3]GB 38031 Safety requirements for traction battery of electric vehicle
 - [4]UN GTR No.20 Electric Vehicle Safety (EVS) (ECE/TRANS/180/Add.20)
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