# NB

ENERGY INDUSTRY STANDARD

OF THE PEOPLE'S REPUBLIC OF CHINA

ICS 29.200

K 81

Registration number: 64301-2018

# NB/T 33001-2018

Replacing NB/T 33001-2010

# Specification for electric vehicle off-board conductive charger

电动汽车非车载传导式充电机技术条件

**Issued on: April 03, 2018** **Implemented on: July 01, 2018**

**Issued by: National Energy Administration**

# Table of Contents

# Foreword

This standard replaces NB/T 33001-2010 " Specification for electric vehicle off-board conductive charger". As compared with NB/T 33001-2010, in addition to editorial changes, the main technical changes are as follows:

- DELETE the clause 7 “Inspection rules” and clause 8 “Test method” from the original standard, such information can be found in NB/T 33008.1;

- In the new standard, ADD the clause 5 “Classification of chargers”, where the chargers are classified from different points of views;

- The clause 8 “Marking, packaging, transportation and storage” of the new standard corresponds to the clause 9 “Marking” of the original standard;

- In the clause 3 “Terms and definitions” of the new standard, MODIFY the clause 3 “Terms and definitions” of the original standard; ADD 19 new terms and definitions;

- In the clause 4 “Basic composition” of the new standard, MODIFY the clause 4 “Basic composition” of the original standard; ADD the structural block diagram;

- In the clause 6 “Functional requirements” of the new standard, MODIFY the “communication function”, “human-machine interaction function”, “input function”, “metering function” in the clause 5 “Functional requirements” of the original standard; DELETE the “type of applicable battery”, “setting method of charging", “low-voltage auxiliary power supply” from the original standard; ADD the “insulation detection function”, “short-circuit detection function of DC output circuit”, “vehicle plug lock function”, “pre-charge function”, “emergency stop function”, “protection function”;

- In the clause 7 “Technical requirements” of the new standard, MODIFY the “environmental conditions”, “power supply requirements”, “weathering requirements”, “temperature rise requirements”, “protection requirements”, “safety requirements”, “electrical insulation performance”, “output voltage and current"; “charger’s efficiency and power factor”, “electromagnetic compatibility requirements”, “mechanical strength”, “noise” of the clause 6 “Technical requirements” of the original standard; DELETE the “reliability index”, “current flow imbalance” from the original standard; ADD the “current ripple”, “constant power output”, “low-voltage auxiliary power supply”, “requirements for charger output response”, “start output overshoot”, “capacity coupling”, “standby power consumption”, “output voltage, current measurement error”, “charge mode and connection method”, “control guide circuit”, “charge control timing and flow”, “mechanical strength”, “characteristics of mechanical switching device”,

# Specification for electric vehicle off-board conductive charger

## 1 Scope

This standard specifies the terms and definitions, basic compositions, classification, functional requirements, technical requirements, marking, packaging, transportation, storage of electric vehicle off-board conductive charger (hereinafter shortly referred to as charger).

This standard is applicable to the electric vehicle off-board conductive charger which uses conductive charging method. The maximum rated voltage of the power supply is 1000V AC or 1500V DC, the maximum rated output voltage is 1500V DC.

## 2 Normative references

The following documents are essential to the application of this document. For the dated documents, only the versions with the dates indicated are applicable to this document; for the undated documents, only the latest version (including all the amendments) are applicable to this standard.

GB/T 2423.1-2008 Environmental testing - Part 2: Test methods - Tests A: Cold

GB/T 2423.2-2008 Environmental testing - Part 2: Test methods - Tests B: Dry heat

GB/T 2423.4-2008 Environmental testing for electric and electronic products - Part 2: Test method - Test Db: Damp heat，cyclic (12 h+12 h cycle)

GB/T 2423.16-2008 Environmental testing - Part 2: Test methods - Test J and guidance: Mold growth

GB/T 2423.17-2008 Environmental testing for electric and electronic products - Part 2: Test method - Test Ka: Salt mist

GB/T 2423.55-2006 Environmental testing for electric and electronic products - Part 2: Test methods - Test Eh: hammer tests

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

**3.3**

**Charging terminal**

When an electric vehicle is charged, a part of the off-board conductive charger which needs to be faced and operated by the charging operators, which generally consists a charging cable, a vehicle plug, a human-machine interface, which may also include the components of metering, communication, control, and the like.

**3.4**

**Split type charger**

The charger which structurally separate the power conversion unit from the charging terminal, which are connected by a cable.

**3.5**

**Integral charger**

A charger which accommodates the power conversion unit, the charging terminal and the like in a cabinet (box), to structurally integrate them.

**3.6**

**Dynamic power allocation**

The charger dynamically adjusts the maximum output power of each vehicle plug according to the vehicle charging demand, its own load status, the superior monitoring and control command, based on the predetermined power distribution control strategy.

**3.7**

**Single interface charger**

A charger which has only one vehicle plug and can only charge one electric vehicle at a time.

**3.8**

**Multiple interface charger**

A charger which has multiple vehicle plugs that can simultaneously or sequentially charge multiple electric vehicles, where dynamic power distribution can be provided between multiple vehicle plugs.

**3.9**

**Standby power**

The input power when the charger is in standby mode, which is called standby power consumption.

**3.16**

**Rated output voltage**

In this standard, the maximum output voltage of the charger during normal operation.

**3.17**

**Rated output current**

In this standard, the maximum output current of the charger at the rated output voltage.

**3.18**

**Maximum output current**

In this standard, the maximum output current of the charger at the rated output power.

**3.19**

**Rated output power**

In this standard, the product of the rated output voltage of the charger and the rated output current.

**3.20**

**DC voltage ripple factor**

The ratio of half of the difference between the peak value and the valley value of the pulsating DC voltage to the average value of the DC voltage.

**3.21**

**Constant power**

The status where the charger's output power is maintained at a constant value.

circuit. The short-circuit detection of the charger is performed during the insulation detection phase. When the DC output circuit has a short-circuit fault, it shall stop the charging process and issue an alarming message.

### 6.5 Vehicle plug lock function

The vehicle plug of the charger shall be provided with a locking device, whose function shall comply with:

a) Requirements of 9.6 of GB/T 18487.1-2015:

b) Requirements of 6.3 of GB/T 20234.1-2015:

c) Requirements of Appendix A of GB/T 20234.3-2015.

Under the following conditions, the locking device shall be unlocked and the voltage at the vehicle's plug end shall not exceed 60 V before unlocking:

a) Charging cannot be continued due to fault;

b) Charging is completed.

### 6.6 Precharge function

The charger shall have a precharge function. At the charging-startup phase, after the electric vehicle closes the vehicle-side DC contactor, the charger shall detect the battery voltage and determine whether the voltage is normal. When the charger detects that the battery voltage is normal, it adjusts the output voltage to the current battery-end's voltage minus 1 V ~ 10 V, then closes the DC output contactor at the charger side.

### 6.7 Man-machine interaction function

#### 6.7.1 Display function

The charger shall display the following status information:

a) The operating status indication of the charger: standby, charging, alarm;

b) The charger with manual charging control shall display manual input information.

The charger should display the following information:

a) The current state of charge of the battery, (SOC), charging voltage, charging current, charging power;

b) The charging time, the electric quantity charged, the amount charged.

current. The input current overshoot generated during power-on or charging-startup shall not exceed 10% of the peak value of the rated input current.

**6.10.8** When the DC output contactor of the charger is connected, the surge current (peak value) from the vehicle to the charger or from the charger to the vehicle shall be controlled below 20 A.

**6.10.9** After the vehicle-side contactor is closed during the charging startup phase, the charger shall detect the vehicle's battery voltage. When the following conditions occur, the charger shall stop the startup process and issue an alarm message:

a) Reverse connection of battery;

b) The absolute value of the difference between the detection voltage and the battery voltage of communication message is greater than 5% of the battery voltage of communication message;

c) The detection voltage is less than the minimum output voltage of the charger or greater than the rated output voltage of the charger.

**6.10.10** The charger shall have a dual protection function for the electric vehicle's power battery. During the charging process, when the detected output voltage is greater than the maximum allowable total charging voltage of the vehicle, or the detected output current is greater than the current demand current of the vehicle, the charger shall disconnect the DC output within 1 s and issue an alarm message.

Note: The output voltage or output current as detected by the charger shall take into account the voltage-regulated accuracy or the current-regulated accuracy plus the measurement error.

**6.10.11** The charger shall have anti-backflow function (such as output plus diode), to prevent battery current from flowing back.

**6.10.12** The charger shall detect the contact adhesion of the DC contactor of the power supply circuit before charging startup, or otherwise detect the contact adhesion of the contactor after the DC contactor is disconnected. When it is detected that any of the main contacts of the DC contactor is adhered, the charger shall not start charging but issue an alarm message.

**6.10.13** During the charging process, when the charger detects a communication interruption with the electric vehicle's battery management system (BMS) or the vehicle controller, the charger shall stop charging and issue an alarm message.

**6.10.14** The charger shall determine the maximum allowable total charging

the provisions of 10.4 of GB/T 18487.1-2015.

### 7.5.4 Grounding requirements

The grounding of the charger shall meet the following requirements:

a) The metal housing of the charger shall be provided with a grounding terminal (bolt), the diameter of which shall not be less than 6 mm, and shall have a grounding mark:

b) The metal door plate, the cover plate, and the like of the charger shall be connected to the main structural frame of the charger by the use of copper protective conductor, the cross-sectional area of the protective conductor shall not be less than 2.5 $mm^2$;

c) All metal casings, partitions of the electrical conductors as well as the metal housings and metal handles of the electrical devices, etc., shall all be effectively equipotential-connected, the grounding continuity resistance shall not be greater than 0.1 Ω;

d) The working grounding and protective grounding in the charger shall be connected separately to the grounding conductor (copper row). It shall not connect multiple electrical devices that need to be grounded in series in one grounding wire.

### 7.5.5 Electrical isolation requirements

Between the power supply input and the DC output of the charger, it shall use the electrical isolation protection measures. For the single interface charger, it shall also use the electrical isolation protection measures between the DC output interfaces.

## 7.6 Electrical insulation performance

### 7.6.1 Insulation resistance

Use a test instrument which has an open circuit voltage of the DC voltage grade as specified in Table 3, to measure the insulation resistance between each of the live circuits of the non-electrical connection of the charger and between the individual live circuits and the ground (metal housing), which shall not be less than 10 MΩ.

### 7.6.2 Dielectric strength

Between the live circuits of the non-electrical connection of the charger, between the independent live circuits and the ground (metal housing), based on the working voltage, it shall be able to withstand the power frequency AC voltage for 1 min as specified in Table 3 (DC voltage may also be used. The

### 7.7.12 Start output overshoot

The charger shall have a soft-start function. During the startup of the voltage-regulated working, the output voltage overshoot shall not be greater than 5% of the current setting value. During startup of the current-regulated working, when the set output DC current is greater than or equal to 30 A, the output current overshoot shall not be greater than 5% of the current setting value; when the set output DC current is less than 30 A, the output current overshoot shall not be greater than 1.5 A.

When the charger resumes the charging state from the suspended state, it shall meet the above requirements.

### 7.8 Capacity coupling

The capacity coupling between the positive, negative poles and ground of the DC output of the charger is generated by the Y capacitor and parasitic capacitance, which is used for electromagnetic compatibility. To prevent the risk of personnel electric shock, for a charger which has a rated output voltage not greater than 500 V, the total capacitance between the positive and negative poles of each charging interface and ground shall not exceed 0.4 μF; for a charger which has a rated output voltage greater than 500 V, it shall meet one of the following conditions:

a) The energy stored by the total capacitance between the DC positive, negative poles of the charger which are connected to the power battery of the electric vehicle and the ground shall not exceed 0.2J at the maximum working voltage;

b) The DC output circuit of the charger uses double insulation or reinforced insulation.

### 7.9 Standby power consumption

At rated input voltage, the standby power consumption of the charger shall not be greater than N × 50 W.

Note: N indicates the number of charging interfaces.

### 7.10 Measurement error of output voltage and current

The measurement error of output voltage of the charger shall not exceed ±5 V, the measurement error of output current shall not exceed ± (1.5% × actual output current + 1) A, the update time of the measured value is not greater than 1 s.

### 7.11 Charger’s efficiency, input power factor

provisions of 7.7.4. Before, during and after the test, the charger shall be able to work normally.

Note: Normal work means that the charging, communication, display and various protection functions of the charger shall be normal, without function loss. The same as below.

### 7.19.2 High-temperature performance

It shall be carried out according to the method as specified in Test Bd of GB/T 2423.2-2008. The test temperature is the upper limit as specified in 7.1.1. When started up after reaching to the test temperature, the charger shall be able to work normally. After working at the test temperature continuously for 2 hours, the current-regulated accuracy of the tested charger shall comply with the provisions of 7.7.4. Before, during and after the test, the charger shall be able to work normally.

### 7.19.3 Cyclic damp heat performance

It is performed according to the method as specified in test Db of GB/T 2423.4-2008. The high temperature of the test is (40 ± 2) °C, the number of cycles is 2. Perform the dielectric strength test and insulation resistance test 2 hours before the end of the test, wherein the insulation resistance shall be not less than 1 MΩ. For the dielectric strength, apply the test voltage 75% of the specified value in Table 3. After the test, return to normal atmospheric conditions, the charger shall be able to work normally after power-on.

## 7.20 Requirements for electromagnetic compatibility

### 7.20.1 Overview

The equipment manufacturer shall, according to the provisions of clause 6.3 of GB/T 18487.2-2017, explain the place of installation and use of the charger. When the equipment manufacturer does not specify the intended use environment of the charger, it shall perform the most stringent emission and immunity test, that is, use the lowest emission limits and the highest immunity test levels.

### 7.20.2 Test configuration of charger

The test configuration of the charger shall comply with the provisions of clause 4 of GB/T 18487.2-2017.

### 7.20.3 Test load conditions of charger

The test load conditions of the charger shall comply with the provisions of clause 5 of GB/T 18487.2-2017.

i) Indoor or outdoor use (IP code for housing protection grade).

Notes: If there are multiple charging interface outputs, it shall indicate the rated output power and the maximum output current of each circuit.

**8.1.2** All kinds of switches, indicators, terminals, terminal blocks, etc. on the charger shall have corresponding text symbol marks and shall be consistent with the text symbols on the wiring diagram. The corresponding position shall have wiring, grounding and safety signs, which shall be clear and easy-to-distinguish, no color fading, no peeling off, evenly arranged, convenient to observe.

**8.2 Packaging**

**8.2.1** The packaging of the charger shall comply with the provisions of GB/T 13384 and shall have the following contents:

a) Name of product;

b) Handle with care;

c) Avoid rain;

d) Total mass;

e) Inversion is prohibited.

**8.2.2** Charger's packing information shall include:

a) Packing list;

b) Exit-factory test report;

c) Certificate of compliance;

d) Instructions for installation and use;

e) List of accompanied accessories and spare parts.

**8.3 Transportation**

During the transportation process, the charger shall not have severe vibration shocks, exposure to sun and rain, or inversed.

**8.4 Storage**

The charger shall be stored in a warehouse with air circulation, temperature between 25 °C ~ 55 °C, monthly average relative humidity not greater than 90%, non-corrosive and explosive gases. During storage, it shall not be exposed to