

	Technical Specification for Verification and Inspection of Electricity Meters		No.	CNMV 46
			Edition	5th Edition
1. These Guidelines are formulated in accordance with Paragraph 2 of Article 14 and Paragraph 2 of Article 16 of the Weights and Measurements Act.				
2. The promulgation dates, document numbers, and enforcement dates of these Guidelines and made revisions are as follows:				
Edition	Promulgation Date	Document No. (Jing Biao 4)	Enforcement Date	Revision
1	May 9,2003	No. 09240005130	Jul 1,2003	
2	Oct 10, 2005	No. 09440003540	Jul 1,2005	Addition of requirements for verification of electronic electricity meters with the var-hour measurement function.
3	Feb 2,2010	No. 09940000540	Mar 16,2010	Addition of definition of related terminology and requirements for heat and fire resistance tests.
4.	Apr 10,2013	No. 10240012290	Jul 1,2013	Listing the categories exclusive from this technical specification, adding the maximum application period of electricity meters and amending the formular for calculating the maximum permissible errors of verification of meters.
5.	Aug 18,2016	No. 10540014790	Aug 18,2016	Add the requirement on the validity of verification and maximum working life for magnetic bearings meters that passed verification by March 16, 1993
3. The criteria applied in these Guidelines are as follows:				
CNS 11437	Instrument transformers (90/12/31)			
IEC 60695-2-10	Fire hazard testing - Part 2-10 : Glowing/hot-wire based test methods – Glow-wire apparatus and common test procedure (2000-10)			
IEC 60695-2-11	Fire hazard testing - Part 2-11 : Glowing/hot-wire based test methods – Glow-wire flammability test method for end-products (2000-10)			
IEC 60695-2-12	Fire hazard testing - Part 2-12 : Glowing/hot-wire based test methods – Glow-wire flammability test method for materials (2000-10)			
Promulgated on: Aug 18, 2016	Bureau of Standards, Metrology and Inspection, Ministry if Economic Affairs		Enforced on Aug 18, 2016	

1 Scope

1.1 This specification applies to watt-hour meters, var-hour meters, watt-hour demand meters, static electricity meters (hereafter all referred to electric meters) as well as current transformers and voltage transformers (hereafter all referred to instrument transformers) matched to electric meters subject to verification and inspection portable electric meters.

1.2 This specification does not apply to:

- (1) Watt-hour meters attached to electrical products.
- (2) Watt-hour meters attached to converters/inverters.
- (3) Panel meters.
- (4) Portable measuring meters.
- (5) Reference electricity meters.
- (6) DC watt-hour meters.
- (7) Energy Transducers.
- (8) Watt-hour meters with voltage over 600V.
- (9) Watt-hour meters with secondary rated current less than 5A current transformers.
- (10) Current transformers with secondary rated current less than 5A.
- (11) Instrument transformers of nominal system voltage is greater than 69kV.

2. Terminology

2.1 Electricity meter

An instrument intended to measure electrical energy by integrating power with respect to time and to store the result.

2.1.1 Watt-hour meter

An electricity meter that is intended to measure active electrical energy by integrating power with respect to time and to store the result. The active energy is normally displayed by kilowatt-hour.

2.1.2 Var-hour meter

An electricity meter that is intended to measure inactive electrical energy by integrating power with respect to time and to store the result. The inactive energy is normally displayed by kilovar-hour as the units of measurement.

2.1.3 Watt-hour demand meter

An electricity meter that consists of Watt-hour meter and Demand meter intends to measure and record total electricity consumption and the maximum demand in a certain interval. The Watt-hour demand meter normally displays in kilowatt-hour as the units of measurement.

2.1.4 Static electricity meter

An electricity meter that is intended to measure active electrical energy by integrating power with respect to time and to store the result via the current and voltage acting on electronic assembly and producing an output proportional to Watt-hour, Var-hour, or demand measured. The static electricity meter normally displays in kilowatt-hour, kilovar-hour and

kilowatt as the units of measurement.

2.1.5 Portable measuring meter

An electricity meter when installed in circuitry or devices, without power down condition, can be disconnected or disassembled by user without tools required and easy to carry.

2.1.6 Reference Electricity meter

A device that is intended to measure electrical energy and when used in a laboratory under controlled environment, can obtain very high accurate and stable result. It is mainly used as an indoor-calibrator in a laboratory. A reference electricity meter may not be equipped with a totalizer to continuously record the cumulative total energy or a gadget to reset the totalizing to a zero when required.

2.1.7 DC power meter

A watt-hour meter that is intended to measure DC electrical energy.

2.1.8 Panel Meter

An electric meter, such as collective digital watt-hour meter, that is mainly embedded in a distribution panel or an electrical equipment for power monitoring and management, and usually measuring voltage, current, power efficiency, and electrical energy.

2.1.9 Converter/Inverter

A converter is a device that converts alternative current (AC) to another AC format or direct current (DC) power format; and an inverter is a device that converts DC into AC.

2.1.10 Energy Transducer

An electronic device that can be used to measure electricity energy, and to measure output by DC pulse. The energy transfer is mainly installed on distribution panels or electrical equipments as power monitoring and management.

2.2 Instrument transformer

Instrument transformers include current transformers and voltage transformers. They make the secondary current and voltage proportional to those of the primary in order to measure or control.

2.2.1 Current transformer (CT)

A current transformer is a type of instrument transformer. Its primary coils connect, in series, to a current-carrying conductor under measure or control. In order to measure or control easily, the current of its secondary coils is proportional to that of primary coils.

2.2.2 Voltage transformer (VT; also called potential transformer, PT)

A voltage transformer is a type of instrument transformer. Its primary coils connect, in series, to a voltage circuit under measure or control in series. In order to measure or control easily, the voltage of its secondary coils is proportional to that of primary coils.

3. Power factor 0 in this specification regulation means zero leg, 0.5 power factor means 0.5 leg, and 0.866 power factor means 0.866 leg.
4. Documents review: each model of watt-hour meter submitted for verification for the first time should provide following documents:
 - (1) Weights and measures business license,
 - (2) The certificate of origin (for importers),
 - (3) Certificates and retive documents of heat resistant and fireproof performance test of electricity meters.
- 4.1 Heat resistant and fire proof performance tests for electricity meters:

In order to keep the safety of electricity meters and prevent the meters from fire hazard, the terminal block, socket, and cover shall not contact electrification components. Testing procedure shall be conducted as IEC 60695-2-10, IEC 60695-2-11, IEC 60695-2-12, or CNS 14607 and the test temperature shall be as below:

 - (1). Terminal block: $960^{\circ}\text{C} \pm 15^{\circ}\text{C}$.
 - (2). Socket and cover: $650^{\circ}\text{C} \pm 10^{\circ}\text{C}$.
 - (3). Test duration: $30\text{sec} \pm 1 \text{ sec}$.
 - (4). The point contacting with the glow-wire can be selected randomly. The meter that the terminal block and meter base are integrated, only the terminal block is testing needed.
- 4.2 A certificate of testing conducted by a third party laboratory in accordance with the requirements in Section 4.1 is needed for each model of electricity meters. However, different models of meters with same material and specifications may be submitted related documents for review and waived of testing certificates.
5. Verification and Inspection equipments: Verification and inspection equipment shall have been calibrated with traceability and uncertainty.
 - (1) Watt-hour standard:

Accuracy: not greater than $\pm 0.3\%$ (under rated voltage, rated current, rated frequency, and power factor 1.0).

Accuracy: not greater than $\pm 0.4\%$ (at rated voltage, rated current, rated frequency, and power factor 0.5).
 - (2) Var-hour standard with feature of Power factor 0 and 0.886.
 - (3) High resistance meter: DC 500v.
 - (4) Single-phase 2-wire electric meter verification platform: test voltage 110v/220V, test current 0A~60A, test frequency 60Hz.
 - (5) Single-phase 3-wire electric meter verification platform: test voltage 110v/220V, test current 0A~60A, test frequency 60Hz.
 - (6) 3-phase electric meter verification platform: test voltage 110v/220V, test current 0A~60A, test frequency 60Hz.

- (7) Demand meter verification platform: test voltage 110v/220V, test current 0A~60A, test frequency 60Hz.
- (8) Single-phase static electric meter verification platform: test voltage 110v/220V, test current 0A~60A, test frequency 60Hz.
- (9) 3-phase static electric meter verification platform: test voltage 110v/220V, test current 0A~60A, test frequency 60Hz.
- (10) Standard current transformer: 5A~5,000A, accuracy within $\pm 0.1\%$.
- (11) Standard voltage transformer: 3.3kV~69kV, accuracy within $\pm 0.1\%$.
- (12) Alternating current voltage resistance test device: alternating current 0V~150kV, accuracy within $\pm 3\%$.
- (13) Current transformer verification platform: test current 0A~5kA, test frequency 60Hz.
- (14) Voltage transformer verification platform: test voltage 0V~69kV, test frequency 60Hz.

6. Verification procedures

6.1 The verification items shall be as below:

- (1) Structure.
- (2) Insulation.
- (3) Creep movement.
- (4) Starting.
- (5) Accuracy.

6.1.1 Structure

6.1.1.1 The markings, labels and graduation lines on electric meters shall be easy scrutiny, wear-resistant and no error-reading concerned.

6.1.1.2 Appearance marking

Electricity meters shall be marked with the following information clearly:

- (1) Name of device.
- (2) Name or logo of manufacturer.
- (3) Model and serial number.
- (4) Number of circuit phases and wires.
- (5) Rated voltage and frequency.
- (6) Basic current (or testing current) and rated current (or current grade, maximum current).
- (7) Year of manufacture.
- (8) Meter constant.
- (9) Accuracy class index: Class 0.2, Class 0.5, Class 1, and Class 2.

However, Class 2 may exempt from labeling accuracy index required.

- (10) For static electric meters, indication of functions code or labeling (such as watt-hour, var-hour, watt-hour demand, time of use rates, or communication, etc.).
- (11) Additional marking required for Meters embeded with instrument transformers.

- 6.1.1.3 The basic current (or testing current) of electricity meters used with no attachment of other devices shall be 10A, 5A, 20A, 30A, 40A, or 50A; while electricity meters used with instrument transformers shall be 2.5A or 5A.
- 6.1.1.4 The indication unit of electricity meters shall be marked on the nameplate of the counter for easy reading.
- 6.1.1.5 *The font of the rotary counter shall be not smaller than 4mm in width and 5mm in height, but the decimal digits may be a little smaller.* 3.5 The font of the rotary counter shall be not smaller than 4mm in width and 5mm in height, but the decimal digits may be a little smaller.
- 6.1.1.6 Counters including decimal digits shall be designed so that the integer and the decimal digits are easy distinguished and no error reading.
- 6.1.1.7 The mechanical structure of electric meters must be sturdy and durable. All moving parts shall be well secured to the meter base and covered by the meter cover. Packing is required between the meter base and meter cover to prevent dust and other foreign objects from interrupt.
- 6.1.1.8 There shall be a proper position for the sealing to seal the meter base and meter cover. Internal parts shall be inaccessible without breaking the sealing.
- 6.1.1.9 There shall be a proper position for the sealing to seal the meter base and the meter socket. Internal wiring shall not be modified without breaking the sealing.
- 6.1.1.10 Under normal use, the bearings and indicators of an electric meter shall be sturdy, durable not likely to malfunction.
- 6.1.1.11 Static watt-hour meters should be equipped with red or near-infrared light output device so that they can be verified, monitored or measured their output easily by the verification equipments, or connected to other monitoring equipments by wiring or coupling.

6.1.2 Insulation

When using a high resistance meter to verify electricity meters at 500V Dcmeasuring with a 500V DC high resistance meter, the insulation resistance value between each coil inside the electric meter and the casing shall be more than $5M\Omega$, and the insulation resistance value between the voltage coil and between two the current coils shall also be more than $5M\Omega$. The test temperature shall be $296K \pm 5K$ ($23^{\circ}C \pm 5^{\circ}C$).

6.1.3 Creep movement

When implementing verification or inspection of creep movement of electricity meters under rated frequency and 110% rated voltage, if there is no current passing through the current coil, the disc of the electric meter shall not turn more than one revolution in 20 minutes, and for static electric meters shall not produce more than 1 pulse.

6.1.4 Starting

For verification of the starting current of electricity meters, procedure shall begin at the point of the current being activated under a rated voltage and a rated frequency at the power factors 1.0 for watt-hour meters, 0 for var-hour meters shown in Table 1.

Table 1

Type of Electric Meter	Power Factor	Starting Current of Each Accuracy Class "Bases (or Test) Current (%)"								
		Watt-hour Meter/Watt-hour Demand Meter			Var-hour Meter	Static Electric Meter				
		Class 0.5	Class 1	Class 2		Class 0.2	Class 0.5	Class 1	Class 2	Class 3
Direct connected meter	1.0	0.5	0.5	1.0	—	0.4	0.4	1.0	1.0	—
	0	—	—	—	1.0	—	—	—	1.0	1.0
Transformer operated meter	1.0	0.5	0.5	1.0	—	0.2	0.2	0.5	0.5	—
	0	—	—	—	1.0	—	—	—	0.5	0.5

6.1.5 Accuracy

6.1.5.1 Electric Meter accuracy test, under the rated voltage, rated frequency, the test conditions are shown in Table 2:

Table 2

Type of Electric Meter			Watt -hour meter/Watt-hour demand meter/ Static watt-hour meter (with watt-hour /demand function)	Var-hour Meter/ Static watt-hour meter (with Var-hour function)
Test conditions				
Reference current	100%	Power Factor	1	0
			0.5	0.866
	10%		1	0

6.1.5.2 For transformer operated electricity meters, the test current shall be as the rated secondary current of the corresponding transformer.

6.1.5.3 For 3-phase, 3-wire watt-hour meter with power factor 0.5, shall be tested both its positive phase sequence and reverse phase sequence.

6.1.5.4 For single-phase, 3-wire watt meter with power factor 1.0 and reference (or test) current 100%, each component shall be tested for its errors of current circuit.

6.1.5.5 For 3-phase 3-wire electronic watt-hour meter with watt-hour portion power factor 0.5 should test positive phase sequence and reverse phase sequence.

6.1.5.6 For single-phase 3-wire static electricity meters electronic with watt-hour portion power factor 1.0 and reference (or test) current 100%, shall be tested both its positive phase sequence and reverse phase sequence.

6.1.5.7 The formulae of calculating the verification error for watt-hour meter are

as follows:

- (1) for watt-hour meter, var-hour meter:

$$\text{Error (\%)} = [(\text{indicated value} - \text{standard value}) / (\text{standard value})] \times 100\%$$
- (2) for demand portion of watt-hour demand meter:

$$\text{Difference (\%)} = [(\text{indicated value} - \text{standard value}) / (\text{Full scale value on demand meter})] \times 100\%$$
- (3) for demand portion of no full scale mark watt-hour demand meter:

$$\text{Error (\%)} = [(\text{indicated value} - \text{standard value}) / (\text{standard value})] \times 100\%$$
- (4) for watt-hour difference of watt-hour demand meter follows watt-hour meter regulations.
- (5) for static watt-hour meter regulations as follows:
 - (a) for the watt-hour portion of static watt-hour meters follow the formular for watt-hour meters.
 - (b) for the var-hour portion of static watt-hour meters follow the formular for var-hour metes.
 - (c) for the demand portion of static watt-hour meters follow the formular for demand portion of matt-hour demand meter regulations.

6.2 The verification and inspection items against instrument transformers are as follows:

- (1) Structure.
- (2) Power frequency voltage resistance.
- (3) Polarity.
- (4) Accuracy.

6.2.1 Structure

6.2.1.1 Appearance mark

Mark should be in prominent location with following information:

- (1) Name of equipment.
- (2) Name or logo of manufacturer.
- (3) Model and series number and year of manufacture.
- (4) Rated primary and secondary voltages (voltage transformer); rated first, secondary current (current transformers).
- (5) Rated frequency.
- (6) Rated output and corresponding level of accuracy.
- (7) Maximum voltage or nominal system voltage of equipment.
- (8) Insulation class.

6.2.1.2 Ther eshall be a proper position for sealing to seal on every instrument transformer. When there is any of following circumstances, following requirements shall be complied.

- (1) The tapping terminal for switch of the instrument transformer and other major portion shall have seal devices for verification. Without breaking the

seal devices, the functions of the instrument transformer shall not be changed.

- (2) The cover and other important removable portion shall be equipped with seal devices.
- (3) When a cover is installed for the secondary terminals, a seal device shall be equipped..
- (4) If there are any additional requirements, a seal device shall be equipped for the primary terminals.

6.2.2 Power Frequency resistant voltage

- (1) Instrument transformers not subject to the CNS 11437, can be tested according to the rated output, rated primary and secondary voltages, rated primary and secondary currents, and rated frequency indicated on the nameplate.
- (2) The voltage resistances of primary power-frequency of instrument transformers are shown in Table 3.

Table

Maximum voltage of equipment U_m (rms) kV	Nominal system voltage (NSV) (rms) kV	Power frequency strength voltage (rms) kV	Rated lightning surge voltage (full waveform wave peak) kV
0.25	0.22	2.5	---
0.46	0.44	3	---
0.66	0.60	4	---
1.20	1.10	6	---
3.60	3.30	10	30
		16	45
7.20	6.60	20	45
		26	60
12.00	11.40	28	75
		34	95
13.97	13.20	34	110
17.50	16.50	40	125
24.00	22.80	50	150
36.50	34.50	70	200
72.50	69.00	140	350

- (3) The earth voltage transformer does not need to implement the strength test of primary power frequency.
- (4) Among the secondary windings sets and between secondary windings of the multi- secondary winding instrument transformer, their strength

voltage test of the primary windings power frequency shall be 2.5 kV (rms).

6.2.3 Polarity

Instrument transformers shall be subtractive polarity.

6.2.4 Accuracy

6.2.4.1 The testing of instrument transformers accuracy shall be done at rated frequency and rated loading, the testing conditions are as shown in Table 4.

Table 4

Test conditions	Current transformer		Voltage transformer		
Rated primary current	100%	10%	-	-	-
Rated primary voltage	-	-	90%	100%	110%
Power Factor	0.8				

6.2.4.2 Instrument transformers not subject to the CNS 11437, can be tested according to the rated output, rated primary and secondary voltages, rated primary and secondary currents, and rated frequency indicated on the nameplate.

6.2.4.3 The difference formula of instrument transformer are as follows:

(1) For current transformer:

$$\text{Error (\%)} = [(k_n I_s - I_p) / I_p] \times 100\%$$

(2) For voltage transformer:

$$\text{Error (\%)} = [(k_n U_s - U_p) / U_p] \times 100\%$$

k_n = Rated transformation ratio

I_p = Actual primary current

I_s = Actual secondary current when I_p circulates

U_p = Actual primary voltage

U_s = Actual secondary voltage when U_p is on

7. Inspection

Agencires(institues) which conducting verification may follow all or part of this technical specification and decide to test all or some items listed in this specification to implement inspection.

8. Maximum permissible errors for verification and inspection

The maximum permissible errors for verification and inspection will be plus and minus.

8.1 For watt-hour meter

8.1.1 The maximum permissible errors for watt-hour meters are shown in Table 5.

Table 5

Accuracy class	Power factor	Base (or test) current (%)	Permissible tolerance (%)	Inspection tolerance (%)
Class 0.5	1.0	100	0.5	0.5
		10		
	0.5	100	0.5	0.5

Class 1	1.0	100	1.0	1.0
		10		
	0.5	100	1.0	1.0
Class 2	1.0	100	2.0	2.0
		10		
	0.5	100	2.5	2.5

8.1.2 The maximum permissible errors for var-hour meter regulations are shown in Table 6.

Table 6

Power factor	Base (or test) current (%)	Permissible tolerance (%)	Inspection tolerance (%)
0	100	2.5	2.5
	10		
0.866	100	2.5	2.5

8.1.3 The maximum permissible errors for watt-hour demand meter: the watt-hour portion is shown in Table 7, the demand portion is shown in Table 8.

Table 7

Power factor	Base (or test) current (%)	Permissible tolerance (%)	Inspection tolerance (%)
1.0	100	2.0	3.0

8.1.4 The maximum permissible errors for the watt-hour, the var-hour and the demand of electronic watt-hour meters are as following:

(1) The watt-hour portion is shown in Table 8.

Table 8

Accuracy class	Power factor	Base (or test) current (%)	Permissible tolerance (%)	Inspection tolerance (%)
Class 0.2	1.0	100	0.2	0.2
		10		
	0.5	100	0.3	0.3
Class 0.5	1.0	100	0.5	0.5
		10		
	0.5	100	0.6	0.6
Class 1	1.0	100	1.0	1.0
		10		
	0.5	100	1.0	1.0
Class 2	1.0	100	2.0	2.0
		10		
	0.5	100	2.0	2.0

(2) The var-hour portion is shown in Table 9. However, when the instrument cannot be tested at power factor 0 cannot, take 0.5 to test instead.

Table 9

Accuracy class	Power factor	Base (or test) current (%)	Permissible tolerance (%)	Inspection tolerance (%)
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Class 0.2	0	100	0.2	0.2
		10		
	0.866	100	0.3	<u>0.3</u>
Class 0.5	0	100	0.5	0.5
		10		
	0.866	100	0.6	<u>0.6</u>
Class 1	0	100	1.0	1.0
		10		
	0.866	100	1.0	<u>1.0</u>
Class 2	0	100	2.0	2.0
		10		
	0.866	100	2.0	<u>2.0</u>

(3) The demand portion is shown in Table 10.

Table 10

Accuracy class	Power factor	Base (or test) current (%)	Permissible tolerance (%)	Inspection tolerance (%)
Class 0.2	1.0	100	0.2	0.3
Class 0.5			0.5	0.8
Class 1			1.0	1.5
Class 2			2.0	3.0

8.2 Instrument transformer

8.2.1 The maximum permissible errors for inspection of instrument transformer are shown in Table 11 (power factor is 0.8.)

Table 11

Type	Current transformer		Voltage transformer
Test conditions	100% rated primary current	10 % rated primary current	90% to 110 % rated primary voltage
Maximum permissible error (%)	0.3	0.6	0.3

8.2.2 In addition to the requirements in the Table 11, the phase shifts of instrument transformers shall also meet the following requirements:

(1) For current transformer

At 100% rated primary current:

$$-0.3 \leq \text{indicated error of current transformer instrument} \times 100 + (\beta \times 100 / 2600) \leq +0.3$$

At 10% rated primary current:

$$-0.6 \leq \text{indicated error of current transformer instrument} \times 100 + (\beta \times 100 / 2600) \leq +0.6$$

Note: β is the phase shift of current transformer expressed in minutes.

(2) For voltage transformer:

$$-0.3 \leq \text{indicated error of current transformer instrument} \times 100 - (\gamma \times 100 / 2600) \leq +0.3$$

Note: γ is the phase shift of voltage transformers expressed in minutes.

9 The validity of verification for electricity meters start from the date of the verification compliance attached to the meter to the first day of following month of the year as below:

9.1 7 years for electricity meters with jewel bearings.

9.2 Electricity meters with magnetic bearing:

(1) 16 years for surge-proof magnetic bearing without transformer or without demand meter is and 20 years for single-phase socket type.

(2) 8 years for surge-proof with transformer or with demand meter.

9.3 8 years for static electricity meter.

10 Maximum working life of electricity meters

10.1 Since July 1, 2013, watt-hour meters submitted for verification shall comply with the requirements of maximum working life and the expired date of verification shall not exceed the end of maximum working life. However, electricity meters that verified prior to June 30, 2013 and exceeded the end of maximum working life the maximum application period, are allowed to be used till the validity of verification are expired.

10.2 Maximum watt-hour meter application period, starts from January of following year as the prescribed number of years:

10.2.1 Diamond bearings watt-hour meter is 14 years.

10.2.2 Magnetic bearings meter:

(1) Anti-surge without transformer or without demand meter is 32 years; single-phase socket type is 32 years.

(2) Anti-surge with transformer or with demand meter is 16 years.

10.2.3 Electronic meter for 16 years.

11 Verification compliance marks

11.1 The verification compliance tag for electric meters shall connect with the casing of the main body, conformity number plate, and body by metal wire. The conformity plate shall bear the information including the validity of verification, the maximum application period and number. The validity period and maximum application period may also be marked clearly on the front of the meter.

11.2 The conformity number plate of instrument transformer shall be sealed with the instrument transformer.

12 The validity of verification and maximum working life for magnetic bearings meters prescribed in this technical specification applies to magnetic bearings meters that passed verification by March 16, 1993 since this edition enters into force.