



中国电动汽车火灾安全指数
CHINA ELECTRIC VEHICLE FIRE SAFETY INDEX

China Electric Vehicles Fire Safety Index

(Version 2026)

Testing and Evaluation Protocol for Thermal Propagation Protection Performance



中国电动汽车火灾安全指数
CHINA ELECTRIC VEHICLE FIRE SAFETY INDEX

Published and implemented on January 19, 2026

Table of Contents

1 Scope	1
2 Normative References	1
3 Terms and Definitions	1
4 Test Conditions	2
4.1 Site and environment	2
4.2 Equipment and facilities	2
4.3 VUT	3
4.4 Thermal runaway triggering mode	3
5 Test Preparation	3
5.1 Vehicle preparation	3
5.2 Preparation of test system	3
6 Test Method	4
6.1 Verification test of emergency door release function	4
6.2 Vehicle thermal propagation test	4
7 Evaluation Methods	5
7.1 Testing and evaluation items and indicators	5
7.2 Score calculation method	6
7.3 Evaluation results	7
Annex A Method for Triggering Thermal Runaway of Battery	8
Annex B Information Confirmation Before Vehicle Thermal Propagation Test	9
Annex C Verification Method for Door Opening and Closing Functions	11
Annex D Information Confirmation After Vehicle Thermal Propagation Test	12

1 Scope

This document specifies the testing and evaluation methods for thermal propagation of electric vehicles.

This document is applicable to M₁ and N₁ electric vehicles, including battery electric vehicles and hybrid electric vehicles.

This document is not applicable to fuel cell electric vehicles.

2 Normative References

The following normative documents contain provisions which, through reference in this text, constitute indispensable provisions of this document. For dated references, only the dated edition applies to this document. For undated references, the latest edition (including all amendments) applies to this document.

GB/T 4780 Terms for Motor Vehicle Body

GB/T 15089 Classification of Power-driven Vehicles and Trailers

GB/T 19596 Terminology of Electric Vehicles

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 4780, GB/T 15089, GB/T 19596, GB 38031, GB/T 16172 and GB/T 5169.22-2015 and the following apply.

3.1 emergency door release function

a stationary vehicle considered to have the emergency door release function when all high and low voltage electricity are disconnected and the door switch can be operated to open the door

3.2 dangerous state

a state that threatens the safety of drivers, passengers and the vehicle itself. In the event of one or more of the following situations, the vehicle can be judged to be in a dangerous state:

- (1) Battery pack explosion;
- (2) Fire outside the vehicle;
- (3) Fire inside the vehicle;
- (4) Carbon monoxide concentration in the passenger compartment > 600 ppm;
- (5) Visible smoke in the vehicle;
- (6) Oxygen concentration in the passenger compartment $\leq 19.5\%$;
- (7) Temperature rise at any temperature monitoring point in the vehicle greater than 35 K.

3.3 heat alert

alarm information sent from inside the passenger compartment when the battery temperature is significantly higher than the maximum operating temperature (defined by the manufacturer), usually in the form of one or a combination of acoustic signals and optical signals

3.4 thermal runaway alarm

alarm information sent from inside the passenger compartment in case of battery thermal runaway, usually in the form of acoustic and optical signals and text

3.5 thermal runaway warning outside the vehicle

warning information sent from outside the vehicle in case of battery thermal runaway, usually

in the form of one or a combination of turning on the hazard warning lamp, turning on the headlamp and sounding the horn

3.6 thermal runaway alarm time

time elapsed from the thermal runaway triggering stopping (see A.3 of Annex A for the triggering stopping conditions) to the vehicle thermal runaway alarm, expressed as t_1

3.7 available safety egress time

time elapsed from the vehicle sending the thermal runaway alarm signal to the vehicle entering a dangerous state, expressed as t_2

3.8 emergency response time

time elapsed from the vehicle sending the thermal runaway alarm signal to the regulatory platform actively contacting the vehicle or owner through text messages, phone calls or APPs, expressed as t_3

4 Test Conditions

4.1 Site and environment

- a) The test shall be carried out in a professional fire test room, with internal dimensions of not less than 20 m×20 m×20 m;
- b) The test room shall be equipped with a fresh air system;
- c) The test room shall be equipped with a smoke treatment system, with an exhaust air volume ≥ 230000 m³/h;
- d) The test room shall have the capacity for sewage collection;
- e) The test room shall be equipped with complete fire-fighting facilities;
- f) During the test, a safe distance and isolation measures shall be set between personnel and the vehicle under test (VUT);
- g) The initial ambient temperature of the test is $> 0^\circ\text{C}$, the relative humidity is 10% ~ 90%, the atmospheric pressure is 86 kPa~106 kPa, and the wind speed is ≤ 2.5 km/h.

4.2 Equipment and facilities

4.2.1.1 Accuracy of instruments and meters

The accuracy of measuring instruments and meters shall at least meet the following requirements:

- a) Voltage measuring device: $\pm 5\%$ FS;
- b) Temperature measuring device: $\pm 0.5^\circ\text{C}$;
- c) Time measuring device: $\pm 0.1\%$ FS;
- d) Gas concentration measuring device: $\pm 5\%$ FS.

4.2.1.2 Measurement process error

The requirements for the error between the control value (actual value) and the target value are as follows:

- a) Voltage: $\pm 1\%$;
- b) Temperature: $\pm 2^\circ\text{C}$;
- c) Gas concentration: $\pm 2\%$ RH.

4.2.1.3 Data recording and recording interval

Unless otherwise specified, the recording interval of test data during the test shall be ≤ 1 s.

4.3 VUT

- a) The SOC of the traction battery shall not be lower than 95% of the normal operating SOC range specified by the manufacturer;
- b) For hybrid vehicles, the fuel tank shall be drained;
- c) The auxiliary battery shall be fully charged;
- d) The vehicle is powered off;
- e) The vehicle communication is normal, and the system is normal without fault alarms (except for fuel tank level faults);
- f) During the test, all doors, windows and the sunroof are closed and locked (the child safety lock is unlocked). For vehicles with a window lowering strategy after thermal runaway, the window lowering function needs to be disabled;
- g) The lighting, signal devices and other auxiliary equipment of the vehicle are turned off, and the A/C system is in internal circulation and turned off;
- h) The vehicle seat is centered fore and aft, the backrest is centered, the headrest is centered up and down and the steering wheel is centered;
- i) The tyre pressure is adjusted to the value specified by the manufacturer;
- j) All components not otherwise specified shall remain in their factory state;
- k) Except for test needs, no items other than those originally equipped for the vehicle shall be placed in the vehicle;

4.4 Thermal runaway triggering mode

See Annex A for details of the triggering mode.

5 Test Preparation

5.1 Vehicle preparation

The vehicle state is adjusted according to 4.3.

5.2 Preparation of test system

5.2.1 Battery thermal runaway triggering device

Set the battery thermal runaway triggering device according to Annex A.

5.2.2 Data acquisition system

Arrange the sensors as specified in Fig. 1 and Table 1. The monitoring points are defined as follows:

- a) A_1 , A_2 and A_3 are respectively the front of seat headrest, the front center of seat backrest and the center of upper surface of seat;
- b) Point B is the floor in front of the seat and above the battery pack;
- c) Point C is the center of the steering wheel;
- d) Point D is the center above the dashboard;
- e) Point E is the center of the interior roof.

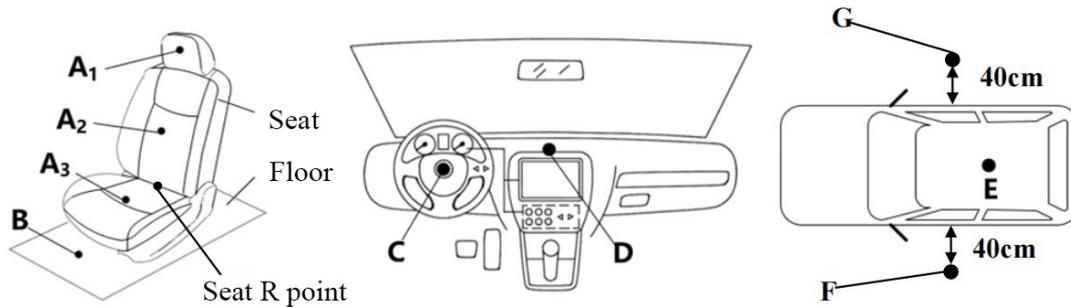


Fig. 1 Monitoring Points

Table 1 Sensor Type and Layout Requirements

S/N	Monitoring Data Type	Layout	Quantity (Units)
1	Temperature	Monitoring points A ₁ , A ₂ , A ₃ and B of all seats	1 for each
		Monitoring points C, D and E inside the passenger compartment	3
2	In-vehicle video	The positions where the instrument, floor, seat and door can be observed inside the vehicle, and the overall situation of the battery pack and vehicle body can be observed outside the vehicle.	To be determined as required
3	Exterior video	The positions around the vehicle body where all angles of the vehicle body and the surrounding environment of the vehicle can be observed	4
4	Vehicle bottom video	The positions underneath the vehicle where the sensor is positioned and oriented upwards to allow for observation of the vehicle bottom	2
5	Smoke sensor	Monitoring point A ₁ in the rear row of driver's seat and front passenger's seat	1 for each
6	Radiant heat flux meter	F and G monitoring points 30 cm away from the test platform and 40 cm away from the vehicle body	1 for each

5.2.3 Soaking

Before the test, soak the vehicle at 25°C±5°C for 12 h.

6 Test Method

6.1 Verification test of emergency door release function

6.1.1 Tester A sits in the vehicle, closes the door and locks it manually.

6.1.2 Turn off the vehicle power supply.

6.1.3 Tester B disconnects the positive and negative poles of the auxiliary battery from the vehicle.

6.1.4 For a vehicle equipped with independent mechanical emergency door switches, the in-vehicle tester pulls all independent mechanical door emergency switches in turn; for a vehicle not equipped with independent mechanical emergency door switches, the in-vehicle tester pulls the regular switches of all doors in turn no less than twice.

6.1.5 Check whether the door can be opened normally.

6.2 Vehicle thermal propagation test

6.2.1 Check the parameters and configuration of the VUT according to Annex B, and confirm the test conditions and vehicle state.

6.2.2 Start the test equipment as follows

- a) Turn on all lighting equipment and close the entrance and exit of the test room;
- b) Start the smoke treatment system and fresh air system in the test room;
- c) Turn on the data acquisition system and confirm that all data acquisition and recording are normal and synchronized.

6.2.3 The battery thermal runaway shall be triggered according to the method in Annex A.

6.2.4 Observe the test data in real time and judge when the vehicle enters a dangerous state.

6.2.5 If the vehicle enters a dangerous state within 5 min after thermal runaway alarm occurs, verify the door opening and closing functions within 10 s after the vehicle enters the dangerous condition; if the vehicle does not enter a dangerous state within 5 min after thermal runaway alarm occurs, verify the door opening and closing functions 5 min after thermal runaway alarm occurs. See Annex C for the verification method for door opening and closing functions.

6.2.6 After the thermal runaway alarm occurs, keep the vehicle still in the test environment and observe for at least 120 min, and observe and record the vehicle state and re-ignition in real time.

6.2.7 After the vehicle temperature drops to room temperature, confirm the vehicle state, disassemble and analyze the vehicle and battery pack, and check the vehicle state and test room interior after the test according to Table D.1.

6.2.8 The test ends.

7 Evaluation Methods

7.1 Testing and evaluation items and indicators

The test shall be conducted according to Chapter 6 of this document, and the vehicle safety shall be scored according to Table 2.

Table 2 Detailed Rules for Comprehensive Scoring

Level-I Indicator	Level-II Indicator	Evaluation Content	Score	Full Score	Weight
Safety prompt	Battery pack heat alert	Visual warning	10	20	20%
		Audible warning, duration > 10 s	10		
	Interior alarm for thermal runaway	Text alarm	15	40	
		Audible alarm, duration > 20 s	15		
		Symbol alarm	10		
	Thermal runaway alarm time t_1	$t_1 \leq 60$ s	30	30	
		$60 < t_1 \leq 300$ s	15		
		$t_1 > 300$ s	0		
Thermal runaway warning outside the vehicle	Warning	10	10		
Emergency rescue	Safety egress	Normal door opening from inside after thermal runaway	30	100	30%
		Normal door opening from outside after thermal runaway	30		
		Emergency release function for all doors	10		
		Clear marking for emergency switch or with color different from that of the door trim panel	10		
		Emergency switch not blocked by internal components	10		

Testing and Evaluation Protocol for Thermal Propagation Protection Performance

Level-I Indicator	Level-II Indicator	Evaluation Content	Score	Full Score	Weight
		All emergency switches arranged in front of the seat R point	10		
Fire protection	Available safety egress time t_2 (min)	$t_2 > 30$	25	25	40%
		$20 < t_2 \leq 30$	20		
		$10 < t_2 \leq 20$	10		
		$5 < t_2 \leq 10$	5		
		$t_2 \leq 5$	0		
	Thermal propagation protection of battery pack	No thermal propagation	20	20	
		Number of thermal propagation cells $n=1$	15		
		Number of thermal propagation cells $n=2$	10		
		Number of thermal propagation cells $n>2$	0		
	Fire safety	No battery pack explosion	15	50	
		No fire outside the vehicle	10		
		No fire in the vehicle	10		
		Temperature rise at interior monitoring point ≤ 10 K	15		
		$10 \text{ k} <$ temperature rise of interior monitoring point ≤ 35 K	5		
		Temperature rise at interior monitoring point > 35 K	0		
Explosion debris splash distance L_{sd} (m)	$L_{sd} \leq 1$	2	2		
	$1 < L_{sd} \leq 4$	1			
	$L_{sd} > 4$	0			
Radial heat flow density H (kW/m^2)	$H \leq 10$	3	3		
	$10 < H \leq 15$	2			
	$15 < H \leq 50$	1			
	$H > 50$	0			
Smoke control	Carbon monoxide concentration C_{CO} (ppm) within 5 min after thermal runaway	$C_{CO} \leq 100$	40	40	
		$100 < C_{CO} \leq 600$	25		
		$C_{CO} > 600$	0		
	Oxygen concentration C_{O_2} (ppm) within 5 min after thermal runaway	$CO_2 > 19.5\%$	30	30	
		$CO_2 \leq 19.5\%$	0		
Smoke concentration in the vehicle within 5 min after thermal runaway	No visible smoke	30	30		
Data linkage	Emergency response time t_3 (min)	$t_3 \leq 3$	100	100	5%
		$3 < t_3 \leq 5$	50		
		$t_3 > 5$	0		

7.2 Score calculation method

The comprehensive score is the weighted sum of the scores of 5 testing and evaluation dimensions: safety prompt, emergency rescue, fire protection, smoke control and data linkage, represented by S_1 .

$$S_1 = \sum_1^5 (s_i \times w_i)$$

Where,

S_1 - comprehensive score;

s_i - score of the i^{th} item;

w_i - weight of the i^{th} item.

7.3 Evaluation results

The evaluation results are divided into five grades, as detailed in Table 3.

Table 3 Evaluation Results and Score Distribution

Evaluation results	Score
★★★★★	$S \geq 90$
★★★★	$80 \leq S < 90$
★★★	$70 \leq S < 80$
★★	$60 \leq S < 70$
★	$S < 60$



中国电动汽车火灾安全指数

CHINA ELECTRIC VEHICLE FIRE SAFETY INDEX

Annex A Method for Triggering Thermal Runaway of Battery

A.1 Trigger object of thermal runaway

The battery cell close to the temperature acquisition point in the battery pack.

A.2 Trigger method of thermal runaway

A.2.1 Nail penetration at the bottom of vehicle

After identifying the trigger object, an opening is made in the bottom protective plate of the vehicle, directly facing the trigger object. The size of the opening shall not be smaller than the diameter of the steel nail. The VUT is placed on the bottom nail penetration platform and secured to prevent movement. The bottom nail penetration module is then adjusted accordingly. A $\phi 6\sim\phi 8$ mm flat-head high-temperature-resistant steel nail is used to penetrate the trigger object at a speed of 0.1~3 mm/s in a direction perpendicular to the internal lamination of the battery cell until thermal runaway occurs in the trigger object. The steel nail remains inserted in the trigger object until the test ends.

A.2.2 Other methods

Other methods (e.g., heating, ball impact on the bottom of the vehicle, battery overcharging, etc.) may be used to trigger thermal runaway of the battery.

A.3 Criteria for determining when to stop nail penetration or heating

- a) The explosion-proof valve of the battery pack opens or releases smoke;
- b) The vehicle issues a thermal runaway alarm.

Triggering shall stop when either condition a) or b) occurs.

Annex B Information Confirmation Before Vehicle Thermal Propagation Test

Table B.1 Test Conditions and Test Equipment

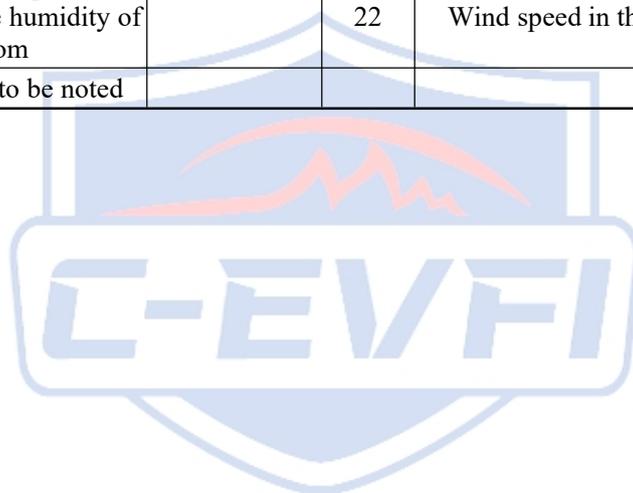
Environmental Conditions	Temperature: ____; relative humidity: ____; atmospheric pressure: ____; wind speed: ____.
Test Equipment State	Is the smoke treatment system normal: <input type="checkbox"/> Yes <input type="checkbox"/> No, abnormal situation: _____.
	Is the air supply system normal: <input type="checkbox"/> Yes <input type="checkbox"/> No, abnormal situation: _____.
	Is the fire extinguishing system normal: <input type="checkbox"/> Yes <input type="checkbox"/> No, abnormal situation: _____.
	Are the crane and lifting appliance normal: <input type="checkbox"/> Yes <input type="checkbox"/> No, abnormal situation: _____.
	Is the test room lighting normal: <input type="checkbox"/> Yes <input type="checkbox"/> No, abnormal situation: _____.
	Is the test bench normal: <input type="checkbox"/> Yes <input type="checkbox"/> No, abnormal situation: _____.
	Is the data acquisition system normal: <input type="checkbox"/> Yes <input type="checkbox"/> No, abnormal situation: _____.
	Is other test equipment normal: <input type="checkbox"/> Yes <input type="checkbox"/> No, abnormal situation: _____.

Table B.2 Vehicle Information

Basic Vehicle Information	Brand:
	Vehicle model:
	Production date:
	Body color:
	Vehicle identification number (VIN):
	Vehicle mileage:
	Model of traction battery system:
	Manufacturer of traction battery system:
	Model of drive motor:
	Model of motor controller:
	Factory certificate No. of the motor vehicle:
	Vehicle appearance:
Vehicle State	Battery system SOC value:
	Vehicle start state:
	Gear:
	Are the emergency lamps and alarm devices of the vehicle normal:
	ON/OFF condition of vehicle auxiliary equipment: <input type="checkbox"/> A/C off, <input type="checkbox"/> lamps off, <input type="checkbox"/> other auxiliary equipment off.
	Other functions to be tested: __, normal or not: <input type="checkbox"/> Yes <input type="checkbox"/> No.

Table B.3 Vehicle and Site Photos before Test

S/N	Shooting Direction	Confirmation	S/N	Shooting Direction	Confirmation
1	Front view of vehicle		2	45° left front view of the vehicle	
3	Left side view of the vehicle		4	45° left rear view of the vehicle	
5	Rear view of the vehicle		6	45° right rear view of the vehicle	
7	Right side view of the vehicle		8	45° right front view of the vehicle	
9	Vehicle chassis view		10	Top view of the vehicle	
11	Central console		12	Front seats	
13	Rear seats		14	Trunk	
15	Front engine compartment		16	Instrumentation	
17	Nameplate		18	VIN	
19	Factory certificate of the motor vehicle		20	Overall situation of the test room	
21	Temperature, atmospheric pressure and relative humidity of the test room		22	Wind speed in the test room	
23	Other information to be noted				



中国电动汽车火灾安全指数
CHINA ELECTRIC VEHICLE FIRE SAFETY INDEX

Annex C Verification Method for Door Opening and Closing Functions

C.1 Verification devices for door opening and closing functions

C.1.1 The installation method of the verification device for external door opening and closing functions is shown in Fig. C.1. The tension device is fixed on the ground of the test room through a column and a fixing plate, the height of the tension device above the ground is the same as that of the door handle, and the steel pull rope is perpendicular to the door handle. During the test, the tester controls the tension device to apply a force of ≥ 50 N to the door handle through the steel pull rope for ≥ 3 s, with a tensile stroke not less than the maximum stroke of the door handle.

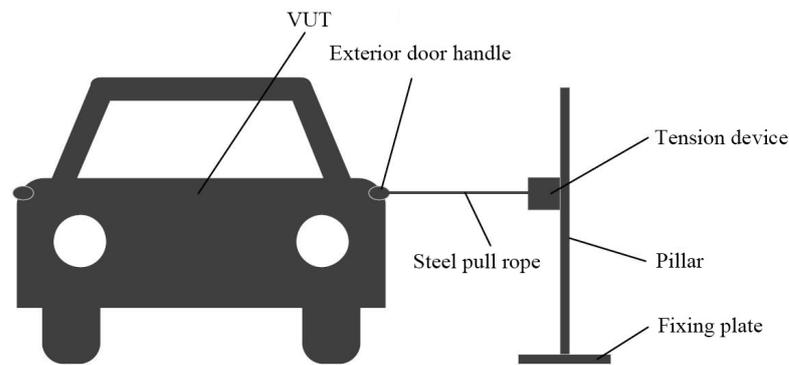


Fig. C.1 Verification Device for Exterior Door Lock Function and Its Installation Method

C.1.2 The verification device for internal door opening and closing functions consists of a door unlocking device and a door thrust application device. It is installed and adjusted according to the actual structure of the vehicle. The door unlocking device applies a tensile force or pressure of ≥ 30 N to the door unlocking handle or button for ≥ 3 s, with a tensile or pressure stroke not less than the maximum stroke of the door lock handle or button; the door thrust application device applies a thrust of ≥ 50 N to the door. During the test, the tester controls the door unlocking device and the door thrust application device to verify the door opening and closing functions.

C.2 Verification sequence and judgment method of door opening and closing functions

First, verify the door opening and closing function from outside the vehicle. If the door can be opened normally, it is determined that the door can be properly opened from both outside and inside. If the door cannot be opened from outside, then verify the door opening function from inside. If the door can be opened normally from inside, it is determined that the door can be opened properly from inside but not from outside. If the door cannot be opened normally, it is determined that the door cannot be opened properly from either inside or outside the vehicle.

Annex D Information Confirmation After Vehicle Thermal Propagation Test

Table D.1 Vehicle and Site Photos After Test

S/N	Shooting Direction	Confirmation	S/N	Shooting Direction	Confirmation
1	Front view of vehicle		2	45° left front view of the vehicle	
3	Left side view of the vehicle		4	45° left rear view of the vehicle	
5	Rear view of the vehicle		6	45° right rear view of the vehicle	
7	Right side view of the vehicle		8	45° right front view of the vehicle	
9	Vehicle chassis view		10	Top view of the vehicle	
11	Central console		12	Front seats	
13	Rear seats		14	Trunk	
15	Front engine compartment		16	Overall appearance of the battery pack	
17	Inside the battery pack		18	Other vehicle details to be noted	
19	Overall situation of the test room		20	Other test room information to be noted	



中国电动汽车火灾安全指数
CHINA ELECTRIC VEHICLE FIRE SAFETY INDEX