JJG

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

JJG 1149—2018

Off-board Charger for Electric Vehicles

2018-02-27 Release

2018-05-27 Implement

Released by the State Administration for Market Regulation

Verification Regulation of Off-board Charger for Electric Vehicles

JJG 1149—2018

Responsible unit:

Metrology Technical Committee on Electromagnetic

Main drafting unit:

National Institute of Metrology, China

Shenzhen Academy of Metrology & Quality Inspection

Participating in the drafting unit:

China Electric Power Research Institute

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

Content

Introduction

This procedure is prepared in accordance with JJF 1002-2010 ***The Rules for Drafting National Metrological Verification Regulation***.

This regulation is formulated with reference to JJG 842—2017 ***Electronic Meters for Measuring Direct-current Electrical Energy*** and NB/T 33001—2010 ***Specification for Electric Vehicle Off-Board Conductive Charger*** and other national metrology verification regulations and standards.

This regulation is released for the first time

Verification Regulation of Off-board Charger for Electric Vehicles

1 Scope

This procedure applies to the initial verification, subsequent verification and in-use inspection of Off-board Charger for Electric Vehicles.

2 Reference

This procedure cites the following documents:

JJG 842—2017 ***Electronic Meters for Measuring Direct-current Electrical Energy***

NB/T 33001—2010 **Specification for Electric Vehicle Off-Board Conductive Charger**

For dated referenced documents, only the dated version shall apply to this Regulation; for undated referenced documents, the latest version (including all amendments) shall apply 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 installed on the ground, converts AC power from the grid into DC power, and uses conduction to charge the power battery of electric vehicles.

3.2 Constant Current Charging

The charging voltage is within the working range and the battery is charged with a controlled constant current.

3.3 Constant Voltage Charging

The charging current is within the working range and the battery is charged at a controlled constant voltage.

3.4 Minimum Pay Variable

The product of the unit price and the minimum energy variable.

3.5 Working Error

DC power measurement error of the charger under on-site operating conditions.

3.6 Test Output

A device used to test the charger, provide pulses, or provide pulses corresponding to the DC power measured by the charger.

3.7 Constant

A value that represents the relationship between the DC power recorded by the charger and the corresponding test output value.

4 Overview

The charger is a special device that converts AC power from the grid into DC power and uses conduction to charge the power battery of electric vehicles. The basic components of the charger include: rectifier and chopper control unit, collection interactive terminal, metering module, conductive charging connection device, etc. Its principle structure is shown in Figure 1.

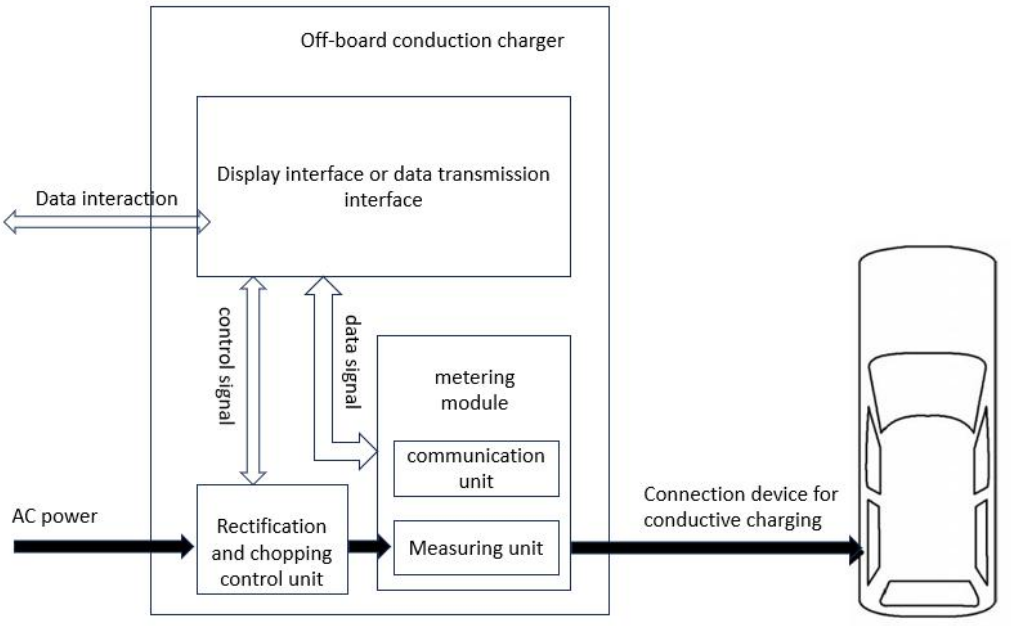

Fig. 1 Structural Diagram of the Working Principle of the Charger

5 Metrology Performance Requirements

5.1 Working Error

The working error of the charger is expressed as relative error. Under the specified site conditions, the working error limit of the charger should meet the requirements of Table 1. The values of the average temperature coefficient of DC energy measurement of the charger are shown in Table 2.

Table 1 Working Error Limit of Charger

Output Voltage [a] U	Output Current [b] I	Accuracy Class of Charger	
		Class 1	Class 2
		Working Error Limit [c]/%	
$U_{min} \le U \le U_{max}$	$I_{min} \le I \le I_{max}$	±1.0	±2.0

Note:

a. U_{min} and U_{max} are the lower limit and upper limit of the rated output voltage range of the charger respectively

b. I_{min}—minimum current； I_{max}—maximum current

C. Under special ambient temperatures (-20℃≤T<-10 ℃ or +40 ℃<T≤+50 ℃), considering the influence of ambient temperature changes, the working error limit plus the correction value e:

$$e=C\times|\triangle T|$$

In the formula:

C —Average temperature coefficient of charger DC energy measurement, %/K

△T —The ambient temperature deviation value is the difference between the current ambient temperature and +40 ℃ when the temperature is high, and the difference between the current ambient temperature and -10 ℃ when the temperature is low.

The ambient temperature should be measured at two orthogonal sections of the charger under test, and the thermometer should be close to the non-air outlet position of the charger under test. Take the average temperature measurement value at different locations of the charger under test as the ambient temperature value. Normally, 4 surfaces should be done, front, back, left and right. If the charger is installed on the wall, this measurement does not need to be made on its back.

Table 2 Average Temperature Coefficient of Charger DC Energy Measurement

Output Voltage U	Output Current I	Accuracy Class of Charger	
		1	2
		Average Temperature Coefficient(%/K)	
$U_{min} \leq U \leq U_{max}$	$I_{min} \leq I \leq I_{max}$	0.05	0.10

5.2 Indication Error

The measurement error of the charging energy displayed by the charger is expressed as relative error. Under the calibration conditions specified in 7.2.1, the indication error should meet the requirements in Table 1.

5.3 Payment Amount Error

The absolute value of the difference between the payment amount displayed by the charger and the amount payable calculated based on the unit price and the charging power indication of the charger should not exceed the minimum payment variable.

5.4 Clock Time Error

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

6 General Technical Requirements

6.1 Identification

There should be the following marks on the nameplate:

—Name and model;

—Manufacturer ;

—The standards on which the product is based;

—Serial number and year of manufacture;

—Nominal voltage, minimum current and maximum current;

—Constant;

—Accuracy class;

—Measurement unit (the measurement unit can be displayed on the display).

6.2 Detection Interface

The technical indicators of the test output interface and communication interface of the charger used for calibration should comply with relevant standards.

6.3 Constants

The charger should have a pulse output for measuring errors, which should be consistent with the constants marked on the nameplate.

6.4 Minimum Energy Variable

The minimum energy variable should be 0.001 kWh。

6.5 Display of the Charger

The charger should be able to display the charging energy, unit price and payment amount. The number of display digits for the energy should be no less than 6 digits (including at least 3 decimal places), and the payment amount should contain 2 decimal places. For charging piles with time-of-use billing function, the current time display resolution is at least 1s.

6.6 Insulation Resistance

Between the live circuits of the non-electrical connection of the power supply equipment, and between each independent live circuit and the ground (metal shell), DC voltage is applied according to Table 3, and the insulation resistance should not be less than 10 MΩ.

Table 3 Test voltage for insulation test

U_1	Insulation resistance test instrument voltage / V
60 V< U_1≤300 V	500
300 V < U_1 ≤700 V	1000
700 V<U_1≤950 V	1000
Note: U_1 is the nominal voltage when the charging pile is working normally.	

7 Measuring Instrument Control

7.1 First Verification, Subsequent Verification

The first verification is a verification of charger that have 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.

7.2 Verification Conditions

7.2.1 Verification Conditions

When verifying charger, the following conditions should be met:

a) The verification conditions and their allowable deviations shall not exceed those specified in Table 4.

b) When verifying the charger, there is no obvious impact load, the seal of the charger is complete, there are no obstacles that cannot be removed in the workplace that affect the verification, and there are no obvious safety hazards.

Table 4 Verification Conditions and Allowable Deviations

Project	Requirement	Remarks
Ambient temperature	—10 ℃~+40 ℃	The extended condition is -20℃~+50℃
Relative humidity	≤90%	—
Atmospheric pressure	63kPa～106kPa	Altitude 4000 m and below
Voltage Ripple Coefficient (Effective Value)	0.5%	—
Output Voltage Allowable Deviation	±0.5 %	—
Output Current Allowable Deviation	±1 %	—

7.2.2 Measurement Standards and Main Supporting Equipment

7.2.2.1 Verification Device and Load

The performance and technical indicators of the calibration device should comply with the relevant requirements of JJG 842-2017. The load can be an electric vehicle, a power battery

pack, a DC electronic load or a resistive load. If a DC electronic load or resistive load is used as the power load, its impedance and power should be adjustable.

7.2.2.2 Thermometer

The measurement range meets-25℃~+55℃, the graduation value is not greater than 0.2℃, and the maximum allowable error in temperature measurement does not exceed ±0.3℃.。

7.2.2.3 Reference Clock

The clock indication error of the standard clock tester used to verify the charger clock should be better than 1 second.

8 Verification Items

Charger verification items-Table 5

Table 5 Charger Verification Items

Test Items	First Verification	Subsequent Verification	In-use Inspection
Appearance and Function Inspection	+	+	+
Insulation Resistance Test	+	+	—
Working Error	+	+	—
Indication Error	+	+	+
Payment Amount Error	+	+	+
Clock Time Error	+	+	—
Note: "+" means items that should be inspected, and "-" means items that can not be inspected.			

9 Verification Method

9.1 Appearance and Function Inspection

In addition to meeting the requirements of 6.1 and 6.2, the appearance of the charger should also check the following items:

a) Whether the logo is complete and the handwriting is clear;

b) Whether there is obvious damage;

c) Are there any measures to prevent unauthorized persons from entering data or operations;

d) Whether the number of display digits meets the requirements;

e) Whether the basic functions are normal.

9.2 Insulation Resistance Test

When conducting the insulation resistance test of the charger, the voltage of the insulation resistance meter should be applied between lines that are not connected during operation. After the reading is stable, the indicated value on the insulation resistance meter should be read. The test voltage is selected according to Table 3, and the measurement results should meet the requirements of 6.6.

9.3 Working Error

9.3.1 Selection of the Test Load Point

When measuring the working error of charger, the load point is usually selected according to the Table 6. It is allowed to add error measurement points as needed.

Table 6 Load Points selected during Charger Working Error Verification

Charging Method	Output Current [a]	Output Voltage
Constant Current Charging	I_{min}	$U_{min} \leq U \leq U_{max}$
	$0.5\ I_{max}$	
	I_{max} [b]	
Constant Voltage Charging	$I_{min} \leq I \leq I_{max}$	U_{max}
		$(U_{max}+U_{min})/2$ [c]
		U_{min}

Note:

a. I_{max} is the maximum rated working output current of the charger， I_{min} is the minimum rated working output current of the charger， U_{max} is the maximum rated working output voltage of the charger， U_{min} is the minimum rated working output voltage of the charger

b. When the user has special requirements..

c. When a non-integer appears, rounding is used to an integer.

9.3.2 Working Error Verification

Compare the DC electric energy value measured simultaneously between the calibration device and the charger under test to determine the working error of the charger under test.

Charger verification using standard meter method:

a) When both the standard electric energy meter and the tested charger are working continuously, the pulses (low frequency or high frequency) output by the tested charger are used to control the count of the standard electric energy meter to determine the working error of the tested charger.

The working error γ (%) of the tested charger is calculated according to formula (1).

$$\gamma = \frac{m_0 - m}{m} \times 100 \quad (1)$$

In the formula:

m_0— the calculated (or preset) number of pulses, calculated according to formula (2);

m — measured pulses number.

$$m_0 = \frac{C_0 N}{C_L} \tag{2}$$

In the formula:

C_o—Constant of standard meter, imp/kWh;

N —The number of low-frequency or high-frequency pulses of the charger under test;

C_L—Constant of the charger under test, imp/kWh.

It is necessary to appropriately select the low-frequency (or high-frequency) pulse number N of the charger under test and the magnification switch of the standard meter, so that the calculated (or preset) pulse number and the measured pulse number meet the requirements of Table 7, and at the same time, the time limit for each test should be no less than 5s.

Table 7 Calculate (or Preset) the Number of Pulses and Display the Decimal Places of the Error of the Charger under Test

Calibration Device Accuracy Class	Class 0.05	Class 0.1	Class 0.2
Calculate (or Preset) the Number of Pulses	10000	10000	10000
Display the Decimal Place of the Error of the Charger under Test /%	0.01	0.01	0.01

b) When both the standard electric energy meter and the charger under test are working continuously, the electric energy indication value output by the charger under test and the electric energy value measured by the standard energy meter determine the working error of the charger.

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

$$\gamma=\frac{E'-E}{E}\times 100+\gamma_0 \qquad (3)$$

In the formula:

E' —the difference between the electric energy value when the charger under test stops charging and when charging starts, kWh;

E —the electric energy value measured by the standard electric energy meter, kWh;

γ_o—the determined system error of the calibration device, when there is no need to correct, γ_o=0.

The standard meter should run synchronously with the charger under test. The ratio(%) of the electric energy value represented by the last word (or the smallest division) on the display of the charger to the accumulated E' should not be greater than 1/10 of the grade index of the charger .

Under each load power, record the error measurement data at least twice and take the average value. If the average value is within the working error limit of 0.8 to 1.2 times the charger under test, conduct two more tests, and take the average of each test data to calculate the working error of the charger under test.

9.4 Indication Error Measurement

Connect the charger under test and the same-phase current line of the calibration device in series and the voltage line in parallel, and apply the maximum load to run for a period of time. After stopping operation, calculate the indication error γ (%) of the charger under test according to formula (4).

$$\gamma=\frac{E'-E}{E}\times 100+\gamma_0 \tag{4}$$

In the formula:

E' — the difference between the electric energy indication value when the charger under test stops charging and when charging starts, kWh;

E — the electric energy value measured by the standard electric energy meter, kWh;

γo — the determined system error of the calibration device, when no correction is needed, γo=0.

During calibration, the calibration device should run synchronously with the charger under test. The ratio (%) of the electric energy value represented by the last word (or the smallest division) on the display of the charger under test to the accumulated electric energy value E' should not be greater than the electric energy value E' being tested. Check 1/10 of the charger grade index.

9.5 Charging Payment Amount Error Measurement

The sum of the amount payable, which is calculated by multiplying the time-phase electricity quantity displayed on the charger by the unit price of the corresponding rate, is compared with the payment amount displayed on the charger to determine the amount error. The result should meet the requirements of 5.3.

9.5.1 Payable Amount Calculation Formula

$$A=\sum_{i=1}^{n} K_i \Delta W_{xi} \tag{5}$$

In the formula:

A — amount payable for charging, CNY (yuan);

K_i — unit price of rate i, CNY (yuan) / kWh;

n — rate number;

i — rate serial number;

$\triangle W_{xi}$ — the electric energy for this charging rate i, kWh.

9.5.2 Calculation Formula For Payment Amount Error

$$E_p = | Y_J - A | \tag{6}$$

In the formula:

E_p — payment amount error, CNY (yuan);

Yj — the payment amount displayed at the charger, CNY (yuan).

9.6 Clock Indication Error Measurement

The charger and the standard clock tester record the indication time at the same time, and the charger clock indication error ΔT is calculated according to formula (7), that is:

$$\Delta T = | T' - T | \tag{7}$$

In the formula:

T' — the display time of the charger under test, s;

T — the display time of the standard clock tester, s.

The test results shall meet the requirements of 5.4.

10 Verification Results Processing And Verification Cycle

10.1 Verification Results Processing

10.1.1 All data shall be judged based on the rounded data.

10.1.2 The rounding interval between working error and indication error is 1/10 of the charger accuracy class.

10.1.3 The rounding interval between the minimum payment variable and the amount payable is 0.01 CNY (yuan) and the rounding interval for the payment amount error is 0.01 CNY (yuan). The rounding interval of the clock indication error is 1s. If the minimum payment variable is less than 0.01 CNY (yuan), then the minimum payment variable is 0.01 CNY (yuan).

10.1.4 Measurement data rounding method

10.1.4.1 *The rounding method when the rounding interval number 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 is increased by 1; if it is less than 0.5, the reserved digit remains unchanged; if it is equal to 0.5, then when the reserved bit is an even number, it remains unchanged, and when the reserved bit is an odd number, it is increased by 1.

Note: "Reserved digit" refers to the number of digit corresponding to the rounding interval. This value is called "reserved digit".

10.1.4.2 *The rounding method when the number of rounding intervals is n (n ≠ 1):*

Divide the measured data by n, and then round it according to the rounding method in 10.1.4.1. After rounding, multiply by n, which is the final rounding result.

10.1.5 If all items meet the requirements, the charger under test will be judged as qualified; otherwise, it will be judged as unqualified. Chargers that pass the verification will be issued with a verification certificate, and a verification mark will be affixed to a prominent location on the charger.

10.1.6 Qualified chargers must be sealed at the location of the electric energy meter or metering module used inside them.

10.1.7 Chargers that fail the verification will be issued a verification result notification, and cancel the original certification seal or certification mark.

10.2 Verification Period

The calibration cycle of chargers generally does not exceed 1 year.

Appendix A

Charger verification original record format

Original record of electric vehicle charger verification

Verification Certificate/Verification Result Notification Number：

Verification Date：

Applicant： Applicant Address：

Name of Instrument: Model: Serial No.:

Manufacturer: Accuracy Class: Access Method:

Voltage: Current: Constants:

Technical Basis: Temperature: ℃ Relative Humidity: %

Supply Voltage: V Frequency: Hz

Verification Address：

<table>
<tr><td>Standard Device Name</td><td>Model</td><td>Serial No.</td><td>Verification/ Calibration Certificate No.</td><td>Validity Period</td><td>Accuracy Class</td></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td colspan="2">Test Items</td><td colspan="4">Test result</td></tr>
<tr><td colspan="2">1. Appearance and Function Inspection</td><td colspan="4">□Qualified /□Unqualified</td></tr>
<tr><td colspan="2">2.Insulation resistance</td><td colspan="4">Test voltage V, Insulation resistance value MΩ,
□Qualified /□Unqualified</td></tr>
<tr><td colspan="2">3.working error</td><td colspan="4">□Qualified /□Unqualified</td></tr>
<tr><td rowspan="2">Voltage</td><td rowspan="2">Current</td><td rowspan="2">Power Factor</td><td colspan="4">Working error/% Temperature correction value: e=</td></tr>
<tr><td>Error 1</td><td>Error 2</td><td>Average</td><td>Rounding Result</td></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td colspan="3">4. Indication error</td><td colspan="4">□Qualified /□Unqualified</td></tr>
<tr><td rowspan="2">Apply maximum load operation</td><td colspan="3" rowspan="2">Checked value/kWh
Temperature correction value: e=</td><td rowspan="2">Standard indication E/kWh</td><td rowspan="2">Error %</td></tr>
<tr><td>Before E′</td><td>After E′</td><td>E′</td></tr>
</table>

5.Payment amount error		□Qualified /□Unqualified			
Display payment amount/CNY (yuan)	Charge payable amount/CNY (yuan)			Error CNY (yuan)	
	Charging power/kWh	Unit price / (CNY (yuan)/kWh)	Amount/ CNY (yuan)		
6.Clock indication error		□Qualified /□Unqualified			
Clock indication error		Charging pile display time	Standard clock display time	Indication error/s	
Verification conclusions and instructions		□Qualified /□Unqualified			

Inspector: Verifier:

Appendix B

Verification Certificate/Calibration Result Notification Inner Page Format (page 2)

Certificate No ××××××-××××

Verification agency authorization instructions				
Verification environmental conditions and location:				
Temperature	℃	Address		
Relative humidity	%	other		
Measurement (base) standard device used for calibration				
Name	Measurement Range	Uncertainty/Accuracy Class /Maximum allowable error	Metrology (basic) standard certificate number	Valid date to
Standard instrument used for verification				
Name	Measurement range	Uncertainty/Accuracy Class /Maximum allowable error	Verification/calibration certificate No	Valid date to

Page × of ×

Appendix C

Verification Certificate/Calibration Result Notice Calibration Result Page Sample

(Page 3)

C.1 Verification certificate page 3

Certificate No ××××××-××××

Verification Results

1. Appearance and function inspection

2.Insulation resistance test：

3.working error：

Voltage	Current	Working error / %

4.Indication error:

5.Payment amount error

6.Clock indication error:

Page × of ×

C.2 Verification result notification page 3

Certificate No ××××××-××××

Verification Results

1.Appearance and function inspection

2.Insulation resistance test：

3.Working error：

Voltage	Current	Working error / %

4.Indication error:

5.Payment amount error

6.Clock indication error:

Unqualified items:

Page × of ×