JJG

National Metrology Verification Regulations of the People's Republic of China

JJG1149-2022

Off-board Chargers for Electric Vehicles (for Trial Implementation)

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Verification Regulation of Off-board Chargers for Electric Vehicle (for Trial Implementation)

JJG 1149-2022
replace **JJG 1149-2018**

Responsible unit:

National Electromagnetic Metrology Technical Committee

Main drafting unit:

China Institute of Metrology

Shenzhen Institute of Metrology and Quality Inspection

Participating in the drafting unit:

Hangzhou Institute of Quality and Technical Supervision and Inspection

This regulation entrusts the National Electromagnetic Metrology Technical Committee to be responsible for interpretation

Contents

Introduction

JJF 1002-2010 <Rules for Compilation of National Metrology Verification Regulations>, JJF1001-2011 <General Metrology Terms and Definitions> and JJF1059-2012 <Measurement Uncertainty and Expression> together constitute the basic series of specifications supporting the formulation of this regulation.

This regulation is a revision of JJG1149-2018 "Verification Regulations for Electric Vehicle Off-board Chargers (Trial)". Compared with JJG1149-2018, the main technical changes are as follows except for editorial modifications:

- Modified scope of application:
- Added the definition of the term charging connection point, and modified the definition of off-board charger:
- Insulation resistance test, payment amount error, and indication error are deleted from the verification items:
- Insulation resistance requirements have been added to the verification conditions:
- Modified selection of test load points:
- Modified the work error verification method:
- Modified the test cycle of the charger.

The previous releases of this regulation are as follows:

- JJG1149-2018

Verification Regulations for Off-board Chargers of Electric Vehicles (Trial)

1. Scope

This regulation is applicable to the first verification, follow-up verification and in-use inspection of off-board chargers for electric vehicles.

The verification of off-board chargers for electric vehicles based on statistical sampling methods can be carried out in accordance with this regulation.

2. Reference

This regulation applies the following documents

JJG842-2017 Electronic DC watt-hour meter

JJF1139 Principles and methods for determining the verification cycle of measuring instruments.

NB/T 33001-2018 Specifications for off-board conduction motors for electric vehicles

For dated references, only the dated version applies to this regulation; for undated references, the latest version (including all amendments) applies to this regulation.

3. Terminology

The following terms and definitions apply to this document

3.1. OFF BOARD CHARGER

It is a special device that is fixedly connected to an AC or DC power supply and converts its electrical energy into DC electrical energy, and charges the power battery of an electric vehicle by conduction. It has the functions of measuring DC energy, storing it, and providing results to users

3.2. CONNECTION POINT

The off-board charger is connected to the contact point of the electric vehicle.

Note: If the output cable is a fixed part of the on-board charger, this point is defined as the connector at the end of the cable. Otherwise, the connection point is defined as the cable insertion point of the off-board charger。

3.3. REAL LOAD TEST METHOD

Method of verification using actual operating load

3.4. VIRTUAL LOAD TEST METHOD

Method for testing with virtual load provided by charging machine testing device。

3.5. CONSTANT CURRENT CHARGE

The charging voltage is within the working range, and the method of charging the battery with a controlled constant current。

3.6. CONSTANT VOLTAGE CHARGE

The charging voltage is within the working range, and the method of charging the battery with a controlled constant voltage。

3.7. OPERATE ERROR

Measurement error of DC electric energy of off board charger under working conditions。

3.8. TEST OUTPUT

A device that provides pulses corresponding to the DC energy measured by off-board chargers。

3.9. CONSTANT

Value representing the relationship between the electrical energy recorded by the off-board charger and the corresponding test output value。

4. Overview

Electric vehicle off-board charger (hereinafter referred to as charger) is a metering device that provides DC power for electric vehicles. It is mainly composed of rectification and chopper control unit, display interface or data transmission interface, metering module, connection device for conductive charging and other parts. The schematic diagram of the charger is shown in Figure 1.

The charger converts the AC power into DC power through the rectification and chopper control unit, and the DC power is sent to the electric vehicle through the connection device for conductive charging to meet the charging demand. The metering module completes the measurement of the DC power and outputs the measured amount to the display interface or data transfer interface.

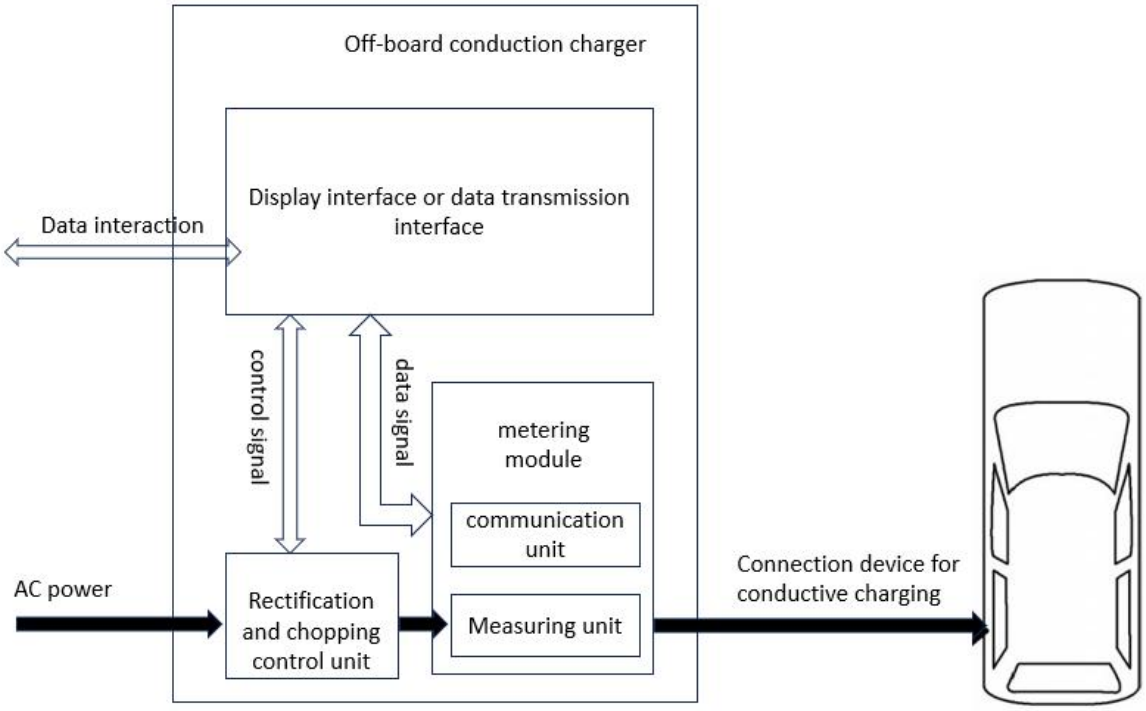

Fig. 1 Block diagram of working principle of off-board charger

5. Measurement performance requirements

5.1. Working error

The working error of the charger is expressed by relative error. Under the verification conditions specified in 7.2.1, the working error of charging should meet the requirements in Table 1. See Table 2 for the value of the average temperature coefficient of the electric energy metering of the charger.

Table 1 The working error limit of the charger

The output voltage	Output current	Charger Accuracy Class	
		CLASS 1	CLASS 2
		Working error limit	
$U_{min} \le U \le U_{max}$	$I_{min} \le I \le I_{max}$	+/- 1.0%	+/-2.0%

1. **U_{min}** and **U_{max}** are the lower limit and upper limit of the rated output voltage range of the charger respectively.
2. **I_{min}** minimum current; **I_{max}** maximum current
3. Under special ambient temperature (-20degreeC ⩽ t < -10degreeC or +40degreeC ⩽ t < +50degreeC), considering the influence of ambient temperature change, the absolute value of the working error limit should be added with the correction value e, e is a positive value
   e = C x| delta T|

In the formula:
C – Average temperature coefficient of electric energy metering of charger %/degreeC;
delta T – Ambient temperature deviation value, the difference between the current ambient temperature +40degreeC is taken at high temperature, and the difference between the current ambient temperature and -10degreeC is taken at low temperature.

The ambient temperature should be measured outside the range of 0.5m from the charger。

Table 2 Average temperature coefficient of electric energy metering of charger

The output voltage	Output current	Charger Accuracy Class	
		CLASS 1	CLASS 2
		Average temperature coefficient (%/C)	
$U_{min} \le U \le U_{max}$	$I_{min} \le I \le I_{max}$	0.05	0.10

5.2. Clock time error

For chargers with time-sharing charging function, the error of the clock time of the charger should not exceed 5s during the first verification; during subsequent verifications, it should not exceed 3min.

6. General technical requirements

6.1. Identification

There should be the following marks on the nameplate;

- name and model;

- the name of the manufacturer;

- the standards to which the product is based;

- serial number and year of manufacture;

- maximum voltage, minimum voltage, minimum current and maximum current;

-constant;

-level of accuracy;

- Unit of measure (unit of measure can be shown in the display).

NOTE：

1．For chargers installed before January 1, 2023, if the maximum current and minimum current are not marked, the maximum current value is: rated power/[(Umax+Umin)/2]; the minimum current value is: 5A.
2．For chargers installed before January 1, 2023, if the accuracy level is not marked, it will be implemented as CLASS 2.

6.2. Detection interface

The technical indicators of the test output and communication interface of the charger for verification shall meet the requirements of relevant standards.

6.3. Constants

The charger should have a pulse output corresponding to the measured DC energy, which should be consistent with the constant marked on the nameplate.

6.4. Minimum energy variable

The minimum energy variable shall be 0.001kW.h.

6.5. Display of charging power

The charger should be able to display the charging energy, and the display digits of the electrical energy should not be less than 6 digits (including at least 3 decimal places).

For chargers with time-sharing billing function, the resolution of clock time display is not greater than 1s.

7. Measuring instrument control

7.1. Initial verification, subsequent verification and in-use inspection.

The first verification is for a charger that has not been verified. Subsequent verification is any kind of verification after the first verification, and the repaired charger must be carried out according to the first verification. In-use inspection is an inspection to find out whether the verification mark or verification certificate of the charger is valid, and whether the verified charger has been significantly modified.

7.2. Test conditions

7.2.1. Test environmental conditions

- Verification conditions and their deviations do not exceed those specified in Table 3.

- There should be no obvious impact load, and the seal of the charger should be intact.

Project	Requirement	Remarks
Environment temperature	-20C~ 50C	-

Relative Humidity	≤95%	-
Voltage Ripple Coefficient (effective value)	1%	-
Output voltage allowable deviation	±0.5%	-
Output current allowable deviation	±1.0%	-
Insulation resistance	≥5MΩ	Between the non-electrically connected live circuits of the power supply equipment, each independent live circuit is between the ground (metal shell). Normal working voltage ⩽ 300V, the applied voltage is 500V, normal working voltage > 300V, the applied voltage is 1kV.
Output voltage/current deviation refers to the deviation between the displayed value output by the charger and the verified value. For the charger with liquid cooling function, it is allowed to unplug its low-voltage connector during the insulation resistance test.		

7.2.2. Measurement standards and main supporting equipment

7.2.2.1. Verification device and load

When using the virtual load verification method or the real load verification method, the performance and technical indicators of the verification device should meet the relevant requirements of JJG842-2017. The load can be electric vehicles, power battery packs, DC electronic loads or resistive loads.

7.2.2.2. Thermometer

The measurement range meets -25C~55C, and the maximum allowable error of temperature measurement does not exceed ±1C.

7.2.2.3. Reference clock

The time error of the reference clock is not greater than 1s.

7.3. Verification items and verification methods

7.3.1. Verification items

Charging Verification Item Table 4.

Table 4 Charger Verification Items

Test items	First verification	Subsequent verification	In-use inspection
Appearance and function inspection	+	+	+
work error	+	+	-
clock time error	+	+	-

Note: "+" means the item should be checked, "-" means not to be check the item

7.3.2. Verification method

7.3.2.1. Appearance and function inspection

In addition to meeting the requirements of 6.1 and 6.2, the appearance of the charger should also be checked:

-Whether the logo is complete and the handwriting is clear:

- Whether there is any obvious damage;

- Whether there are measures to prevent data input or operation by unauthorized persons;

- Display whether the number of digits complies with the regulations;

- Whether the basic functions are normal.

Note: For chargers installed before January 1, 2023, the appearance and function inspection items can be postponed until December 31, 2027.

7.3.2.2. Working error

Selection of test load point

When measuring the working error of the charger, a load point is usually selected according to Table 5. Additional load points are allowed as required.

Table 5 The load point to be selected when the charger is working error verification

charging method	Output current	The output voltage
Constant current charging	Imin ≤ I ≤ Imax	Umin ≤ U ≤ Umax
Constant voltage charging		Umax
		(Umax + Umin)/2
		Umin
Imax is the rated output maximum current of the charger, **Imin** is the rated minimum output current of the charger, **Umax** is the rated maximum output voltage of the charger, and **Umin** is the rated minimum output voltage of the charger. When the user specifically requests. When there is a non-integer, use the rounding method to round to an integer.		

Verification work error

Compare the DC power value measured simultaneously by the verification device and the charger under test to determine the working error of the charger under test.

According to the principle, it can be divided into real load test method and virtual load test method.

REAL LOAD TEST

Connect the charger calibrator and load composition verification device to the current connection point, and use **method 1** or **method 2** at the selected load point to compare the DC electric energy value measured by the verification device and the charger under test at the same time, so as to determine the Check the working error of the charger.

Method 1:

When both the charging pile calibrator and the checked charger are working continuously, the pulse output by the checked charger is used to control the counting of the charging pile calibrator to determine the working error of the checked charger. When using this method, use method 2 to check whether the charger constant is correct.

The working error (Y) of the tested charger is calculated according to (1).

$$(\mathrm{Y}) = \frac{m_0 - m}{m} \times 100\%$$

In the formula:

m – measured pulse number;

m_0 – calculate the determined number of pulses, calculated according to formula (2).

$$m_0 = \frac{C_0 N}{C_L}$$

In the formula:

N – Number of pulses of the charger under test:

C_O = calibrator constant, imp/(kW.h);

C_L = constant of the charger under test, imp/(kW.h).

Note: Select the appropriate pulse number N of the charger under test so that the quantization error of the calculated pulse number is not greater than 1/10 of the grade index of the charger under test.

Method 2:

When both the charging pile calibrator and the checked charger are working continuously, use the output power indication value of the checked charger and the measured electric energy value of the charging pile calibrator to determine the working error of the checked charger.

The working error (γ) formula of the charger under test is calculated according to (3):

$$(\gamma) = \frac{E' - E}{E} X100\% + ((Y)_0)$$

In the formula:

E'- The difference between the indicated value of the output electric energy when the charger under test stops charging and starts charging, kW.h;

E – electric energy value measured by the standard meter, kW.h;

$((Y)_0)$ – The established systematic error of the verification device, when no correction is required $((Y)_0) = 0$.

The charging pile calibrator shall run synchronously with the checked charger, and the ratio (%) of the electric energy value represented by the undigitized word (or the minimum scale value)

on the monitor of the checked charger to the accumulated E^' shall not be greater than the checked charger. 1/5 of the charger grade index.

During the verification process, record the error measurement data at least twice, and take the average value to calculate the working error.

Virtual load test

The verification device is used to compare the DC electric energy value measured by the verification device and the charger under test at the same time, so as to determine the working error of the charger under test. When using the virtual load test method, the influence of the connection position on the test results should be considered.

Refer to the provisions of 1) for the standard meter method to verify the charger

Watt-second test. Use a calibrator to measure the set constant power, or determine the power with the standard power source. The quantization error of the number of digits displayed by the calibrator or power source should not be greater than 1/10 of the grade index of the tested charger. The charger measures the time required for the charger to output several pulses at a constant power, and the actual DC power obtained by multiplying the time with the constant power is compared with the DC power measured by the charger to determine the working error of the charger.

Working error is calculated according to formula (4).

$$(\text{Y}) = \frac{m - m_0}{m_0} \times 100$$

In the formula:

m – measured pulse number;

m_0 – Calculate the determined number of pulses, calculated according to formula (5)。

$$m_0 = \frac{C_L P T_n}{3.6 \times 10^6}$$

in:

C_L - the constant of the charger under test, imp/(kW.h);

T_n – selected measurement time, s

P – set constant power value, W.

The standard timer is controlled by an automatic method, and the tested charger runs continuously, and the measurement time is not less than 10s. If the power pulse sequence sent by the calibrator or the standard power source is not uniform or the corresponding speed is slow, the measurement time needs to be increased appropriately.

During the verification process, record the error measurement data at least twice, and take the average value to calculate the working error.

7.3.2.3. Clock time error

Compare the display time of the charging pile with the display time of the reference clock, and calculate the time error ΔT of the charging pile clock according to formula (6), namely

$\Delta T=|T-T_0|$

In the formula:

T – reference clock display time, XX h XX min XXX s;

T_0 - The display time of the charging pile under inspection, XX h XX min XXX s.

, The test results should meet the requirements of 5.2.

7.4. Verification result processing

7.4.1. Processing of verification results

7.4.1.1. Judgment of all data shall be based on the rounded data。

7.4.1.2. The rounding interval of the working error is 1/10 of the accuracy level of the charger。

7.4.1.3. The rounding interval of clock time error is 1s。

7.4.2. Judgment of all data shall be based on the rounded data

7.4.2.1. Rounding off method when the rounding distance is 1: For the reserved digit number 1 on the right side of the reserved digit, if it is greater than 0.5, the reserved digit will be added by 1; if it is less than 0.5, the reserved digit will remain unchanged; if it is equal to 0.5, Then the reserved bit remains unchanged when it is an even number, and adds 1 when the reserved bit is an odd number.

Note: "Reserved digit" refers to the number corresponding to the rounding interval, and this value is called "reserved digit"

7.4.2.2. The rounding method when the rounding interval is n (n ≠1): Divide the measured data by n, and then round off according to the method in 7.4.2.1. After rounding, multiply by n, that is, the final rounding result.

7.4.3. If all items meet the requirements, it is judged as qualified, otherwise it is judged as unqualified. The chargers that pass the verification will be issued a verification certificate (see Appendix B and C for the format of the verification certificate) and a verification mark.

7.4.4. The certified charger must be sealed at the position of the electric energy meter or metering module used inside it, and the shunt used separately must also be sealed。

Note: For chargers installed before January 1, 2023, the implementation of shunt seal requirements will be suspended until December 31, 2027 under special circumstances.

7.4.5. For chargers that fail the verification, a verification result notification (see Appendix B and C for the format) will be issued, and the original verification seal or verification mark will be cancelled

7.5. Verification cycle

The verification cycle of the charger generally does not exceed 3 years, and the verification cycle can be adjusted appropriately according to the regulations of JJF1139 and the measurement administrative department. For chargers with metering performance on-line monitoring conditions or anti-cheating functions, and data output has been implemented, the verification cycle can be appropriately extended upon approval of the metering administrative department.