



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 Charging Safety Performance



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

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1 Scope

This document specifies the testing and evaluation methods for charging safety of electric vehicles.

This document is applicable to M₁ and N₁ electric vehicles, including battery electric vehicles and plug-in 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 18487.1 Electric Vehicle Conductive Charging System - Part 1: General Requirements

GB/T 19596 Terminology of Electric Vehicles

GB/T 20234.1 Connection Set for Conductive Charging of Electric Vehicles - Part 1: General Requirements

GB/T 27930 Digital Communication Protocols between Off-board Conductive Charger and Electric Vehicle

GB/T 27930.2 Digital Communication Protocols Between Off-board Conductive Charger and Electric Vehicle - Part 2: Communication Protocols for GB/T 20234.3

GB/T 43332 Safety Requirements of Conductive Charging and Discharging for Electric Vehicles

GB 44263 Safety Requirements for Electric Vehicle Conductive Charging System

GB 44495 Technical Requirements for Vehicle Cybersecurity

3 Terms and Definitions

For the purposes of this document, the following terms and definitions and those defined in GB/T 18487.1, GB/T 19596, GB/T 20234.1, GB/T 27930, GB/T 27930.2, GB/T 43332, GB 44263 and GB 44495 apply.

3.1 virtual simulation charging safety

the capability of a vehicle to ensure safety during charging through fault simulation and injection techniques

3.2 charging compatibility safety

the capability to ensure the safety of drivers and passengers while maintaining compatibility with various charging equipment

3.3 charging safety under extreme conditions

the capability to perform normal charging and ensure the safety of drivers and passengers under extreme environmental conditions, system states, or external stresses

3.4 charging information security

the capability of a vehicle's charging system to be protected from threats

4 Test Conditions

4.1 Site and environment

The test shall be conducted in a professional charging test room, which shall meet the

following requirements:

- 1) The test room shall be equipped with a temperature regulation system;
- 2) The test room shall be equipped with adequate fire protection facilities;
- 3) During the test, a sufficient safety distance shall be maintained between the test personnel and the vehicle under test (VUT);
- 4) The ambient temperature is $>0^{\circ}\text{C}$, the relative humidity is 10%~90%, and the atmospheric pressure is 86 kPa~106 kPa.

4.2 Equipment and facilities

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

- 1) Voltage measuring device: $\pm 0.5\%$ FS;
- 2) Current measuring device: $\pm 0.5\%$ FS;
- 3) Time measuring device: For measurement durations > 1 s, the relative error shall not exceed 0.5%; for measurement durations ≤ 1 s, the relative error shall not exceed 0.1%.

4.3 VUT

- 1) The traction battery SOC shall meet the requirements of the corresponding test section;
- 2) The auxiliary battery shall be fully charged;
- 3) Vehicle communication and system operation shall be normal, with no fault alarms;
- 4) All other components not mentioned above shall remain in their factory state.

5 Test Preparation

5.1 Vehicle preparation

The vehicle state shall be adjusted in accordance with the specifications of Clause 4.3.

5.2 Preparation of test system

Before the test, all equipment shall be calibrated in accordance with the specified requirements. After stable operation of the equipment for 5 min, the test may begin.

6 Test Method

6.1 Virtual simulation charging safety test

6.1.1 Current fault test

- 1) Adjust the vehicle SOC to $\text{SOC} < 80\%$;
- 2) Connect the VUT to the test system and Initiate charging;
- 3) Allow the test equipment to simulate the charging pile outputting an actual current that exceeds the vehicle's required current by 30%;
- 4) Monitor the vehicle status in real time in accordance with the evaluation content of current faults in the virtual simulation charging safety section specified in the scoring details of Table 1.

6.1.2 Communication fault test

6.1.2.1 Adjust the vehicle SOC to $\text{SOC} < 80\%$.

6.1.2.2 S+ to PE short circuit before charging

- 1) Before charging, use the charging simulation test equipment to simulate an S+ to PE short circuit;

2) Initiate charging and monitor the vehicle status in real time in accordance with the evaluation content of communication faults in the virtual simulation charging safety section of the scoring details in Table 1.

6.1.2.3 S+ to PE short circuit during charging

1) Initiate charging and simulate the short circuit of S+ to PE by means of the charging simulation test equipment during the charging process;

2) Monitor the vehicle status in real time in accordance with the evaluation content of communication faults in the virtual simulation charging safety section of the scoring details in Table 1.

6.1.2.4 S+/S- open circuit before charging

1) Simulate the open circuit of S+ and S- separately by means of the charging simulation test equipment before charging;

2) Initiate charging and monitor the vehicle status in real time in accordance with the evaluation requirements for communication faults in the virtual simulation charging safety section of the scoring details in Table 1.

6.1.2.5 S+/S- open circuit during charging

1) Initiate charging and simulate the open circuit of S+ and S- separately by means of the charging simulation test equipment during the charging process;

2) Monitor the vehicle status in real time in accordance with the evaluation content of communication faults in the virtual simulation charging safety section of the scoring details in Table 1.

6.1.3 Overcharge fault test

6.1.3.1 DC overcharge fault test

1) Adjust the vehicle SOC to $SOC \geq 97\%$;

2) Connect the test system and initiate DC charging;

3) When the SOC of VUT reaches 100% or meets the full-charge conditions set by the manufacturer, the charging test system shall ignore the stop-charging command sent by the vehicle and continue charging for a duration of more than 10 seconds, with the charging current being equal to the average charging current within 1 minute prior to the issuance of the stop-charging command;

4) Monitor the vehicle status in real time in accordance with the evaluation content for overcharge faults in the virtual simulation charging safety section of the scoring details in Table 1.

6.1.3.2 AC overcharge fault test

1) Adjust the vehicle SOC to $SOC \geq 97\%$;

2) Connect the test system and initiate AC charging;

3) When the SOC of the vehicle under test reaches 100% or meets the full-charge conditions set by the manufacturer, the charging test system shall ignore the stop-charging request sent by the vehicle and continue charging for a duration of more than 10 seconds, with the charging current being equal to the average charging current within 1 minute prior to the issuance of the stop-charging command;

4) Monitor the vehicle status in real time in accordance with the evaluation content for overcharge faults in the virtual simulation charging safety section of the scoring details in Table 1.

6.1.4 Thermal fault test

- 1) Adjust the vehicle SOC to $SOC < 80\%$.
- 2) Connect the heating test device and initiate charging. During the process, adjust the heating power of the charging terminal of the test device, maintain the temperature at $70\text{ }^{\circ}\text{C} \pm 2\text{ }^{\circ}\text{C}$ and hold it for 2 minutes;
- 3) Stop charging, continue to adjust the heating power of the charging terminal of the test device until the temperature reaches $140\text{ }^{\circ}\text{C}$ and maintain it for 5 minutes, then initiate charging;
- 4) Monitor the vehicle status in real time in accordance with the evaluation content for thermal faults in the virtual simulation charging safety section of the scoring details in Table 1.

6.2 Charging compatibility safety

The charging compatibility safety test shall be conducted using 35 mainstream DC charging piles, 10 AC charging piles, and 5 in-cable control and protection devices (IC-CPDs). The charging pile manufacturers and models are listed in Annex A. Before testing, adjust the VUT's state of charge (SOC) to $SOC < 80\%$.

6.2.1 In-vehicle operations during charging

- 1) Connect the vehicle to the charging pile and initiate charging;
- 2) Turn on the air conditioner at maximum cooling power for 30 s, then turn it off;
- 3) Turn on the air conditioner at maximum heating power for 30 s, then turn it off;
- 4) Open and close the doors, trunk, engine hood, wipers, windows, and sunroof;
- 5) Operate the display screen, play multimedia, and connect Bluetooth;
- 6) Adjust the seats;
- 7) Turn on various lights;
- 8) During these operations, observe the vehicle status and monitor the consistency between the current demanded by the vehicle and the actual output current of the charging pile.

6.2.2 Charging pile emergency stop

6.2.2.1 Charging pile emergency stop before current output

- 1) Initiate charging and press the emergency stop button of the charging pile or cut off its output before the charging pile delivers the charging current;
- 2) Monitor the vehicle status in real time in accordance with the evaluation content for emergency stop of the charging pile in the charging compatibility safety section of the scoring details in Table 1.

6.2.2.2 Charging pile emergency stop during charging

- 1) Initiate charging and press the emergency stop button of the charging pile or cut off its output during the charging process;
- 2) Monitor the vehicle status in real time in accordance with the evaluation content for emergency stop of the charging pile in the charging compatibility safety section of the scoring details in Table 1.

6.3 Charging safety under extreme conditions

6.3.1 Charging safety at high temperature

- 1) Adjust the vehicle SOC to $SOC < 20\%$;
- 2) Keep the vehicle in a $50^{\circ}\text{C} \pm 2^{\circ}\text{C}$ environment for 12 h;
- 3) Conduct DC charging for 10 min using a charging pile with a single-plug output capability

of no less than 600 A;

4) After 10 min, perform the operations specified in 6.2.1;

5) Monitor the vehicle status in real time in accordance with the evaluation content for high-temperature charging safety in the extreme operating condition charging safety section of the scoring details in Table 1.

6.3.2 Charging safety at low temperature

1) Adjust the vehicle SOC to $SOC < 20\%$;

2) Disconnect the vehicle's low-voltage battery;

3) Keep the vehicle in a $-30^{\circ}\text{C}\pm 2^{\circ}\text{C}$ environment for 12 h;

4) Conduct DC charging until the vehicle enters normal charging mode and continue charging for 30 min, using a charging pile with a single-plug output capability of no less than 600 A;

5) After 30 min, perform the operations specified in 6.2.1;

6) Monitor the vehicle status in real time in accordance with the evaluation content for low-temperature charging safety in the extreme operating condition charging safety section of the scoring details in Table 1.

6.3.3 Charging safety in rain conditions

6.3.3.1 DC charging safety under simulated rain

1) Adjust the vehicle SOC to $SOC < 80\%$;

2) Connect the DC charging pile, close all doors and windows, and expose the VUT's DC charging port to a rainfall environment with a spray flow rate of 12.5 ± 0.625 L/min and a vertically downward spray direction for 10 min;

3) Initiate charging and continue for 10 min in the spraying condition;

4) Observe the vehicle status in real time.

6.3.3.2 AC charging safety under simulated rain

1) Adjust the vehicle SOC to $SOC < 80\%$;

2) Connect the AC charging pile, close all doors and windows, and expose the VUT's DC charging port to a rainfall environment with a spray flow rate of 12.5 ± 0.625 L/min and a vertically downward spray direction for 10 min;

3) Initiate charging and continue for 10 min;

4) Monitor the vehicle status in real time in accordance with the evaluation content for rain exposure charging safety in the extreme operating condition charging safety section of the scoring details in Table 1.

6.4 Charging information security

6.4.1 Unauthorized access

1) Adjust the vehicle SOC to $SOC < 80\%$;

2) Connect the vehicle to the test device without initiating charging;

3) Configure the information security test tool to send Diagnostic Session Control [10 01] and Tester Present [3E 00] UDS diagnostic messages to the vehicle's DC charging coupler;

4) Monitor the vehicle status in real time in accordance with the evaluation content for unauthorized access in the charging information security section of the scoring details in Table 1.

6.4.2 Message tampering

- 1) Adjust the vehicle SOC to $SOC < 80\%$;
- 2) Connect the vehicle to the test device and configure the information security test tool;
- 3) Initiate charging, and during the process, automatically modify the battery charging limit (BCL) current request parameter using the test tool. The modified value shall exceed the original parameter by 30%;
- 4) Monitor the vehicle status in real time in accordance with the evaluation content for message tampering in the charging information security section of the scoring details in Table 1.

6.4.3 Replay attack

- 1) Adjust the vehicle SOC to $SOC < 80\%$;
- 2) Connect the vehicle to the test device, initiate charging, and use the test tool to capture all communication messages for 3 min during the charging process, saving them in ASC or BLF format. Then stop charging;
- 3) Reconnect the charging gun without initiating charging, and replay the captured 3-minute communication messages to the vehicle's DC charging coupler;
- 4) Monitor the vehicle status in real time in accordance with the evaluation content for replay attacks in the charging information security section of the scoring details in Table 1.

7 Evaluation Methods

7.1 Testing and evaluation items and indicators

Conduct the test in accordance with Chapter 6 of this document and score the vehicle's charging safety performance based on Table 1.

Table 1 Scoring Details

Level-I Indicator	Level-II Indicator	Evaluation Content	Score	Full Score	Weight
virtual simulation charging safety	Current fault	The vehicle stopped charging. After testing, no faults were found and the charging function is intact.	20	100	55%
		Before charging, S+ was short-circuited to PE, causing the vehicle to be unable to charge. After testing, no faults were generated and the charging function was intact	5		
	Communication fault	During charging, S+ short-circuited to PE, causing the vehicle to stop charging. After testing, no faults were found and the charging function remained intact.	5		
		Before charging, S+/S- were disconnected separately, rendering the vehicle unable to charge. No faults were detected after testing, and the charging function remained intact.	5		
		During charging, S+/S- were disconnected separately, causing the vehicle to stop charging. No faults were detected after testing, and the charging function remained intact.	5		
		Overcharge fault	The vehicle stops charging after reaching the full-charge condition during DC charging. No faults were detected after testing, and the charging function remained intact		
	The vehicle stops charging after reaching the full-charge condition during AC charging. No faults were detected after testing, and the		20		

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Level-I Indicator	Level-II Indicator	Evaluation Content	Score	Full Score	Weight
charging compatibility safety		charging function remained intact.		100	10%
	Thermal fault	The vehicle stops charging or reduces the charging power. No faults were detected after testing, and the charging function remained intact	20		
	Internal vehicle operations during charging	The vehicle is charged normally, and the charging current and voltage are stable	50		
	Emergency stop of charging pile	The vehicle is able to stop charging. No faults were detected after testing, and the charging function remained intact	50		
charging safety under extreme conditions	High temperature charging safety	Vehicle charging normally and charging compatibility passed during charging process.	25	100	25%
	Low temperature charging safety	Vehicle charging normally and charging compatibility passed during charging process.	25		
	Safety of Charging in the Rain	The DC charging process proceeds normally under water spray conditions. No faults were detected after testing; the vehicle's charging function remains intact, and the insulation resistance of the charging port is greater than 500Ω/V	25		
		The AC charging process proceeds normally under water spray conditions. No faults were detected after testing; the vehicle's charging function remains intact, and the insulation resistance of the charging port is greater than 500Ω/V	25		
charging information security	Unauthorized access	The vehicle's DC charging port does not respond to the following messages: Diagnostic Session Control Response [50 01], Tester Present Response [7E 00], and Negative Response [7F xx xx xx]	10	100	10%
		The vehicle's OBD port neither receives nor responds to the following messages: Diagnostic Session Control [10 01], Tester Present [3E 00], Diagnostic Session Control Response [50 01], Tester Present Response [7E 00], and Negative Response [7F xx xx xx]	10		
	Message tampering	The vehicle stops charging and the charging function remains intact	30		
	Replay attack	The vehicle does not display the charging status and sends a corresponding prompt message	50		
		The vehicle does not display the charging status and does not send the corresponding prompt information	30		
		The vehicle displays the charging status and stops displaying within 1 min	10		
	Vehicle charging status display for more than 2 min	0			

7.2 Score Calculation Method

The comprehensive score, denoted as S_3 , is calculated as the weighted sum of the scores for the following four items: virtual simulation charging safety, charging compatibility safety, extreme operating condition charging safety, and charging information security.

$$S_3 = \sum_{i=1}^4 (s_i \times w_i)$$

Where,

S_3 - 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 shall be classified into five grades, with details specified in Table 2.

Table 2 Evaluation Results and Their Score Distributions

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

Annex A Charging Compatibility Safety Test Charging Pile Manufacturers and Models**Table A.1 Manufacturer and Model of DC Charging Pile**

S/N	Manufacturer	Model
1	Gresgying Digital Energy Technology Co., Ltd.	F3
2	Shenzhen Kehua Hengsheng Technology Co., Ltd.	EVD~120TF
3	Zhejiang Wanma New Energy Technology Co., Ltd.	DSNOIM02A3
4	Integrated Electronic Systems Lab Co., Ltd.	iES~ICS
5	Guangdong Tianshu New Energy Technology Co., Ltd.	YFD1000~120kW
6	NARI Technology Control System Co., Ltd.	CEV1263~F1
7	Hangzhou Zhongheng Electric Co., Ltd.	DCP120T
8	Dalian Luobinsen Power Equipment Co., Ltd.	L120kW
9	Hangzhou Aoneng Power Supply Equipment Co., Ltd.	ANDC1~60kW/1000V
10	Guangdong Poulton Technology Co., Ltd.	PLT~1000~120Y~2
11	Beijing Hexin Ruitong Power Technology Co., Ltd.	DCIP750V/120kW10~F2CSW
12	Beijing Huashang Sanyou New Energy Technology Co., Ltd.	FDC~60/750~L2~R002
13	Jiangxi Lv C-chong Charging Technology Co., Ltd.	AD120002P2
14	Shenzhen CEGN Co., Ltd.	CL5899~B08
15	Wanbang Digital Energy Co., Ltd.	DC1200GB09302F0101
16	CSG Smart Science & Technology Co., Ltd.	CSG~BCG~D3110
17	Shenzhen Sinexcel Electric Co., Ltd.	SEV1000/160Y~7
18	Qingdao TGOOD Electric Co., Ltd.	TCDZ~DC0.7/60
19	Shenzhen EN Plus Technologies Co., Ltd.	DC060K
20	Xuchang Relay Research Institute Co., Ltd.	XJyjsDC10/80kW/L/M1/Q2
21	Guangzhou Wancheng Wanchong New Energy Technology Co., Ltd.	MQC7000
22	Shenzhen Hongjiali New Energy Co., Ltd.	DCL120B
23	Sicon Chat Union Electric Co., Ltd.	EVDS-750B120CK
24	Xi'an LINCHR New Energy Technology Co., Ltd.	LCCDZ-DC1.00/120
25	Zhengzhou Senyuan New Energy Technology Co., Ltd.	SZCD-Z120
26	Zhejiang AMPPAL New Energy Technology Co., Ltd.	CLX-DC-120-Y-B-Z-4-H
27	CYG Sunri Co., Ltd.	PRS-7576T-1000/120-2
28	Shenzhen Winline Technology Co., Ltd.	YLCED160K
29	Zhuhai Titans Technology Co., Ltd.	TEVC-160 kW/1000V
30	Shenzhen Techone Tech Co., Ltd.	GPEV160-AA102-S2E
31	Shanghai Zhida Technology Development Co., Ltd.	AWDC120YBZ4HB4
32	Shenzhen Orange New Energy Technology Co., Ltd.	OSD750-120K02
33	Yichong New Energy (Shenzhen) Co., Ltd.	ECD-750/120-C2-F
34	East Group Co., Ltd.	EVDC-120KW-10YHW-2
35	Sungrow Power Supply Co., Ltd.	CDC120-2-G3

Table A.2 Manufacturer and Model of AC Charging Pile

S/N	Manufacturer	Model
1	Wanbang Digital Energy Co., Ltd.	AC0070GB021
2	Guangdong Tianshu Energy Technology Co., Ltd.	YFA220-7kW
3	Guangdong Purton Technology Co., Ltd.	PLT-220-7
4	Shenzhen Sinexcel Electric Co., Ltd.	SEA220/32-U-G-1
5	NARI Technology Nanjing Control System Co., Ltd.	CEV1107-P1(B71A301)

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6	Zhejiang Wanma New Energy Co., Ltd.	WMJ220032
7	Wuhan NIO Energy Equipment Co., Ltd.	PG200 7/220-5R100S
8	Beijing Jiye Changda New Energy Technology Co., Ltd.	CAC2
9	Chongqing Guohan Energy Development Co., Ltd.	ABBD2142001
10	Chongqing Sanjiang New Energy Co., Ltd.	SJ01AC7kW-V8

Table A.3 IC-CPD Manufacturer and Model

S/N	Manufacturer	Model
1	Goneo Group Co., Ltd.	D2-C16A
2	Shanghai Zhida Technology Development Co., Ltd.	ZDA1-CB1-Q21G
3	Wanbang Digital Energy Co., Ltd.	AC0035GB048
4	Qingdao TELD New Energy Co., Ltd.	TCDZ-AC220/3.5-KG
5	Nanjing Ruifanda New Energy Technology Co., Ltd.	P2-16A02



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