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**Alternating-current watt-hour meters
(for connection through instrument
transformer)—Part 1: General
measuring instrument**

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Foreword

This translation has been made based on the original Japanese Industrial Standard established by the Minister of Economy, Trade and Industry through deliberations at the Japanese Industrial Standards Committee in accordance with the Industrial Standardization Law.

Consequently **JIS C 1216**:1995 was withdrawn and replaced with this Standard.

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JIS C 1216 series consists of the following 2 parts under the general title “*Alternating-current watt-hour meters (for connection through instrument transformer)*”:

Part 1: General measuring instrument

Part 2: Measuring instruments used in transaction or certification

Alternating-current watt-hour meters (for connection through instrument transformer)—Part 1: General measuring instrument

Introduction

This Japanese Industrial Standard is established in order to specify the technical requirements needed for watt-hour meters (for connection through instrument transformer) as general measuring instrument. Since this Standard does not include the requirements concerning the marking method, the watt-hour meters can not be given the marking as stipulated in Article 19 of the Industrial Standardization Law, which indicates their conformity to this Standard.

1 Scope

This Standard specifies the watt-hour meters for general use, namely, normal watt-hour meters, precision watt-hour meters, special precision watt-hour meters, precision watt-hour meters for summation measurement of multi circuits of the current composing system, transmitter-incorporating normal watt-hour meters, transmitter-incorporating precision watt-hour meters, transmitter-incorporating precision watt-hour meters for summation measurement of multi circuits of the current composing system, that are used in combination with instrument transformers in single-phase two-wire system, single-phase three-wire system, three-phase three-wire system and three-phase four-wire system circuits (hereafter referred to as “meters”).

In addition, the transmitters of watt-hour meters (for connection through instrument transformer) for centralized and automatic meter reading shall be in accordance with Annex A. For meters provided with auxiliary devices, this Standard shall be applied to the watt-hour meter units under such a condition that the auxiliary devices are attached.

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this Standard. The most recent editions of the standards (including amendments) indicated below shall be applied.

JIS B 1101 *Slotted head screws*

JIS B 1135 *Slotted head wood screws*

JIS C 1210 *General rules for electricity meters*

JIS C 1211-1 *Alternating-current watt-hour meters (for direct connection)—Part 1: General measuring instrument*

JIS C 1281 *Weather-proof performance of electricity meters*

JIS C 1736-1 *Instrument transformers for metering service—Part 1: General measuring instrument*

JIS C 4003 *Thermal evaluation and classification of electrical insulation*

JIS C 60068-2-6 *Environmental testing Part 2: Tests—Test Fc: Vibration (sinusoidal)*

JIS C 60068-2-27 *Basic environmental testing procedures Part 2: Tests, Test Ea and guidance: Shock*

3 Classification

3.1 Phase and wire system

The meters, of respective types, are classified according to the phase and wire system as shown in table 1.

Table 1 Phase and wire system of meters

Type of meter	Phase and wire system
Normal watt-hour meter	Single-phase two-wire system, single-phase three-wire system, three-phase three-wire system, three-phase four-wire system
Precision watt-hour meter	Three-phase three-wire system, three-phase four-wire system
Special precision watt-hour meter	

3.2 Applicable circuits

The types of circuits used for multi-circuit summation meters in the current composing system shall be the 2-circuit and 3-circuit types.

The meters to be used for the above circuits shall be only the precision watt-hour meter of three-phase four-wire system, which are used in combination with current transformers.

3.3 Rated voltage, rated current, rated frequency and weather resistance

The classification of meters by the rated voltage, rated current, rated frequency and weather resistance shall be as given in table 2.

Table 2 Rated voltage, rated current, rated frequency and weather resistance

Classification			Rated voltage V	Rated current A	Rated frequency Hz	Weather resistance
Normal watt-hour meter	Meters used in combination only with current transformer	Single-phase two-wire system	100 120 200 240	5	50 60	Normal weatherproof
		Single-phase three-wire system	100			
		Three-phase three-wire system	200			
		Three-phase four-wire system	100 240			
	Meters to be used in combination with instrument trans- former and current transformer	Single-phase two-wire system	110			
		Three-phase three-wire system				
		Three-phase four-wire system	$\frac{110}{\sqrt{3}}$ 110			
Precision watt-hour meter	Meters to be used in combination only with current trans- former	Three-phase four-wire system	240			
	Meters to be used in combination with instrument trans- former and current transformer	Three-phase three-wire system	110			
		Three-phase four-wire system	$\frac{110}{\sqrt{3}}$ 110			
Special precision watt-hour meter		Three-phase three-wire system	110			
		Three-phase four-wire system	$\frac{110}{\sqrt{3}}$			
NOTE : The rated voltage of a meter refers to the voltage applied to a voltage circuit, and for the three-phase three-wire system, it refers to line-to-line voltage, and for the three-phase four-wire system, phase voltage.						

3.4 Meter constant

The classification of precision meters and special precision meters according to the meter constant is as given in table 3, with meter constant expressed by the number of revolutions per 1 kWh.

Table 3 Meter constant

Unit: rev/kWh

Type of meter		Meter constant
Precision watt-hour meter	Three-phase three-wire system	1 000, 1 200
	Three-phase four-wire system	250, 400, 600, 1 000, 1 600
Special precision watt-hour meter		800, 1 000

3.5 Pulse constant

The classification of transmitter-incorporating meters by the pulse constant shall be the integral multiple of 100, and the pulse constant shall be expressed by the number of pulses generated by the transmitter per 1 kWh.

4 Performance

4.1 General

The performance of meters shall be in accordance with the requirements specified in **4.2** to **4.8**, and the performance requirements of normal weatherproof meters as specified in **JIS C 1281**.

4.2 Allowable limits of measurement error

When the meter is tested in accordance with **6.2.1**, the measurement error shall not exceed the allowable limits specified in table 4 according to the load current for each type of meter.

The allowable limits of overall error shall be as specified in Annex B.

Table 4 Allowable limits of measurement error

Type of meter	Load current ^{a)} (% with respect to rated current)	Power factor	Allowable limits %	
			Positive phase sequence	Negative phase sequence ^{b)}
Normal watt-hour meter	5 to 120	1	±2.0	±2.0
	10 to 120	0.5 (lagging current)	±2.5	±2.5
Precision watt-hour meter	2.5 ^{c)}	1	±2.5	±2.5
	5	1	±1.5	±1.5
	10 to 20	1	±1.0	±1.5
	35 to 120	1	±1.0	±1.0
	10	0.5 (lagging current)	±1.5	±2.0
	20	0.5 (lagging current)	±1.0	±1.5
	50 to 120	0.5 (lagging current)	±1.0	±1.0
Special precision watt-hour meter	2.5 ^{c)}	1	±1.25	±1.25
	5	1	±0.75	±0.75
	10 to 120	1	±0.5	±0.5
	10	0.5 (lagging current)	±0.75	±0.75
	20 to 120	0.5 (lagging current)	±0.5	±0.5
Notes ^{a)} The allowable limits at other currents than the load current specified above shall be decided by interpolation. ^{b)} Negative phase sequence shall be applied only to the three-phase meters. ^{c)} Allowable limits shown for 2.5 % (power factor 1) are informative values.				

4.3 Electrical performance

4.3.1 Starting current

When the meter is tested in accordance with **6.2.2 a)**, the rotor shall start and continue the rotation.

4.3.2 Creeping

When the meter is tested in accordance with **6.2.2 b)**, the rotor shall not make one or more revolutions.

4.3.3 Influence of self-heating

When the meter is tested in accordance with **6.2.2 c)**, the variation in error caused by self-heating shall not exceed the limits for each type of meter in table 5.

Table 5 Limits of variation in error due to self-heating

Type of meter	Time min	Power factor	Limit of variation in error %
Normal watt-hour meter	0 to 30	1	1.0
		0.5 (lagging current)	
	30 to 120	1	0.5
		0.5 (lagging current)	
Precision watt-hour meter	0 to 30	1	0.5
		0.5 (lagging current)	
	30 to 120	1	0.2
		0.5 (lagging current)	0.3
Special precision watt-hour meter	0 to 30	1	0.2
		0.5 (lagging current)	
	30 to 120	1	0.1
		0.5 (lagging current)	

4.3.4 Current characteristics

When the meter is tested in accordance with **6.2.2 d)**, the variation in error generated due to the change of load current shall not exceed the limits specified for each type of meter in table 6.

Table 6 Current characteristics

Type of meter	Load current (% with respect to rated current)	Power factor	Limit of variation in error %
Normal watt-hour meter	5 to 120	1	1.5
	10 to 120	0.5 (lagging current)	2.0
Precision watt-hour meter	5 to 120	1	1.0
	10 to 120	0.5 (lagging current)	1.5
Special precision watt-hour meter	5 to 120	1	0.4
	10 to 120	0.5 (lagging current)	0.6

4.3.5 Influence of unbalanced load

- a) When the multi-element meter is tested in accordance with **6.2.2 e) 1)**, the variation in error relative to the balanced load condition shall not exceed the allowable limits specified in table 7 according to the load current of each type of meter.

Table 7 Limits of variation in error

Type of meter	Load current (% with respect to rated current)	Power factor	Limit of variation in error %
Normal watt-hour meter	50	1	2.5
		0.5 (lagging current)	2.5
Precision watt-hour meter	10	1	2.5
	20 to 100	1	2.0
	20	0.5 (lagging current)	2.5
	50 to 100	0.5 (lagging current)	2.0
Special precision watt-hour meter	10 to 100	1	1.0
	20 to 100	0.5 (lagging current)	1.5

- b) When the multi-element meter is tested in accordance with **6.2.2 e) 2)**, the error shall not exceed the allowable limits given in table 8 according to the load current by the type of meter, phase and wire system.

Table 8 Allowable limits of error

Type of meter	Phase and wire system	Load current (% with respect to rated current)	Power factor	Allowable limits of error %	
				Positive phase sequence	Negative phase sequence
Normal watt-hour meter	Single-phase three-wire system	10 to 50	1	±3.0	—
		20 to 50	0.5 (lagging current)		
	Three-phase three-wire system	8.7 to 50	1		±3.0
		17.3 to 50	0.5 (lagging current)		
	Three-phase four-wire system	15 to 50	1		
		30 to 50	0.5 (lagging current)		
Precision watt-hour meter	Three-phase three-wire system	10	1	±2.5	±3.0
		20 to 100	1	±2.0	±2.5
	Three-phase four-wire system	20	0.5 (lagging current)	±2.5	±3.0
		50 to 100	0.5 (lagging current)	±2.0	±2.5
Special precision watt-hour meter	Three-phase three-wire system	10 to 100	1	±1.0	±1.0
	Three-phase four-wire system	20 to 100	0.5 (lagging current)	±1.5	±1.5

4.3.6 Temperature characteristics

When the meter is tested in accordance with **6.2.2 f)**, the variation in error generated due to the change of ambient temperature shall not exceed the limits for each type of meter in table 9.

Table 9 Limits of variation in error due to change of temperature

Type of meter	Ambient temperature °C	Power factor	Limit of variation in error %
Normal watt-hour meter	-10 to +40	1	0.6
		0.5 (lagging current)	1.0
Precision watt-hour meter	0 to 30	1	0.4
		0.5 (lagging current)	0.5
	-10 to 0	1	0.5
	30 to 40	0.5 (lagging current)	0.7
Special precision watt-hour meter	0 to 40	1	0.2
		0.5 (lagging current)	0.2

4.3.7 Voltage characteristics

When the meter is tested in accordance with **6.2.2 g)**, the variation in error generated due to the change of voltage shall not exceed the limits for each type of meter in table 10.

Table 10 Limits of variation in error due to change of voltage

Type of meter	Power factor	Limit of variation in error %
Normal watt-hour meter	1	1.0
	0.5 (lagging current)	1.0
Precision watt-hour meter	1	1.0
	0.5 (lagging current)	1.0
Special precision watt-hour meter	1	0.4
	0.5 (lagging current)	0.6

4.3.8 Frequency characteristics

When the meter is tested in accordance with **6.2.2 h)**, the variation in error generated due to the change of frequency shall not exceed the limits specified for each type of meter in table 11.

Table 11 Limits of variation in error due to change of frequency

Type of meter	Power factor	Limit of variation in error %
Normal watt-hour meter	1	1.0
	0.5 (lagging current)	2.0
Precision watt-hour meter	1	1.0
	0.5 (lagging current)	1.5
Special precision watt-hour meter	1	0.8
	0.5 (lagging current)	0.8

4.3.9 Influence of external magnetic field

When the meter is tested in accordance with **6.2.2 i)**, the variation in error generated due to application of external magnetic field shall not exceed the limits specified for each type of meter in table 12.

Table 12 Limits of variation in error due to external magnetic field

Type of meter	Limit of variation in error %
Normal watt-hour meter	1.0
Precision watt-hour meter	1.0
Special precision watt-hour meter	0.5

4.3.10 Influence of waveform

When the meter is tested in accordance with **6.2.2 j)**, the variation in error generated due to the inclusion of third harmonics shall not exceed the limits specified for each type of meter in table 13.

Table 13 Limits of variation in error due to waveform

Type of meter	Limit of variation in error %
Normal watt-hour meter	1.0
Precision watt-hour meter	0.8
Special precision watt-hour meter	0.6

4.3.11 Apparent power loss of voltage circuit

When the meter is tested in accordance with **6.2.2 k)**, the apparent power loss of a voltage circuit shall not exceed the limits specified for each type of meter in table 14 for each element.

Table 14 Apparent power loss of voltage circuit

Unit: VA

Type of meter	Apparent power loss of voltage circuit	
	Without transmitter	With transmitter
Normal watt-hour meter	7.5	—
Precision watt-hour meter	10	15
Special precision watt-hour meter	25	30

4.3.12 Apparent power loss of current circuit

When the meter is tested in accordance with **6.2.2 l)**, the apparent power loss of the current circuits shall not exceed 5 VA for each element.

4.3.13 Influence of overcurrent

When the meter is tested in accordance with **6.2.2 m)**, an improper temperature rise, or electrical or mechanical damage shall not occur, and the variation in error generated by passing an overcurrent shall not exceed the limits specified for each type of meter in table 15.

Table 15 Limits of variation in error due to overcurrent

Type of meter	Limit of variation in error %	
	First test	Second test
Normal watt-hour meter	1.0	1.0
Precision watt-hour meter	0.5	0.5
Special precision watt-hour meter	0.3	0.2

4.4 Mechanical performance

4.4.1 Variation in error under light load

When the meter is tested in accordance with **6.2.3 a)**, the variation in error shall not exceed the limits specified for each type of meter in table 16.

Table 16 Limits of variation in error due to light load

Type of meter	Limit of variation in error %
Normal watt-hour meter	1.0
Precision watt-hour meter	0.5
Special precision watt-hour meter	0.2

4.4.2 Influence of register

When the meter is tested in accordance with **6.2.3 b)**, the variation in error when a register is removed shall not exceed the limits specified for each type of meter in table 17. Furthermore, if the register is a cyclometer type register, the variation in error produced when the counting figure drum steps up shall not exceed the limit of 1.0 %.

Table 17 Limits of variation in error when the register is removed

Type of meter	Limit of variation in error %
Normal watt-hour meter	1.5
Precision watt-hour meter	1.0
Special precision watt-hour meter	0.5

4.4.3 Influence of inclination

When the meter is tested in accordance with **6.2.3 c)**, the variation in error with respect to the error at the normal posture shall not exceed the limits specified for each type of meter in table 18.

Table 18 Limits of variation in error due to inclination

Type of meter	Load current (% with respect to rated current)	Limit of variation in error %
Normal watt-hour meter	5	2.0
	50 to 100	1.0
Precision watt-hour meter	5	1.5
	50 to 100	0.5
Special precision watt-hour meter	5	0.4
	50 to 100	0.1

4.4.4 Noise

When the meter is tested in accordance with **6.2.3 d)**, the noise produced by the meter shall not exceed 30 dB.

4.4.5 Influence of vibration

When the meter is tested in accordance with **6.2.3 e)**, no mechanical damage shall occur. The variation in error generated by applying vibration shall not exceed the limits specified for each type of meter in table 19, and each of the requirements in **4.3.1**, **4.3.2** and **4.4.1** shall be satisfied.

Table 19 Limits of variation in error due to vibration and impact

Type of meter	Load current (% with respect to rated current)	Power factor	Limit of variation in error %
Normal watt-hour meter	5 to 120	1	1.0
	10 to 120	0.5 (lagging current)	1.2
Precision watt-hour meter	5	1	0.8
	10 to 120	1	0.5
	10	0.5 (lagging current)	0.8
	20 to 120	0.5 (lagging current)	0.5
Special precision watt-hour meter	5	1	0.4
	10 to 120	1	0.25
	10	0.5 (lagging current)	0.4
	20 to 120	0.5 (lagging current)	0.25