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**Electric energy metering for
electric vehicle off-board charger**

电动汽车非车载充电机电能计量

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Foreword

This Standard is drafted according to the rules stated in GB/T 1.1-2009.

This Standard is the basic standard for electric vehicle charging metering, and shall be used in combination with corresponding standards selected in accordance with characteristics of electric energy metering device used for charging facilities.

This Standard was proposed by and shall be under the jurisdiction of China Electricity Council.

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Electric energy metering for electric vehicle off-board charger

1 Scope

This Standard specifies the configuration installation requirements, technical requirements, test methods and inspection rules of the DC electric energy metering device for the electric vehicle off-board charger (hereafter referred to as the charger), as well as the charger metering technical requirements.

This Standard applies to the electric energy metering of charger.

2 Normative references

The articles contained in the following documents have become part of this Standard when they are quoted herein. For the dated documents so quoted, only the dated versions apply to this document. For the undated documents, all the modifications (including all corrections) or revisions made thereafter shall be applicable to this Standard.

GB/T 2423.1-2008 Environmental testing - Part 2: Test methods - Tests A: Cold (IEC 60068-2-1:2007, IDT)

GB/T 2423.2-2008 Environmental testing - Part 2: Test methods - Tests B: Dry heat (IEC 60068-2-2:2007, IDT)

GB/T 2423.4-2008 Environmental testing for electric and electronic products - Part 2: Test method - Test Db: Damp heat, cyclic (12h+12h cycle) (IEC 60068-2-30:2005, IDT)

GB/T 2423.57-2008 Environmental testing for electric and electronic products - Part 2: Tests - Test Ei: Shock - Shock response spectrum synthesis (IEC 60068-2-81:2003, IDT)

GB/T 2423.58-2008 Environmental testing for electric and electronic products - Part 2: Tests - Test Fi: Vibration - Mixed Mode (IEC 60068-2-80:2005, IDT)

GB/T 3928-2008 D.C. resistive volt ratio boxes (IEC 60524:1997, IDT)

GB 4208-2008 Degrees of protection provided by enclosure(IP code)

GB/T 5169.11-2006 Fire hazard testing for electric and electronic products - Part 11: Glowing/hot-wire based test methods - Glow-wire flammability test method for end-products (IEC 60695-2-11:2000, IDT)

GB/T 15284-2002 Particular requirements for multi-rate electricity meters

GB/T 17215.211 Electricity metering equipment (a.c.) - General requirements, tests and test conditions - Part 11: Metering equipment (GB/T 17215.211-2006, IEC 62052-11:2003, IDT)

GB/T 17215.421-2008 Electricity metering equipment (a.c.) - Tariff and load control - Part 21: Particular requirements for time switches (IEC 62054-21:2004, IDT)

GB/T 17626.2-2006 Electromagnetic compatibility (EMC) - Testing and measurement techniques - Electrostatic discharge immunity test (IEC 61000-4-2:2001, IDT)

GB/T 17626.3-2006 Electromagnetic compatibility - Testing and measurement techniques - Radiated radio-frequency electromagnetic field immunity test (IEC 61000-4-3:2002, IDT)

GB/T 17626.4-2008 Electromagnetic compatibility - Testing and measurement techniques - Electrical fast transient/burst immunity test (IEC 61000-4-4:2004, IDT)

GB/T 17626.5-2008 Electromagnetic compatibility - Testing and measurement techniques - Surge immunity test (IEC 61000-4-5:2005, IDT)

GB/T 29317 Terminology of electric vehicle charging/battery swap infrastructure

JJG 842-1993 Verification Regulation of D.C. Kilowatt-hour Meter

JB/T 9288-1999 External shunts

NB/T 33001 Specification for electric vehicle A.C. charging spot

3 Terms and definitions

Those defined in GB/T 29317 AND the following terms and definitions apply to this Standard.

3.1

Direct connected meter

It refers to the electric energy meter of which the current circuit of connected instrument is current signal, including the instrument with integrated design of electric energy meter and shunt.

3.2

Shunts connected meter

It refers to the electric energy meter of which current circuit of connected instrument is

All circuit of electric energy meter to the ground shall be able to withstand AC voltage test with 4kV power frequency for 1min. AC voltage test with 2kV power frequency for 1min shall be able to be withstood among the disconnected circuit of electric energy meter. There shall have no flashover, spark discharge or breakdown in the test.

5.1.5.3 Insulation resistance

Insulation resistance of all circuit of electric energy meter to ground shall not be less than 40MΩ.

5.1.6 Output interface

5.1.6.1 Electrical energy test pulse outputs

Electric energy meter shall have electric pulse and optical pulse test access port proportional to its electrical energy. Electric pulse shall be output after optoelectronic isolation; pulse width is: 80ms±20ms. Use super bright and long-life LED as power pulses indication for optical pulse; mean time between failures (MTBF) of LED shall be greater than or equal to 100, 000h under normal operating conditions. Outputs of electrical energy test pulse shall be able to be hit from the right side

5.1.6.2 Clock signal outputs

Used to test the accuracy of electric energy meter timing; the output frequency is 1Hz.

5.1.7 Functional requirements

5.1.7.1 Electric energy metering

The electric energy meter can measure the total electrical energy and various rates electrical energy.

5.1.7.2 Storage function

Storage function shall meet the following requirements:

- a) The electric energy meter shall at least store the total power energy and all rates of electricity data of the first two months or the first two settlement cycle; the default value of data archived separation time shall be at 24:00 of the last day of each month, or at any time of 1st -28th of each month.
- b) After power supply of electric energy meter failure, the stored data shall be kept for at least 1 year;
- c) Electric energy and other key charging information shall be stored in built-in security module of electric energy meter to prevent key data from being tampered.

5.1.7.3 Clock, time frame and rate

Clock, time frame and rate shall meet the following requirements:

- a) The built-in hardware clock circuit with temperature compensation function has the automatic switching function among calendar, timing and leap year. Under the reference temperature, the clock accuracy is $\leq \pm 0.5\text{s/d}$. The variation of the accuracy of the clock with temperature shall be less than $0.15\text{s/}^\circ\text{C}$ per 24h. The clock can be timed under the programming state, and perform broadcast timing under the non-programming state; the clock error of the broadcast timing shall not be more than 5min; and it can be timed only once a day.
- b) Electric energy meter shall have at least two sets of rate time frame; the automatic switching of the two sets of rate time frame can be achieved via pre-setting the time. Each rate time frame can at least set 2 time zones in the whole year; it can at least set 8 time frames within 24h; the minimum time interval of time frame is 15min; and the time frame can be set crossing the zero point.

5.1.7.4 Measurement and monitoring

It can measure voltage, current, power, power factor and other operating parameters. Measurement error (fiducial error) does not exceed $\pm 1\%$.

5.1.7.5 Communication function

Communication function shall meet the following requirements:

- a) Electric energy meter shall have RS 485 communication interfaces to conduct information exchange with billing equipment or system, and modulated infrared interfaces to communicate with the hand-held meter reading unit;
- b) Initial velocity of RS485 communication interface is 2400bps, can be set to 1200bps, 4800bps, 9600bps by software; communication rate of modulated infrared interface is 1200bps.

5.1.7.6 Display function

Display function shall meet the following requirements:

- a) The display screen of electric energy meter shall have backlight function; the backlight can be lit by buttons, infrared and other trigger modes, and close the backlight after two auto slideshow cycles;
- b) Electric energy meter shall have two slideshow methods of automatic cycle and buttons;
- c) Electric energy meter shall be able to display the accumulated electrical energy, voltage, current, power, time, alarm and other information;
- d) The electrical energy displays in eight-digit, with the default of two decimals; units of

measurement: kWh; the decimal digits can be programmed.

5.1.7.7 Event recording

Event recording shall meet the following requirements:

- a) Record the total number of programming, the time of the last 10 times of programming, the operator code and programming options;
- b) Record the total number of timing (excluding the broadcast timing) and the time before and after the last 10 times of timing.

5.1.8 Electromagnetic compatibility

Electric energy meter shall be designed to ensure no damage or no substantial affect under the harassment influences of electrostatic discharge, radiofrequency electromagnetic fields, electrical fast transient pulse train, and surge electromagnetism.

5.1.9 Power supply mode

Electric energy meter is powered by the auxiliary power supply, supply voltage is AC 220V, DC 24V self-adaption.

5.1.10 Reliability

Under normal operating conditions, mean time to failures (MTTF) of electric energy meter is not less than 2.19×10^4 h.

5.2 Shunt

Technical conditions of shunt shall meet the requirements of JB/T 9288.

5.3 Requirements of charger

- a) The charger shall meet the requirements of NB/T 33001; it shall collect the electric energy meter data and display the data of current, voltage, charging time, electric quantity, and rate time frame; also, it shall calculate and display the electric charge information correctly;
- b) The battery charger shall show battery charging volume for this time, and can reset the number to zero;
- c) The charger can record charging behaviors for at least 100 times, the recorded content include starting time of charging, electric quantity value at starting time, ending time, electric quantity value at ending time and charging electric quantity;
- d) The data collected by charger from the electric energy meter shall be consistent with its corresponding display content.

6.2.4 Insulation performance test

The pulse voltage and AC voltage test shall be conducted in accordance with the provisions of GB/T 17215.211; the insulation resistance measurements shall be carried out in accordance with the regulations of Article 11 of JJG 842-1993.

6.2.5 Functional check

After the electric energy meter is powered, check whether the electric energy meter function meets the requirements of 5.1.7 by visual, buttons round display, software copy reading and other ways.

6.2.6 Electromagnetic compatibility test

6.2.6.1 Electrostatic discharge noise immunity test

Test under the following conditions according to GB/T 17626.2-2006:

- As a desktop device testing;
- The instrument is in operating condition: the voltage circuit and auxiliary power circuit are applied to rated voltage; current circuit is open;
- 8kV contact discharge (if there are no exposed metal parts, perform 15kV air discharge);
- Discharge times: Ten times.

Before and after the test, check the function of the electric energy meter and read the memory data of the electric energy meter separately; it shall not occur any data-change.

6.2.6.2 Radiofrequency electromagnetic field radiation noise immunity test

The test shall be in accordance with GB/T 17626.3-2006, and be carried out under the following conditions:

- As a desktop device testing;
- The instrument is in operating condition: The voltage circuit and auxiliary power circuit are applied to rated voltage; current circuit is open;
- Frequency range: 80 MHz ~ 2000 MHz;
- Unmodulated test strength: 30V/m.

Before and after the test, check the function of the electric energy meter and read the memory data of the electric energy meter separately; it shall not occur any data-change.

6.2.6.3 Electrical fast transient noise immunity test

cooled to $-25^{\circ}\text{C} \pm 3^{\circ}\text{C}$ in the non-operating condition; recover to 23°C after keeping 72h. After the test is completed for 24h, the electric energy meter shall not be damaged or information-changed; and it can work normally.

6.2.7.3 Alternating damp heat test

According to the provisions of the GB/T 2423.4-2008, use rated voltage for all the voltage circuit of the electric energy meter; the current circuit has current and the change pattern is 1; the ceiling temperature for the indoor electric energy meter is $40^{\circ}\text{C} \pm 2^{\circ}\text{C}$; for outdoor electric energy meter, it is $55^{\circ}\text{C} \pm 2^{\circ}\text{C}$; the test shall be carried out for 6 cycle if no special measures is taken to eliminate the surface moisture. After the test is completed for 24h, the electric energy meter shall not be damaged or information-changed; and it can work normally.

6.2.8 Mechanical requirements testing

6.2.8.1 Impulse test

In accordance with the provisions of GB/T 2423.57-2008, test under the following conditions:

- The electric energy meter is in non-working condition, without packaging;
- Half-wave sine wave;
- Peak acceleration: 300g;
- Impulse time: 18ms.

After the test, the electric energy meter shall not be damaged or information-changed; and it can work normally.

6.2.8.2 Vibration test

Test under the following conditions according to the provisions of GB/T 2423.58-2008:

- The electric energy meter is in non-working condition, without packaging;
- Frequency range: 10Hz ~ 150 Hz;
- Crossover frequency: 60Hz;
- $f < 60\text{Hz}$, constant amplitude is 0.075mm;
- $f > 60\text{Hz}$, constant acceleration is 9.8m/s^2 ;
- Single-point control;
- Each axial scan cycles: 10.

After the test, the electric energy meter shall not be damaged or information-changed; and it can work normally.

6.2.8.3 Spring hammer test

The electric energy meter is installed in the normal position; the spring hammer is applied on the outer surface of the case (including windows) and the end cap with the kinetic energy of $0.2\text{J} \pm 0.02\text{J}$. After the test, if the case and the end cap do not appear damages which may affect the function of the electric energy meter and which may access to the live parts, then the test results are acceptable. Slight damage which shall not weaken the protection for indirect contact or the protection for foreign matter, dust and water is allowed.

6.2.8.4 Heat-resisting and anti-flaming test

Test under the following temperature according to the provision of GB/T 5169.11-2006:

- Wiring terminal: $960^{\circ}\text{C} \pm 15^{\circ}\text{C}$;
- Wiring end cap and the case: $650^{\circ}\text{C} \pm 10^{\circ}\text{C}$;
- Action time: $30\text{s} \pm 1\text{s}$.

During the test, the tested position can not burn or the flame is extinguished after the glow-wire removed.

6.2.8.5 Dust-proof test

Test under the following conditions according to the requirements of GB 4208-2008:

- The electric energy meter is in non-operating condition and is installed in a simulated wall;
- Tested in the condition an analog cable (exposed end is sealed) with a certain length;
- For indoor use electric energy meter, it shall remain the same internal and external atmospheric pressure;
- The first characteristic numeral: 5 (IP5X).

The amount of dust entered shall not hinder the operation of the electric energy meter and not weaken its insulating strength.

6.2.8.6 Water-proof test

Test under the following conditions according to the requirements of GB4208-2008, and:

- The electric energy meter is in non-operating condition;

- The second characteristic numeral: 1 (IPX1) is suitable for indoor use electric energy meter;
- The second characteristic numeral: 4 (IPX4) is suitable for outdoor use electric energy meter;
- The amount of water entered shall not hinder the operation of the electric energy meter and not weaken its insulating strength.

6.3 Shunt

The shunt test item and method shall be carried out in accordance with the JB/T 9288-1999.

6.4 Charger

Compare the relevant measurement information displayed on the charger with the corresponding electric energy meter displays, so as to determine whether they are consistent.

7 Inspection rules

7.1 Electric energy metering device test

7.1.1 Exit-factory inspection

Each electric energy metering product produced shall be inspected by the manufacturer in accordance with the test methods provided by this Standard; the exit-factory seal shall be applied; the quality certification shall be issued after passing the inspection. The electric energy meter's test items are shown in Table 5; the shunt inspection items are shown in the Annex of JB/T 9288- 1999.

7.1.2 Type inspection

If the type identification of new products or the structure, process, the main material (components) of the existing products, as well as the software has significant changes, then type test shall be carried out. The electric energy meter's test items are shown in Table 5; the shunt's test items are shown in the Annex B of JB/T 9288-1999

Table 5 Test Item for electric energy meter

S/N	Test item	Clause	Type inspection	Exit-factory inspection
1	Visual inspection	6.2.1	√	√
2	Insulation Test	6.2.4	√	√
3	Basic error under rated voltage	6.2.2.1	√	√

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