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JAPANESE INDUSTRIAL STANDARD

Watt-Hour, Var-Hour and Maximum Demand Indicators for Telemetry

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In the event of any doubt arising,
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Watt-Hour, Var-Hour and Maximum Demand
Indicators for Telemetry

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1. Scope

This Japanese Industrial Standard specifies separate type indicators and multi-circuit summation indicators, hereinafter referred to as the "indicators", which indicate watt-hour, var-hour and maximum demand by receiving pulses transmitted from watt-hour meters with transmitter and var-hour meters with transmitter which are to be combined with instrument transformers in circuits of three-phase 3-wire system and three-phase 4-wire system.

The requirements other than specified in this standard are as given in JIS C 1210.

This standard applies to totalizing metering of addition only in the multi-circuit summation indicators.

In this standard, the permissible limits of indication error and overall indication error due to the driving device and combination of driving device and instrument transformer are specified in Appendix 1 and watt-hour indicators for centralized metering system are specified in Appendix 2.

2. Definitions

For the purpose of this standard the following principal definitions apply:

- (1) watt-hour indicator A device which indicates watt-hour by receiving pulses transmitted from a watt-hour meter with transmitter.
- (2) var-hour indicator A device which indicates var-hour by receiving pulses transmitted from a var-hour meter with transmitter.
- (3) maximum demand indicator A device which indicates maximum demand of power by receiving pulses transmitted from a watt-hour meter with transmitter.
- (4) watt-hour indicator with maximum demand indicator A device which indicates watt-hour and maximum demand power by receiving pulses transmitted from a watt-hour meter with transmitter.
- (5) multi-circuit summation indicator A device in the category of (1) to (4) which registers watt-hours, var-hours or maximum demands by receiving pulses transmitted from each driving device with transmitter in two to four circuits, the totalizes and indicates such measured and which accommodates a pulse totalizer.

Applicable Standards and Reference Standards: See page 54.

- (6) driving device A watt-hour meter with transmitter or var-hour meter with transmitter which transmits electric pulses proportional to the watt-hour or var-hour.
- (7) pulse totalizer A device in multi-circuit summation indicator that totalizes pulses transmitted from the driving device in each circuit and generates a pulse output.
- (8) demand interval (demand integration period) The interval of time based on which the average power is determined.
- (9) demand power The average of power during the demand interval.
- (10) maximum demand power The maximum demand power during a measuring period of demand power.
- (11) (pointer) pusher The mechanism in a pointer-type maximum demand indicator that advances the demand pointer to indicate the maximum demand power (maximum demand pointer) repeatedly according to the demand power of each demand interval.
- (12) demand register The indicator which indicates the demand power repeatedly every demand interval in a digital indicating type maximum demand meter.
- (13) auxiliary power supply circuit The circuit on which the voltage to operate an indicator is applied i.e. the circuit connected between auxiliary power supply terminals of the indicator.
- (14) rated load The power (including reactive power) applied to a driving device as the load when the secondary side of instrument transformer is at the rated voltage, rated current and power factor 1 (0 in reactive power) (the total load of all circuits in the case of multi-circuit totalizing indicator).
- (15) rated input pulse The number of pulses per minute of an indicator corresponding to the transmitted pulses from the driving device at the rated load. Pulse/min is used as the unit.
- (16) mechanism error This error means the error of a maximum demand indicator itself, and is expressed as the percentage of the difference between the power value indicated in the rated demand interval and the power value corresponding to the number of input impulses divided by the later.
- (17) pulse count error The error at the time of pulse counting in a maximum demand indicator. If counted number is denoted by n , number of input circuits by m , pulse constant by R (pulse/kWh), rated demand interval by T (min) and load power by P (kW), then the pulse count error u (%) is expressed by the following formula:

$$u = -\frac{m}{n} \times 100 (\%)$$

$$= -\frac{m}{P} \times \frac{60}{T} \times \frac{100}{R} (\%)$$

- (18) indication error The total error when an indicator and a driving device are combined. This is expressed as the algebraic sum of the mechanism error and the error of driving device.
- (19) overall indication error The total error when an indicator, a driving device and instrument transformer(s) are combined. This is expressed by the algebraic sum of the indication error and the resultant error (of instrument transformer).

3. Combination of Indicator and Driving Device

The combination system of indicators and driving devices shall be either one system given in Table 1. However, the driving device when the totalizing system is current totalizing system shall only be the one of three-phase 4-wire system to be used in combination with current transformer only.

Table 1

Totalizing system	No. of circuits	Symbol of system	Maximum demand indicator	Symbol of system	Watt-hour indicator with max. demand indicator	Symbol of system	Watt-hour indicator or var-hour indicator
Pulse totalizing	1	1A-3		1B-3		1C-3 (1D-3)	
	2	2A-4		2B-4		2C-4 (2D-4)	
	3	3A-4		3B-4		3C-4 (3D-4)	
	4	4A-4		4B-4		4C-4 (4D-4)	
Current totalizing	2	2A-6		2B-6		2C-6 (2D-6)	
	3	3A-6		3B-6		3C-6 (3D-6)	

- Remarks 1. Pointer type indicators are illustrated for the maximum demand indicators.
2. The symbols in parentheses denote the case of var-hour indicator and the kWh in the figure should be read as kvarh.

4. Classification

4.1 Indicator Indicators are classified into watt-hour indicators, var-hour indicators, maximum demand indicators and watt-hour indicators with maximum demand indicator.

4.2 Indication System Indication systems in maximum demand indicators are classified into pointer type and digital display type.

4.3 Driving Device Driving devices⁽¹⁾ are classified into precise watt-hour meters, special precise watt-hour meters and var-hour meters.

Note ⁽¹⁾ JIS C 1210, JIS C 1216, JIS C 1263 and JIS C 1281 shall apply to the driving device.

4.4 Number of Service Circuits and Totalizing System The number of service circuits and totalizing system in multi-circuit summation indicators shall be as given in Table 2.

Table 2

Number of service circuits	Totalizing system ⁽²⁾
Two, three or four circuits	Pulse totalizing system
Two or three circuits	Current totalizing system

Note ⁽²⁾ There are two kinds of totalizing system in multi-circuit summation indicators, one is the (5+5) A system in which the sum of the rated loads of every circuit becomes the rated load of the indicator and the other is the 5 A system in which the rated load of any one of the circuits becomes the rated load of the indicator. However, the 5 A system is applicable only for two-circuit summation indicators of pulse totalizing system.

4.5 Rating The ratings shall be as follows:

- (1) The rated demand interval of maximum demand indicators is 30 min.
- (2) The rated voltage of auxiliary power supply is 110 V and the rated frequency is 50 Hz or 60 Hz.

5. Performance

5.1 Performance of Watt-hour Indicator and Var-hour Indicator

5.1.1 Electrical Performance When an indicator is subjected to the test of 7.3.1 (1) the indication of register shall correctly progress corresponding to the number of input pulses. The apparent power loss of auxiliary power supply circuit shall be as specified in (6).

- (1) Response to Input Pulse The indicator shall operate normally at the number of input pulses when subjected to the test of 7.3.1 (1) (a).
- (2) Influence of Auxiliary Power Supply The indicator shall operate normally over the extent of auxiliary power supply when subjected to the test of 7.3.1 (b).
- (3) Influence of External Magnetic Field The indicator shall operate normally at the external magnetic field when subjected to the test of 7.3.1 (1) (c).
- (4) Influence of Temperature The indicator shall operate normally at the temperature when subjected to the test of 7.3.1 (1) (d).
- (5) Influence of Humidity The indicator shall operate normally at the humidity when subjected to the test of 7.3.1 (1) (e).
- (6) Apparent Power Loss of Auxiliary Power Supply Circuit When an indicator is subjected to the test of 7.3.1 (1) (f) the apparent power loss of the auxiliary power supply circuit shall not exceed 15 VA.

5.1.2 Mechanical Performance When an indicator is subjected to the test of 7.3.1 (2), the indication of register shall correctly progress corresponding to the number of input pulses. The noise shall be as specified in (4).

- (1) Influence of Inclination The indicator shall operate normally at the inclination when subjected to the test of 7.3.1 (2) (a).
- (2) Influence of Vibration The indicator shall operate normally without suffering any mechanical damage from the vibration when subjected to the test of 7.3.1 (2) (b).
- (3) Influence of Shock The indicator shall operate normally without any mechanical damage influenced by the shock when subjected to the test of 7.3.1 (2) (c).
- (4) Noise When an indicator is subjected to the test of 7.3.1 (2) (d), the noise generated from the specimen shall not exceed 60 dB.

5.1.3 Insulation Performance The insulation performance shall comply with the following requirements:

- (1) Insulation Resistance The indicator shall show an insulation resistance not less than 5 MΩ when subjected to the test of 7.3.1 (3) (a).
- (2) Commercial-Frequency Withstand Voltage The indicator shall withstand the test voltage when subjected to the test of 7.3.1 (3) (b).

- (3) Lightning Impulse Withstand Voltage The indicator shall show no abnormality such as discharge and breaking of wire in the auxiliary power supply circuit, lead wires, etc. when subjected to the test of 7.3.1 (3) (c).

5.1.4 Durability When an indicator is subjected to the test of 7.3.1 (4), the indication of register shall correctly progress corresponding to the number of input pulses every lapse of time specified as one continuous operation.

5.2 Performance of Maximum Demand Indicator

5.2.1 Permissible Limits of Mechanism Error When an indicator is subjected to the test of 7.3.2 (1), the mechanism error shall not exceed the permissible limits given in Table 3.

Table 3

Input pulse (% to rated input pulse)	Permissible limits %	
	Pointer type	Digital display type
20	—	± 2.0
35	± 2.0	—
50 to 120	± 1.0	± 1.0

5.2.2 Electrical Performance The electrical performances shall comply with the following requirements:

- (1) Response to Input Pulse When a maximum demand indicator is subjected to the test of 7.3.2 (2) (c), the indication shall correctly progress corresponding to the number of input pulses.
- (2) Tolerance on Demand Interval When an indicator is subjected to the test of 7.3.2 (2) (b), the difference between the measured time interval and the rated demand interval shall not exceed 10 sec.
- (3) Influence of Auxiliary Power Supply When an indicator is subjected to the test of 7.3.2 (2) (c), the mechanism error shall not exceed the limits of 1 % at the rated input pulse and the specimen shall comply with the requirement of 5.2.2 (2).
- (4) Influence of External Magnetic Field When an indicator is subjected to the test of 7.3.2 (2) (d), the change in mechanism error caused by the external magnetic field shall not exceed the limits of change in error given in Table 4.

Table 4

Input pulse (% to rated input pulse)	Limits of variation in error %	
	Pointer type	Digital display type
20	—	1.5
35	1.5	—
100	1.0	1.0

- (5) Influence of Temperature When an indicator is subjected to the test of 7.3.2 (2) (e), the mechanism error shall not exceed the limits of mechanism error given in Table 5 at the test temperature.

Table 5

Input pulse (% to rated input pulse)	Limits of mechanism error %	
	Pointer type	Digital display type
20	—	± 2.0
35	± 2.0	—
100	± 1.0	± 1.0

- (6) Influence of Humidity When an indicator is subjected to the test of 7.3.2 (2) (f), the mechanism error shall not exceed the limits of mechanism error given in Table 5 at the test humidity.
- (7) Apparent Power Loss of Auxiliary Power Supply Circuit When an indicator is subjected to the test of 7.3.2 (2) (g), the apparent power loss of auxiliary power supply circuit shall not exceed 15 VA.

5.2.3 Mechanical Performance The mechanical performances shall comply with the following requirements:

- (1) Fluctuation of Mechanism Error When an indicator is subjected to the test of 7.3.2 (3) (a), the fluctuation of mechanism error shall not exceed the limits of variation in error given in Table 6.

Table 6

Input pulse (% to rated input pulse)	Limits of variation in error %	
	Pointer type	Digital display type
20	—	2.0
35	2.0	—
100	1.0	1.0

- (2) Influence of Inclination When an indicator is subjected to the test of 7.3.2 (3) (b), the variation in mechanism error due to the inclination shall not exceed the limits of variation in error given in Table 4.
- (3) Influence of Vibration When an indicator is subjected to the test of 7.3.2 (3) (c), no mechanical damage shall appear and the variation in mechanism error due to the vibration shall not exceed the limits of variation in error given in Table 4.
Further the fluctuation of mechanism error shall not exceed the limits of variation in error given in Table 6.
- (4) Influence of Shock When an indicator is subjected to the test of 7.3.2 (3) (d), no mechanical damage shall appear, and the variation in mechanism error due to the shock shall not exceed the limits given in Table 4.
Further the fluctuation of mechanism error shall not exceed the limits of variation in error given in Table 6.
- (5) Noise When an indicator is subjected to the test of 7.3.2 (3) (e), the noise generated by the specimen shall not exceed 60 dB.

5.2.4 Insulation Performance The insulation performance shall comply with the following requirements:

- (1) Insulation Resistance The indicator shall show an insulation resistance not less than 5 M Ω when subjected to the test of 7.3.2 (4) (a).
- (2) Commercial Frequency Withstand Voltage The indicator shall withstand the test voltage when subjected to the test of 7.3.2 (4) (b).
- (3) Lightning Impulse Withstand Voltage The indicator shall show no abnormality such as discharge and breaking of wires in the auxiliary power supply circuit, lead wires, etc. when subjected to the test of 7.3.2 (4) (c).

5.2.5 Durability When an indicator is subjected to the test of 7.3.2 (5), the variation in mechanism error every lapse of 1000 h from that at immediately after initiation of test shall not exceed the limits of variation in error given in Table 4.

Further the fluctuation of mechanism error shall not exceed the limits of variation in error given in Table 6.

5.3 Performance of Pulse Totalizer

5.3.1 Electrical Performance When a pulse totalizer is subjected to the test of 7.3.3 (1), the number of output pulses shall correspond to the number of input pulses and these pulses shall be those complying with the pulse symbol specified in 6.2.1. The apparent power loss of auxiliary power supply circuit shall be as specified in (6).

- (1) Response to Input Pulse The pulse totalizer shall operate normally over the extent of number of input pulses when subjected to the test of 7.3.3 (1) (a).
- (2) Influence of Auxiliary Power Supply The pulse totalizer shall operate normally over the range of auxiliary power supply when subjected to the test of 7.3.3 (1) (b).
- (3) Influence of External Magnetic Field The pulse totalizer shall operate normally at the external magnetic field when subjected to the test of 7.3.3 (1) (c).
- (4) Influence of Humidity The pulse totalizer shall operate normally at the temperature when subjected to the test of 7.3.3 (1) (b).
- (5) Influence of Humidity The pulse totalizer shall operate normally at the humidity when subjected to the test of 7.3.3 (1) (e).
- (6) Apparent Power Loss of Auxiliary Power Supply Circuit When a pulse totalizer is subjected to the test of 7.3.3 (1) (f), the apparent power loss of auxiliary power supply circuit shall not exceed 15 VA.

5.3.2 Mechanical Performance When a pulse totalizer is subjected to the test of 7.3.3 (2), the number of output pulses shall correspond to the number of input pulses, and these pulses shall be those complying with the pulse symbol specified in 6.2.1. The noise shall be as specified in (4).

- (1) Influence of Inclination The pulse totalizer shall operate correctly at the inclination when subjected to the test of 7.3.3 (2) (a).
- (2) Influence of Vibration The pulse totalizer shall operate correctly without being affected by the vibration when subjected to the test of 7.3.3 (2) (b).
- (3) Influence of Shock The pulse totalizer shall operate correctly without being affected by the shock when subjected to the test of 7.3.3 (2) (c).
- (4) Noise When a pulse totalizer is subjected to the test of 7.3.3 (2) (d), the noise generated from the specimen shall not exceed 60 dB.

5.3.3 Insulation Performance The insulation performance shall comply with the following requirements:

- (1) Insulation Resistance The pulse totalizer shall show an insulation resistance not less than 5 M Ω , when subjected to the test of 7.3.3 (3) (a).
- (2) Commercial-Frequency Withstand Voltage The pulse totalizer shall withstand the test voltage, when subjected to the test of 7.3.3 (3) (b).
- (3) Lightning Impulse Withstand Voltage The pulse totalizer shall show no abnormality such as discharge and breaking of wires in the auxiliary power supply circuit, lead wires, etc. when subjected to the test of 7.3.3 (3) (c).

5.3.4 Durability When a pulse totalizer is subjected to the test of 7.3.3 (4), the number of output pulse shall correspond to the number input pulses and these pulses shall be those complying with the pulse symbol specified in 6.2.1.

6. Construction and Dimensions

6.1 Component The components of an indicator shall be as follows:

- (1) A watt-hour indicator or a var-hour indicator shall consist of a register and a pulse receiver.
- (2) A pointer type maximum demand indicator shall consist of a single scale, maximum demand pointer, pusher, timing device, maximum demand pointer resetting device and pulse receiver.
- (3) A digital display type maximum demand indicator shall consist of a maximum demand graduated drums, demand register, timing device, maximum demand graduated drum resetting device and pulse receiver.
- (4) A multi-circuit summation indicator shall be composed of a pulse totalizer in addition to the said components, if pulse totalizing system is employed.

6.2 Indicator

6.2.1 Pulse Transmission System and Pulse Reception System The pulse transmission system and pulse reception system of indicators and pulse totalizers are classified according to the differences in the wire-system of transmission circuit, a.c. or d.c. system, existence or non-existence of polarity, pulse voltage, pulse current, pulse capacity, pulse width and minimum rest time, and the transmission system determined by the combination of such systems and amounts is denoted by symbols.

6.2.2 Pulse Receiver The pulse receiver shall be so structured that it receives the pulses from the driving device and surely transmits the action corresponding to the pulse signal to the metering register and maximum demand indicator.

6.2.3 Watt-hour Indicator and Var-hour Indicator The registers of watt-hour indicators and var-hour indicators shall be as follows:

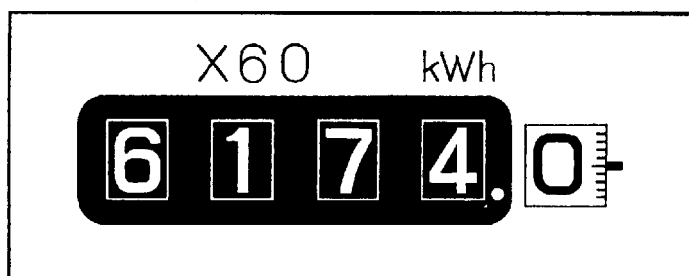
- (1) The register shall operate correctly, and no difference shall appear between the indication of the register and the indication of watt-hour or var-hour on the driving device.
- (2) The register shall be of drum type, the meter plate shall be so structured that reading of indication is easy, kWh or kvarh shall be used as the unit of measurement and clearly marked as given in the example of Fig. 1.

Remark: In a special case, MWh or Mvarh may be used.

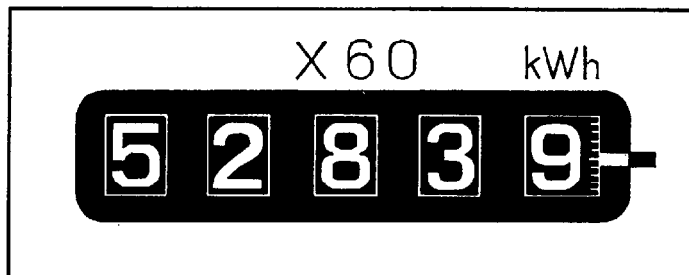
- (3) The figures of five digits shall be indicated on the meter plate. The figure windows shall be arranged as shown in the example of Fig. 1.
- (4) The digit wheel at the lowest digit shall be of gradually progressing type to allow reading of 1/100 revolution.
- (5) The size of figures on the digit wheel shall be at least 4 mm in width and 5 mm in height. However, the width of figure in last digit, in spite of the last digit is in decimal position or integer position, may be made slightly smaller.
- (6) In a meter plate containing a decimal point, the integer position and decimal position shall be clearly identified as illustrated in the example of Fig. 1.

Fig. 1. Example of Indication on Meter Plate

(1) With Decimal Point



(2) Without Decimal Point



Remark: In a var-hour indicator kWh in the figure should be replaced by kvarh.

6.2.4 Pointer Type Maximum Demand Indicator The single scale maximum demand pointer, pusher, timing device and maximum demand pointer resetting device of a pointer type maximum demand indicator shall be as follows:

(1) Single Scale

- (a) The direction of scaling shall be as shown in the example of Fig. 2.
- (b) The length of scale from zero scale to the rated load indication point shall be 125 mm or more.

Remark: The length of scale is expressed by the length of arc passing the tips of subscale marks.

- (c) The maximum scale value shall be 120 % of the indication value at the rated load, as the standard.
- (d) The scale spacing shall be not less than 0.6 mm when measured between centres of two adjacent scale marks at their ends near the revolution centre of maximum demand pointer.

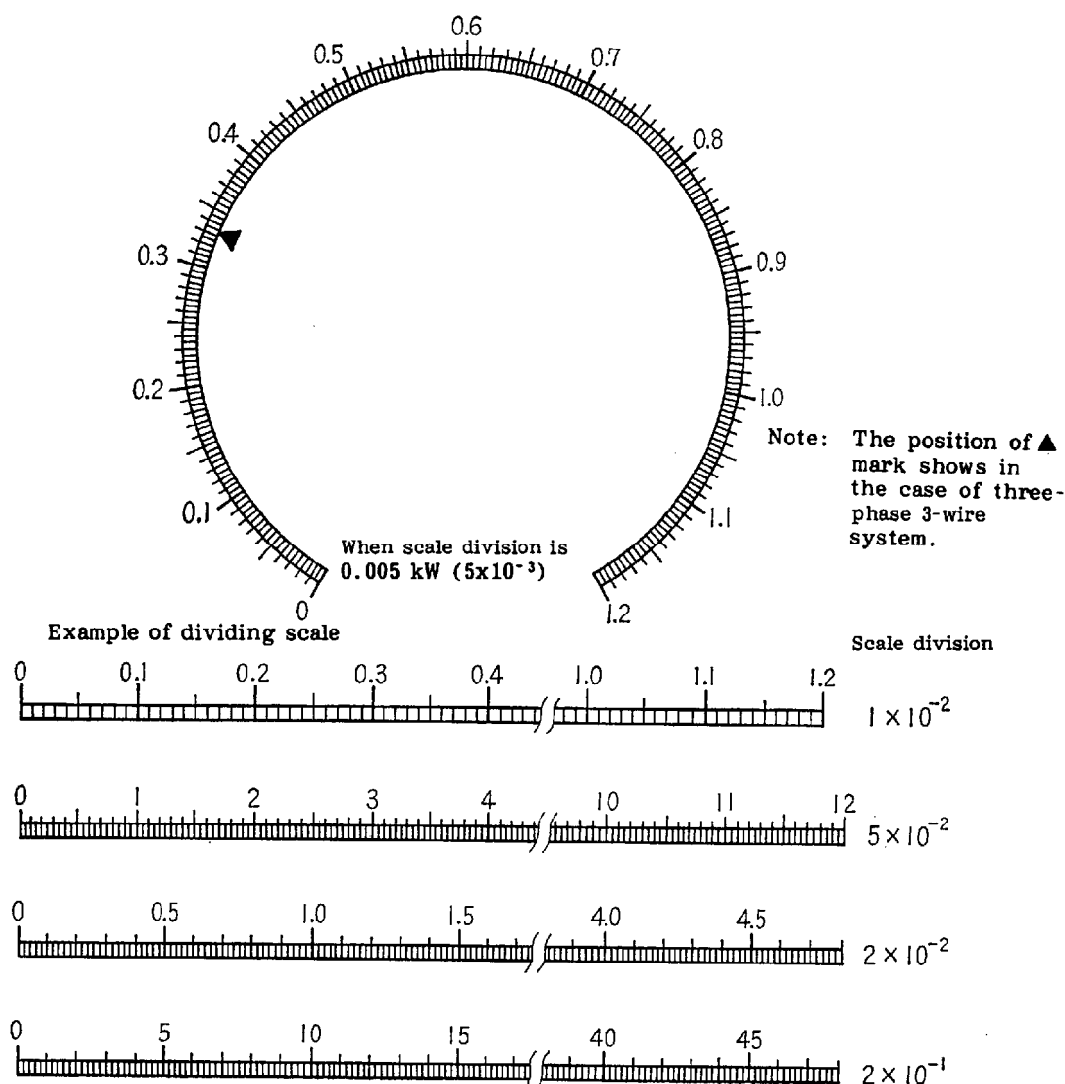
Remark: If scale spacing is 1.2 mm or more, an auxiliary scale mark may further be inserted between two scale marks.

- (e) The length of subscale marks shall be 2 to 2.5 mm and the thickness of all the scale marks shall be 0.15 mm as the standard.
- (f) Each scale interval shall correspond 1, 2 or 5, or that multiplied by integer power of 10, and the scale value shall be clearly marked on the scale plate as shown in the example of Fig. 2 by employing kW as the unit.

Remark: In a special case, MW may be used.

- (g) At the scale mark corresponding to 35 % of the rated load, the mark ▲ shall be marked as shown in the example of Fig. 2.

Fig. 2. Example of Single Scale



- (h) The dial shall have adequate strength and shall be firmly fixed not to cause eccentricity from the revolution centre of the maximum demand pointer.
- (i) The painting of dial and the scale marks shall be so finished that it will not easily cause change or deterioration in colour.
- (j) When a mirror is attached to the dial, a good mirror free from blur, flaw, distortion, etc. shall be employed and attached to a position where it is most convenient to read the maximum demand pointer.

(2) Maximum Demand Pointer

- (a) The maximum demand pointer shall be surely advanced by the pusher and shall remain surely at that point when the pusher retracts.
- (b) The maximum demand pointer shall have adequate strength not to allow easy deformation and shall be sufficiently stable against external vibration and/or shock.
- (c) The maximum demand pointer shall be finished in black colour so that change, deterioration, or peel-off of colour will not appear easily.
- (d) The length of maximum demand pointer shall be such that the tip of pointer lies within a range of 1 mm from the top ends of subscale marks, and the width of tip of pointer is 0.2 mm.
- (e) The space between the maximum demand pointer and the dial without mirror shall not exceed 3 mm.

(3) Pusher

- (a) The pusher shall correctly operate corresponding to the change of load, shall advance the maximum demand pointer completely, and shall return surely in response to the operation of timing device without giving any influence to the maximum demand pointer.

The time necessary for resetting pusher to zero position shall be within 5 sec.

- (b) The pusher shall be finished in red colour in a way not to allow easy change, deterioration or peel-off of colour.
- (c) The pusher shall have adequate strength and structure so that the maximum demand pointer does not move to lower position over the pusher due to resetting operation of maximum demand pointer, vibration or shock.

(4) Timing Device

- (a) A demand interval display shall be attached to an easily visible place of an indicator.
- (b) If a timing device includes a motor, the terminals of motor shall be marked and connected to the voltage circuit.
- (c) If the motor for timing device is also used for other operations, the timing device shall be structured to avoid incorrect timing operation due to the said other operations.

(5) Maximum Demand Pointer Resetting Device

- (a) A resetting device which returns the maximum demand pointer to a lower position easily by a simple manual or automatic operation with the cover completely attached, shall be mounted on the front face of an indicator. This device shall be so constructed that it can not move the maximum demand pointer to the upper position, and that the pointer does not pass over zero position when moved to the lower position.
- (b) The maximum demand pointer resetting device shall be equipped with a separate seal from the seal of the base and cover of the main apparatus, and the maximum demand pointer shall be not capable of being moved without breaking of this seal.

6.2.5 Digital Display Type Maximum Demand Indicator The maximum demand drums, demand register, timing device and maximum demand drum resetting device of a digital display type maximum demand indicator shall be as follows:

(1) Maximum Demand Drums

- (a) The size of the figures on the maximum demand drums shall be at least 2 mm in width and 4 mm in height.
- (b) The maximum demand drums shall progress corresponding to the demand register, and surely remains at that indication when the demand register returns to zero position at the completion of the demand interval.
- (c) The maximum demand drums shall have adequate strength and sufficiently stable against external vibration and shock.
- (d) The meter plate for maximum demand drums shall be finished in a way not to allow easy change, deterioration or peel-off of colour as shown in the example of Fig. 3., and the demand register shall be clearly distinguished.
- (e) The meter plate for maximum demand drums shall be so structured that reading of the indication is easy, and kW shall be used as the unit of measurement and clearly marked on the meter plate as shown in the example of Fig. 3.

Further the numerical value of the rated load shall be clearly marked on the right bottom of plate as shown in the example of Fig. 3.

Remark: In a special case, MW may be used.

- (f) Figures of the maximum demand drums shall, as a rule, be of four digits.
- (g) In a meter plate containing a decimal point, the integer part and decimal part shall be clearly identified as illustrated in the example of Fig. 3.