JJG

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

JJG 1148—2018

AC Charging Spot for Electric Vehicles

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Verification Regulation of AC Charging Spot for Electric Vehicles

JJG 1148—2018

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

Contents

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 596-2012***Verification Regulation of Electrical Meters for Measuring Alternating-current Electrical Energy***, JJG 597-2005 ***Verification Regulation of Verification Equipment for AC Electrical Energy Meters***, DL/T 1478-2015 ***On-site Inspection Procedures for Electronic AC Watt-hour Meter***, NB/T 33002-2010 ***Specification for electric vehicle AC charging point*** and other national metrology verification regulations and standards.

This regulation is released for the first time.

Verification Regulation of AC Charging Spot for Electric Vehicles

1. Scope

This procedure applies to the initial verification, subsequent verification and in-use inspection of AC charging spots for electric vehicles (hereinafter referred to as charging spot).

2. Reference

This procedure cites the following documents:

JJG 596—2012 ***Electronic AC energy meter***

JJG 597—2005 ***AC energy meter calibration device***

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 AC Charging Spot

A special power supply device that uses conduction to provide AC power for electric vehicles with on-board charging equipment.

3.2 Real Load Test Method

Calibration method using actual operating load.

3.3 Virtual Load Test Method

A method of verification using the simulated load provided by the charging spot verification device.

3.4 Minimum Pay Variable

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

3.5 Working Error

AC power measurement error of charging spot under on-site operating conditions.

3.6 Test Output

A device used to test charging spots, provide pulses, or provide pulses corresponding to the AC power measured by the charging spots.

3.7 Constant

A value that represents the relationship between the electric energy recorded by the charging spot and the corresponding test output value.

3.8 Nominal Voltage

The voltage at which the charging spot works normally.

4. Overview

Charging spot refers to a special power supply device that uses conduction to provide AC power for electric vehicles with on-board charging equipment. The charging spot consists of a conductive charging connection device, a control unit, a metering module, a collection interactive terminal and other parts. Its principal structure is shown in Figure 1.

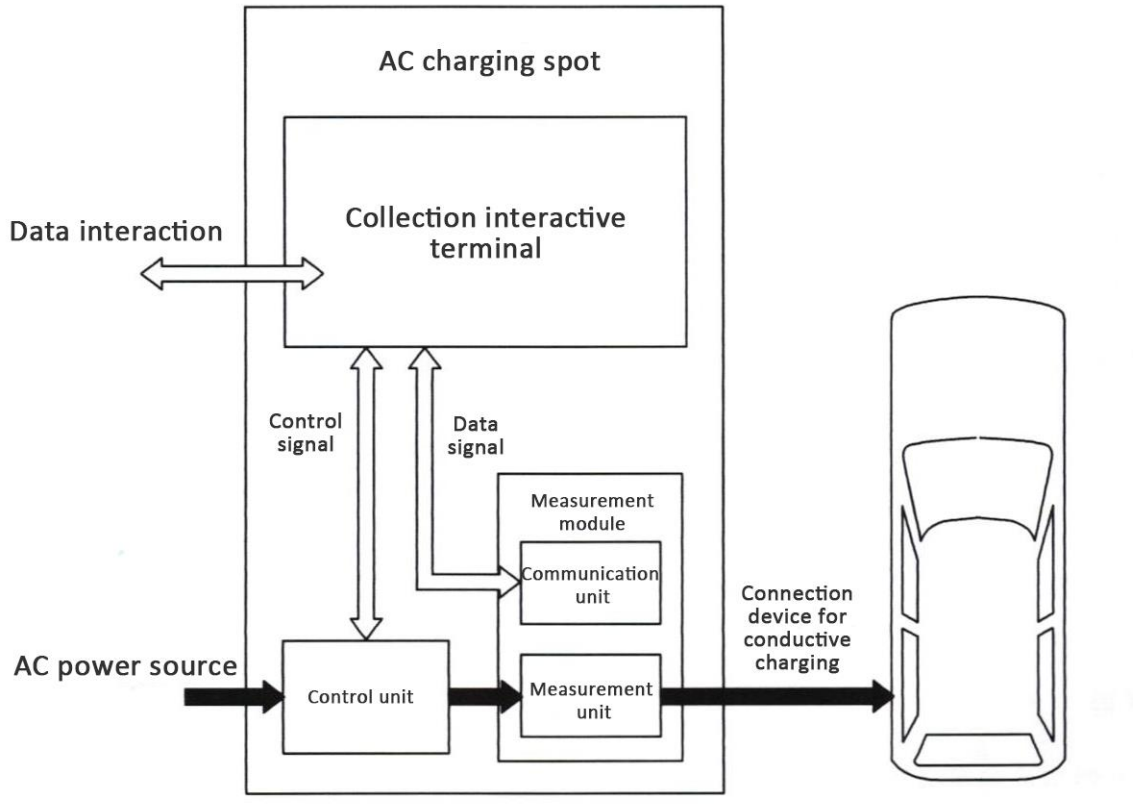

Figure 1 Structural diagram of the working principle of the charging spot

5. Metrology Performance Requirements

5.1 Working error

The working error of the charging spot is expressed as relative error. Under the specified verification conditions, the working error limit of the charging spot should meet the requirements of Table 1. The values of the average temperature coefficient of electric energy measurement at charging spot are shown in Table 2.

Table 1 Working error limits of charging spot

Load current I[a]	Power factor $\cos\varphi$[b]	Accuracy class of charging spot	
		1	2
		working error limit [c]/%	
$I_{min} \le I \le I_{max}$	1	±1.0	±2.0

Note:

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

b. ϕ is the phase difference between the phase voltage and phase current of the load branch.

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 charging spot electric energy measurement, %/K;

△T - Ambient temperature deviation value. When the temperature is high, it is the difference between the current ambient temperature and +40 ℃. When the temperature is low, it is the difference between the current ambient temperature and -10 ℃.

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

Table 2 Average temperature coefficient of charging spot electric energy measurement

Load current I	Power factor $\cos\varphi$	Accuracy class of charging spot	
		1	2
		Average temperature coefficient /(%/K)	
$I_{min} \le I \le I_{max}$	1	0.05	0.10

5.2 Indication Error

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

5.3 Payment Amount Error

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

5.4 Clock Time Error

For charging spot with time-sharing charging function, the clock indication error of the charging spot 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 charging spot used for calibration should comply with relevant standards.

6.3 Constants

The charging spot 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 Charging Spot

The charging spot 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 spots 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
Note: U_1 is the nominal voltage when the charging spot is working normally.	

7 Measuring Instrument Control

7.1 First Verification, Subsequent Verification

The first verification is a verification of charging spot that have not been verified; subsequent verification is any kind of verification after the first verification, and the repaired charging spot must be carried out according to the first verification.

7.2 Verification Conditions

7.2.1 Verification Environmental Conditions

When verifying charging spot, 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 charging spot, there is no obvious impact load, the seal of the charging spot 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
Charging spot output voltage allowable deviation	±10%	—
Charging spot output current allowable deviation	±5%	—
Charging spot output power factor	≥0.90	—
Charging spot output voltage and current waveform	Waveform distortion ≤5%	—

7.2.2 Measurement Standards and Main Supporting Equipment

7.2.2.1 Verification Device and Load

When using the virtual load test method or the real load test method, the calibration device should comply with the relevant requirements of JJG 597-2005. The load can be an electronic load or a physical load, and 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 charging spot clock should be better than 1 second.

8. Verification Items

Charging spot verification items-Table 5

Table 5 Charging Spot 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 charging spot 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 charging spot, 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 Operation Error

9.3.1 Selection of the Test Load Point

When measuring the working error of charging spot, 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 that should be selected when verifying the working error of charging spot

Power factor $\cos\varphi$	Load current I
1	I_{max}, $0.5\ I_{max}$, I_{min}

9.3.2 Working Error Verification

Compare the electric energy value measured simultaneously between the calibration device and the charging spot under inspection to determine the working error of the charging spot under inspection.

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

9.3.2.1 Real Load Test

The calibration device is composed of a standard electric energy meter and a power load. Under the specified load point, the standard meter method is used to compare the electric energy values measured simultaneously by the calibration device and the charging spot under test to determine the error of the charging spot under test.

Charging spot verification using standard meter method:

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

The working error γ (%) of the inspected charging spot 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.

$$m_0 = \frac{C_0 N}{C_L} \quad (2)$$

In the formula:

C_0—Constant of standard meter, imp/kWh;

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

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

It is necessary to appropriately select the low-frequency (or high-frequency) pulse number N of the charging spot 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 Calculated (or preset) pulse number, number of display digits of the power meter or power source, and decimal places of the error of the charging spot 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
Number of digits displayed by a power meter or power source	6	6	6
Display the decimal place of the error of the charging spot under test /%	0.01	0.01	0.01

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

The working error γ (%) of the charging spot 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 charging spot under test stops charging and when charging starts, kWh;

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

γ_0—the determined system error of the calibration device, when no correction is needed, γ_0=0.

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

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 charging spot under test, conduct two more tests, and take the average of each test data to calculate the working error of the charging spot under test.

9.3.2.2 Virtual Load Test

Disconnect the charging spot under test from the power grid, use a calibration device, and compare the electric energy values measured simultaneously by the calibration device and the

charging spot under test at the specified load point to determine the error of the charging spot under test.

The standard meter method for testing charging spot shall be implemented in accordance with the provisions of 9.3.2.1.

Test the charging spot using the watt-second method. Use a standard power meter to measure the set constant power, or use a standard power source to determine the power. The number of digits displayed by the power meter or power source should meet the requirements of Table 7. At the same time, use a standard timer to measure the time required for the charging spot to output several pulses at constant power. The actual electric energy obtained by multiplying this time with the constant power is compared with the electric energy measured by the charging spot to determine the relative error of the charging spot.

The relative error is calculated according to formula (4):

$$\gamma = \frac{m - m_0}{m_0} \times 100 \tag{4}$$

In the formula:

m —the number of measured pulses, imp;

m_0—the calculated (or preset) number of pulses, imp, is calculated according to formula (5).

$$m_0 = \frac{C_L P T_n}{3.6 \times 10^6} \tag{5}$$

In the formula:

C_L—constant of the charging spot under test, imp/kWh; s

P—set constant power value, W;

T_n—Selected measurement time, s.

Use an automatic method to control the standard timer, the charging spot under test operates continuously, and the measurement time is not less than 10 seconds. If the power pulse sequence sent by the standard power meter or standard power source is not uniform enough or its response speed is slow, the measurement time needs to be appropriately increased.

Under each load power, record the error measurement data at least twice and take the average value. If the pulse number of the tested charging spot cannot be collected correctly, the measured data will be discarded. The obtained relative error is equal to 0.8 to 1.2 times the working error

limit of the charging spot under test. Take two more tests, and take the average of each measurement data to calculate the relative error.

9.4 Indication Error Measurement

Connect the charging spot 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 charging spot under test according to formula (6).。

$$\gamma=\frac{E'-E}{E}\times 100+\gamma_0 \tag{6}$$

In the formula:

E' — the difference between the electric energy indication value when the charging spot 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 charging spot under test. The ratio (%) of the electric energy value represented by the last word (or the smallest division) on the display of the charging spot 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 charging spot 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 charging spot by the unit price of the corresponding rate, is compared with the payment amount displayed on the charging spot to determine the amount error. The result should meet the requirements of 5.3.

9.5.1 Payable Amount Calculation Formula

$$A=\sum_{i=1}^{n} K_i \Delta W_{xi} \tag{7}$$

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

$$E_p = | Y_J - A | \tag{8}$$

In the formula:

E_p — payment amount error, CNY (yuan);

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

9.6 Clock Indication Error Measurement

The charging spot and the standard clock tester record the indication time at the same time, and the charging spot clock indication error ΔT is calculated according to formula (9), that is:

$$\Delta T = | T' - T | \tag{9}$$

In the formula:

T' — the display time of the charging spot 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 charging spot 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 digits 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 charging spot under test will be judged as qualified; otherwise, it will be judged as unqualified. Charging spots that pass the verification will be issued with a verification certificate, and a verification mark will be affixed to a prominent location on the charging spot.

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

10.1.7 Charging spots that fail the verification will be issued a verification result notification, and the original verification seal or verification mark will be canceled.

10.2 Verification Period

The calibration cycle of charging spots generally does not exceed 1 year.

Appendix A

Charging spot verification original record format

Original record of electric vehicle AC charging spot 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: Phase Line: Constants:

Technical Basis: Temperature: ℃ Relative Humidity: %

Nominal Voltage: V Frequency: Hz

Verification Address：

<table>
<tr><td>Standard device</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="3">Test Items</td><td colspan="3">Test result</td></tr>
<tr><td colspan="3">1. Appearance and function inspection</td><td colspan="3">□Qualified /□Unqualified</td></tr>
<tr><td colspan="3">2.Insulation resistance</td><td colspan="3">Test voltage V, Insulation resistance value MΩ, □Qualified /□Unqualified</td></tr>
<tr><td colspan="3">3.Working error</td><td colspan="3">□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="3">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>
<tr><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td colspan="3">5.Payment amount error</td><td colspan="4">□Qualified /□Unqualified</td></tr>
<tr><td colspan="2">Display payment</td><td colspan="4">Charge payable amount/CNY (yuan)</td><td>Error</td></tr>
</table>

amount/CNY (yuan)	Charging power/kWh	Unit price / (CNY (yuan)/kWh)	Amount/ CNY (yuan)	CNY (yuan)
6.Clock indication error	□Qualified /□Unqualified			
Clock indication error		Charging spot 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

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：

□Single-phase/□Three-phase balanced load working error/%

Voltage	Current	cosφ=1

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：

☐Single-phase/☐Three-phase balanced load working error/%

Voltage	Current	cosφ=1

4.Indication error:

5.Payment amount error

6.Clock indication error:

Unqualified items:

Page × of ×