

JIS

JAPANESE INDUSTRIAL STANDARD

Alternating-Current Watt-Hour
Meters(for Connection through
Instrument Transformer)

JIS C 1216—1979

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Alternating-Current Watt-Hour Meters

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(for Connection through Instrument Transformer)

1. Scope

This Japanese Industrial Standard specifies normal watt-hour meters, precision watt-hour meters, special precision watt-hour meters, precision watt-hour meters for summation measurement of polycircuits of the current composing system, and those watt-hour meters, other than normal watt-hour meters, provided with transmitters, which are used in combination with instrument transformers in single-phase 2-line, single-phase 3-line, three-phase 3-line, and three-phase 4-line circuits, hereinafter referred to as the "meters".

Those meters shall comply with the specifications of JIS C 1210 in addition to the specifications of this standard.

For meters provided with auxiliary devices, this standard shall be applied to their watt-hour meter units in the condition in which such auxiliary devices are attached.

The transmitters of transmitter-incorporating watt-hour meters used for collective meter examination and automatic meter examination in this standard shall comply with the specifications of Appendix 1, the current transformers for polycircuit summation meters used in combination with polycircuit summation meters shall comply with the specifications of Appendix 2, and the method of combination with instrument transformers and the allowable limits of overall errors shall comply with the specifications of Appendix 3.

Remark: The units and numerical values given in { } in this standard are in accordance with the International System of Units (SI) and are appended for reference.

Applicable Standards and Reference Standards: See page 48.

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2. Classification

2.1 Phase and Line System The phase and line systems of meters shall be classified as shown in Table 1 according to the types of meters.

Table 1

Type of meter	Phase and line system
Normal meters	Single-phase 2-line, single-phase 3-line, three-phase 3-line, and three-phase 4-line system
Precision meters	Three-phase 3-line and three-phase 4-line systems
Special precision meters	

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

Meters to be used for the above circuits shall be only those precision meters of the three-phase 4-line system used in combination with current transformers.

2.3 Ratings The classification of rated voltages, rated currents, and rated frequencies of meters shall be as specified in Table 2 according to the division.

Table 2

Division		Rated voltage V	Rated current A	Rated frequency Hz
Normal meter	Meter used in combination only with current trans- former	Single-phase 2-line 100 120 200 240	5	50 60
		Single-phase 3-line 100		
		Three-phase 3-line 200		
		Three-phase 4-line 100 240		
	Meter used in combination with instrument trans- former and instrument current transformer	Single-phase 2-line 110		
		Three-phase 3-line		
		Three-phase 4-line $\frac{110}{\sqrt{3}}$ 110		

Table 2 (Continued)

Division		Rated voltage V	Rated current A	Rated frequency Hz
Precision meter	Meter used in combination only with current trans- former	240	5	50 60
	Meter used in combination with instrument trans- former and instrument current transformer	110		
		$\frac{110}{\sqrt{3}}$ 110		
Special precision meter	Three-phase 3-line	110	5	50 60
	Three-phase 4-line	$\frac{110}{\sqrt{3}}$ 110		

Remark: The rated voltage of a meter means the voltage applied to the voltage circuits, representing the line-to-line voltage in the three-phase 3-line system, and the phase voltage in the three-phase 4-line system.

2.4 Instrumental Constant The kind of instrumental constants in precision meters and special precision meters shall be as specified in Table 3, and the instrumental constant shall be expressed by the number of revolutions per 1 kWh.

Table 3

Unit: rev/kWh

Type of meter		Instrumental constant
Precision meter	Three-phase 3-line	1000, 1200
	Three-phase 4-line	250, 400, 600, 1000, 1600
Special precision meter		800, 1000

2.5 Pulse Constant The values of pulse constant of transmitter-incorporating meters shall be numbers consisting of 100 multiplied by integers, and the pulse constant shall be expressed by the number of pulses generated by the transmitter per 1 kWh.

3. Performances

3.1 General Performances The performances of meters shall meet the following requirements and also the performance requirements of normal weather-proof meters specified in JIS C 1281.

3.2 Allowable Limit of Measuring Error When the test of 5.2.1 is performed, the measuring error (hereinafter referred to as the "error", expressed in percentage error) of meters shall not exceed the allowable limit specified in Table 4 according to the load current for each type of meter.

Table 4

Type of meter	Load current ⁽¹⁾ (percentage relative to rated current)	Power factor	Allowable limit %	
			Positive phase sequence	Negative phase sequence ⁽²⁾
Normal meter	5 to 120	1	± 2.0	± 2.0
	10 to 120	0.5 (lagging current)	± 2.5	± 2.5
Precision meter	2.5 ⁽³⁾	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 meter	2.5 ⁽³⁾	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 ⁽¹⁾ Allowable limits at other current values than those load current values specified in this Table shall be decided by interpolation.

⁽²⁾ The negative phase sequence shall be applied only to three-phase meters.

⁽³⁾ The allowable limit value of 2.5 % (power factor 1) shall be used as a reference value.

3.3 Electrical Performance

3.3.1 Starting Current When the test of 5.2.2 (1) is performed, the rotor of the meter shall start rotation and continue its rotation.

3.3.2 Creeping When the test of 5.2.2 (2) is performed, the rotor of the meter shall not rotate by one revolution or more.

3.3.3 Influence of Self-Heating When meters are tested according to 5.2.2 (3), the variation in error caused by self-heating shall not exceed the limit of variation in error specified in Table 5 for each type of meter.

Table 5

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

3.3.4 Current Characteristics When meters are tested according to 5.2.2 (4), the variation in error produced by the change in load current shall not exceed the limit of variation in error specified in Table 6 for each type of meter.

Table 6

Type of meter	Range of load current (percentage relative to rated current)	Power factor	Limit of variation in error %
Normal meter	5 to 120	1	1.5
	10 to 120	0.5 (lagging current)	2.0
Precision meter	5 to 120	1	1.0
	10 to 120	0.5 (lagging current)	1.5
Special precision meter	5 to 120	1	0.4
	10 to 120	0.5 (lagging current)	0.6

3.3.5 Influence of Unbalanced Load

- (1) When multi-element meters are tested according to 5.2.2 (5) (a), the variation in error relative to the balanced load condition shall not exceed the limit of variation in error specified in Table 7 according to the load current for each type of meter.

Table 7

Type of meter	Load current (percentage relative to rated current)	Power factor	Limit of variation in error %
Normal meter	50	1	2.5
		0.5 (lagging current)	2.5
Precision 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 meter	10 to 100	1	1.0
	20 to 100	0.5 (lagging current)	1.5

- (2) When multi-element meters are tested according to 5.2.2 (5) (b), the error shall not exceed the allowable limit specified in Table 8 according to the load current for each type of meter and each phase and line system.

Table 8

Type of meter	Phase and line system	Load current (percentage relative to rated current)	Power factor	Allowable limit %	
				Positive phase sequence	Negative phase sequence
Normal meter	Single-phase 3-line	10 to 50	1	± 3.0	—
		20 to 50	0.5 (lagging current)		
	Three-phase 3-line	8.7 to 50	1		± 3.0
		17.3 to 50	0.5 (lagging current)		
	Three-phase 4-line	15 to 50	1		
		30 to 50	0.5 (lagging current)		
Precision meter	Three-phase 3-line Three-phase 4-line	10	1	± 2.5	± 3.0
		20 to 100	1	± 2.0	± 2.5
		20	0.5 (lagging current)	± 2.5	± 3.0
		50 to 100	0.5 (lagging current)	± 2.0	± 2.5
Special pre- cision meter	Three-phase 3-line	10 to 100	1	± 1.0	± 1.0
	Three-phase 4-line	20 to 100	0.5 (lagging current)	± 1.5	± 1.5

3.3.6 Temperature Characteristics When meters are tested according to 5.2.2 (6), the variation in error produced by the variation in ambient temperature shall not exceed the limit of variation in error specified in Table 9.

Table 9

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

3.3.7 Voltage Characteristics When meters are tested according to 5.2.2 (7), the variation in error produced by the variation in voltage shall not exceed the limit of variation in error specified in Table 10 for each type of meter.

Table 10

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

3.3.8 Frequency Characteristics When meters are tested according to 5.2.2 (8), the variation in error produced by the change in frequency shall not exceed the limit of variation in error specified in Table 11 for each type of meter.

Table 11

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

3.3.9 Influence of External Magnetic Field When meters are tested according to 5.2.2 (9), the variation in error produced by application of an external magnetic field shall not exceed the limit of variation in error specified in Table 12 for each type of meter.

Table 12

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

3.3.10 Influence of Waveform When meters are tested according to 5.2.2 (10), the variation in error produced by the inclusion of the third harmonic wave shall not exceed the limit of variation in error specified in Table 13 for each type of meter.

Table 13

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

3.3.11 Apparent Power Loss of Voltage Circuits When meters are tested according to 5.2.2 (11), the apparent power loss of the voltage circuits shall not exceed the value specified in Table 14 for each element and each type of meter.

Table 14

Unit: VA

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

3.3.12 Apparent Power Loss of Current Circuits When meters are tested according to 5.2.2 (12), the apparent power loss of the current circuits shall be not greater than 5 VA for each element.

3.3.13 Influence of Overcurrent When meters are tested according to 5.2.2 (13), there shall not occur improper temperature rise or electrical or mechanical damage, and the variation in error caused by passing of an overcurrent shall not exceed the limit of variation in error specified in Table 15 for each type of meter.

Table 15

Type of meter	Limit of variation in error %	
	1st test	2nd test
Normal meter	1.0	1.0
Precision meter	0.5	0.5
Special precision meter	0.3	0.2

3.4 Mechanical Performances

3.4.1 Variation in Error at Light Load When meters are tested according to 5.2.3 (1), the variation in error shall not exceed the limit of variation in error specified in Table 16 for each type of meter.

Table 16

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

3.4.2 Influence of Register When meters are tested according to 5.2.3 (2), the variation in error produced when the register is removed shall not exceed the limit of variation in error specified in Table 17 for each type of meter.

For cyclometer counter, the variation in error produced when the digit wheel steps up shall not exceed the limit of 1.0 %.

Table 17

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

3.4.3 Influence of Inclination When meters are tested according to 5.2.3 (3), the variation in error relative to the error at the normal position shall not exceed the limit of variation in error specified in Table 18 for each type of meter.

Table 18

Type of meter	Load current (percentage relative to rated current)	Limit of variation in error %
Normal meter	5	2.0
	50 to 100	1.0
Precision meter	5	1.5
	50 to 100	0.5
Special precision meter	5	0.4
	50 to 100	0.1

3.4.4 Noise When meters are tested according to 5.2.3 (4), the noise produced by the meters shall not exceed 30 dB.

3.4.5 Influence of Vibration When meters are tested according to 5.2.3 (5), no mechanical damage shall occur.

In addition, according to the load current for each type of meter, the variation in error produced by the application of vibration shall not exceed the limit of variation in error specified in Table 19, and further, the meters shall meet the requirements of 3.3.1, 3.3.2, and 3.4.1 respectively.

Table 19

Type of meter	Load current (percentage relative to rated current)	Power factor	Limit of variation in error %
Normal meter	5 to 120	1	1.0
	10 to 120	0.5 (lagging current)	1.2
Precision 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 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

3.4.6 Influence of Impact When meters are tested according to 5.2.3 (6), no mechanical damage shall occur.

In addition, according to the load current for each type of meter, the variation in error produced by the application of impact shall not exceed the limit of variation in error specified in Table 19, and further, the meters shall meet the requirements of 3.3.1, 3.3.2, and 3.4.1 respectively.

3.4.7 Driving Torque When meters are tested according to 5.2.3 (7), the driving torque for each type of meter shall be not less than the value specified in Table 20.

Table 20

Unit: gf·cm{ μ N·m}

Type of meter	Driving torque		
	Single-phase 2-line system	Single-phase 3-line and three-phase 3-line systems	Three-phase 4-line system
Normal meter	7{6.9}	11{10.8}	15{14.7}
Precision meter	—	15{14.7}	20{19.6}
Special preci- sion meter	—	20{19.6}	30{29.4}

3.4.8 Friction Torque of Register and Bearings When special precision meters are tested according to 5.2.3 (8), the friction torque of the register shall be not more than 0.05 % of the driving torque, and the total friction torque, which is the sum of the friction torque of the register and that of the bearings, shall be not more than 0.1 % of the driving torque.

3.5 Temperature Rise of Current Coils and Terminals When meters are tested according to 5.2.4, the temperature rise of the current coil surface and terminals shall not exceed the limit of temperature rise specified in Table 21.

Table 21

Unit: °C

Measuring position	Limit of temperature rise (°C)
Current coil surface	65
Terminals	40

Note (°C) These limits of temperature rise are based on the case of using Class A insulating material [refer to JIS C 4003].

3.6 Insulation Performance

3.6.1 Insulation Resistance When the test of 5.2.5 (1) is performed, the meters shall have an insulation resistance of not less than 5 M Ω .

3.6.2 Commercial Frequency Withstand Voltage When meters are tested according to 5.2.5 (2), they shall withstand the test.

3.6.3 Lightning Impulse Withstand Voltage When meters are tested according to 5.2.5 (3), such abnormalities shall not occur as discharging in the voltage coils, current coils, supplementary power source circuits, or lead wires, or wire breakage in the voltage coils.

3.7 Durability and Stability

3.7.1 Durability When normal meters are tested according to 5.2.6 (1), the variation in error for each time elapse of 500 h relative to the error measured directly after starting the test shall not exceed the limit of variation in error specified in Table 22, and in addition, the meters shall meet the requirements of 3.3.1, 3.3.2, and 3.4.1 respectively.

Table 22

Load current (percentage relative to rated current)	Limit of variation in error %
100	0.7
5	0.9

3.7.2 Stability When precision meters and special precision meters are tested according to 5.2.6 (2), the variations in error of items (1), (2), and (3) obtained shall not exceed the limits of variation in error specified in Table 23, respectively.

Table 23

Item	Load current (percentage rela- tive to rated current)	Power factor	Limit of variation in error %	
			Precision meter	Special preci- sion meter
(1) Difference between the maximum and the minimum of 20 measured values of error obtained on one day	5	1	0.5	0.2
	100	0.5 (lagging current)	0.2	0.1
	100	1		
(2) Difference between the maximum and the minimum of daily mean values of error obtained during 3 days	5	1	0.6	0.3
	100	0.5 (lagging current)	0.3	0.15
	100	1		
(3) Difference between the maximum and the minimum values of three-day mean values of error	5	1	0.6	0.3
	100	0.5 (lagging current)	0.3	0.15
	100	1		