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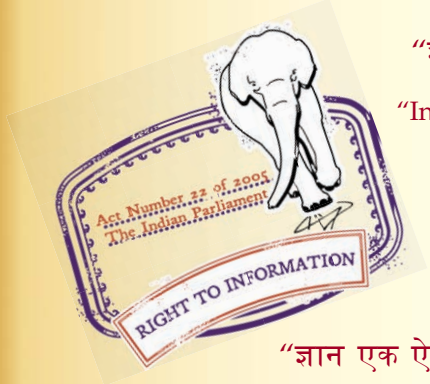
IS 13010 (2002): ac Watthour Meters, Class 0.5, 1 and 2 [ETD 13: Equipment for Electrical Energy Measurement and Load Control]



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"Knowledge is such a treasure which cannot be stolen"

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भारतीय मानक

एसी वाट घंटा मीटर, क्लास 0.5, 1 एवं 2 — विशिष्टि

(पहला पुनरीक्षण)

Indian Standard

ac WATTHOUR METERS, CLASS 0.5, 1 AND 2 — SPECIFICATION

(First Revision)

ICS 17.220.20

BUREAU OF INDIAN STANDARDS
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI 110002

September 2002

Price Group 9

FOREWORD

This Indian Standard (First Revision) was adopted by the Bureau of Indian Standards, after the draft finalized by the Equipment for Electrical Energy Measurement and Load Control Sectional Committee had been approved by the Electrotechnical Division Council.

This standard was first published in 1990. This revision has been brought out to update some of the requirements.

The test levels as specified in this standard are regarded as minimum values to guarantee the proper functioning of the meter under normal working conditions. For special applications other test levels might be necessary and have to be fixed between the user and the manufacturer.

An explanatory note in relation to watthour meters of Class 0.5 is given in Annex A.

The following publications have also been referred to in this standard:

a) IEC 60068-2-75 (1997) Environmental testing — Part 2-75 : Tests — Test Eh : Hammer tests.

b) ISO 75-1 : 1993 Determination of temperature of deflection under load — Part 1 : General test method.

c) ISO 75-2 : 1993 Determination of temperature of deflection under load — Part 2 : Plastics and ebonite.

d) IEC 61000-4-5 (1995) Electromagnetic compatibility (EMC) — Part 4 : Testing and measurement techniques — Section 5 Surge immunity test.

e) IEC 60387 (1992-08) Symbols for alternating-current electricity meters.

While preparing this standard, assistance has been derived from IEC 60521 (1988) 'Class 0.5, 1 and 2 alternating-current watthour meters', issued by the International Electrotechnical Commission'.

For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test or analysis, shall be rounded off in accordance with IS 2 : 1960 'Rules for rounding off numerical values (*revised*)'. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

Indian Standard

ac WATTHOUR METERS, CLASS 0.5, 1 AND 2 — SPECIFICATION

(First Revision)

1 SCOPE

1.1 This standard applies only to induction type watthour meters of accuracy Class 0.5,1 and 2, for the measurement of alternating current electrical active energy.

1.2 It applies to the assembly of meters and accessories, including current transformers, when enclosed in the meter case. It does not apply to maximum demand indicators which is covered by IS 8530.

1.3 It does not apply to any kind of measuring devices such as those used for telemetering electrical energy covered by IS 14451 (Part 1).

1.4 This standard applies to multi-rate meters, but does not apply to other special types of meters (for example, excess consumption meters), or to meters used for testing purposes covered by IS 11426.

1.5 It does not apply to watthour meters where the voltage across the connection terminals exceeds 600 V (line to line voltage for meters for polyphase systems).

NOTE — For portable meters and meters for outdoor use, additional requirements may be necessary.

2 REFERENCES

2.1 The Indian Standards listed in Annex B are necessary adjuncts to this standard.

3 TERMINOLOGY

3.0 For the purpose of this standard, the following definitions shall apply.

3.1 Watthour Meter (Active Energy Meter)

An instrument which measures active energy by integrating active power with respect to time and registers in watthour or in suitable multiples thereof.

3.2 Induction Meter

A meter in which fluxes produced by currents in fixed coils react with the eddy currents induced in a conducting moving element, generally as disc(s), which causes the movement of the moving element.

3 3 Multi-Rate Meter

An energy meter provided with a number of registers, each becoming operative at specified time interval corresponding to different tariffs.

3.4 Meter Rotor

The moving element of the meter upon which the magnetic fluxes of fixed windings and of braking elements act, and which operates the register.

3.5 Meter Driving Element

A working part of the meter which produces a torque by the action of its magnetic fluxes upon the currents induced in the moving element. It comprises electromagnets with their control devices and adjusting devices.

3.6 Reverse Running Stop

A mechanism to prevent reverse registration.

3.7 Meter Braking Element

The part of the meter which produces a braking torque by the action of its magnetic flux upon the currents induced in the moving element. It comprises one or more permanent magnets and their adjusting devices.

3.8 Register of Meter (Counting Mechanism)

The part of the meter which enables the measured value, that is, energy, to be registered.

3.9 Meter Base

The back of the meter by which it is generally fixed and to which are attached the frame, the terminals or the terminal block and the cover.

For a flush-mounted meter, it may include the sides of the case.

3.9.1 *Meter Socket*

An enclosure with jaws to accommodate terminals of a detachable meter and which has connectors from the termination of the circuit conductors. It may be a singleposition socket for one meter or a multi-position socket for two more meters.

3.10 Meter Cover

The enclosure on front of the meter made either wholly of transparent material or of opaque material provided with window(s) through which the movement of the rotor can be seen and the register can be read.

3.11 Meter Case

This comprises the base and the cover.

3.11.1 Insulating encased meter of protective Class 1: Meter in which protection against electric shock does not rely on basic insulation only, but which includes an additional safety precaution such that conductive accessible parts are connected to the protective earthing conductor in the fixed wiring of the installation in such a way that conductive accessible parts cannot become live in the event of a failure of the basic insulation.

NOTE — This provision includes a protective earth terminal.

3.11.2 Insulating encased meter of protective Class 2 : Meter with a case of insulating material in which protection against electric shock does not rely on basic insulation only, but in which additional safety precautions, such as double insulation or reinforced insulation, are provided, there being no provision for protective earthing or reliance upon installation conditions.

3.12 Meter Frame

The part to which are affixed the driving elements, the rotor bearing, the register, usually the braking element and sometimes the adjusting devices.

3.13 Accessible Conducting Part

A conducting part which can be touched by the standard test finger when the meter is installed ready for use.

NOTE — To determine whether a part is accessible, either visual inspection shall be used; or the flexible test finger given in the Fig. 1 of IS 1401, or the rigid test finger given in Fig. 2 of IS 1401 shall be applied. In case of doubt, the latter shall be applied with a maximum force of 30 N.

3.14 Protective Earth Terminal

The terminal connected to accessible conducting parts of a meter for connection to the earth, for the sake of safety.

3.15 Terminal Block

A support made of insulating material on which all or some of the terminals of the meter are grouped together.

3.16 Terminal Cover

A cover which encloses the meter terminals and, if required, the ends of the external wires or cables connected to the terminals.

3.17 Current Circuit

The winding of the driving element and the internal connections of the meter through which flows the current of the external circuit, to which the meter is connected.

NOTE — When the meter incorporates a current transformer, the current circuit also includes the transformer windings.

3.18 Voltage Circuit

The windings of the driving element and internal connections of the meter, supplied with the voltage of the circuit to which the meter is connected.

3.19 Auxiliary Circuit

The element (windings, lamps, contacts, etc.) and connections of an auxiliary device within the meter case intended to be connected to an external device, for example, clock, relay and impulse counter.

3.20 Basic Current [1](Ib)

The value of current in accordance with which the relevant performance of the meter is fixed.

3.21 Rated Maximum Current [1]($I\,max$)

The highest value of current at which the meter purports to meet the accuracy requirements of this standard.

3.22 Reference Voltage[1]

The value of voltage in accordance with which the relevant performance of the meter is fixed.

3.23 Reference Frequency

The value of frequency in accordance with which the relevant performance of the meter is fixed.

3.24 Basic Speed

The nominal speed of rotation of the rotor expressed in revolutions per minute when the meter is under reference conditions and carries basic current at $\cos \Phi = 1$.

3.25 Basic Torque

The nominal value of torque on the rotor at rest when the meter is under reference conditions and when basic current is applied at $\cos \Phi = 1$.

3.26 Meter Constant

Constant expressing the relation between energy registered by the meter and corresponding number of revolutions of the rotor, expressed in revolutions per kilo watthour (rev/kWh).

3.27 Reference Temperature

The ambient temperature specified for reference conditions.

[1]The terms voltage and current indicates rms values, unless specified.

3.28 Clearance

The shortest distance measured in air between conductive parts.

3.29 Creepage Distance

The shortest distance measured over surface of insulation between the conductive parts.

3.30 Percentage Error

The percentage error is given by the following formula:

$$\text{Percentage error} = \frac{R - A}{A} \times 100$$

where

R = energy registered by the meter, and

A = true energy.

NOTE — Since the true value cannot be determined, it is approximated by a value with a stated uncertainty that can be traced to standards agreed upon between manufacturer and user or to national standards vide IS 12346.

When determined from the rotor speed,

$$\text{Percentage error} = \frac{T - t}{t} \times 100$$

where

T = true time, that is, the time a correct meter would require for the same number of revolutions of the rotor; and

t = observed time for a given number of revolutions of the rotor.

The terms voltage and current indicates rms values, unless specified.

3.31 Variation of Error Due to an Influence Quantity

The difference between percentage errors of meter when only one influence quantity assumes successively two specified values, one of them being the reference value.

3.32 Influence Quantity or Factor

Any quantity or any factor, generally external to meter, which may affect the measured value.

3.33 Distortion Factor

The ratio of rms value of the harmonic content (obtained by subtracting from a non-sinusoidal alternating quantity, its fundamental component) to the rms value of the non-sinusoidal quantity. The distortion factor is usually expressed as a percentage.

3.34 Mean Temperature Coefficient

The ratio of variation of percentage error to the change of temperature which produces this variation.

3.35 Vertical Working Position

The position of the meter in which the shaft of the rotor is vertical.

3.36 Class Index

A number which gives the limits of permissible percentage error, for all values of current, between 10 percent of Ib and I max, for $\cos \Phi = 1$ (and in case of polyphase meters with balanced load) when the meter is tested under reference conditions (including permitted tolerances on the reference values) as defined in this standard.

3.37 Classification Angle (Degree of Phase Displacement)

The nominal phase displacement between voltage and current magnetic fluxes of a single driving element (*see* Note) in principal air gaps when the voltage and current applied to this single element are in phase.

NOTE — Driving element includes any necessary accessories, resistors, inductors and shunts.

3.38 Type

Designation used for defining a particular design of meter manufactured by one manufacturer, having:

a) similar metrological properties,

b) the same uniform construction of parts determining these properties,

c) the same number of ampere-turns for the current winding at basic current and the same number of turns per volt, for the voltage winding at reference voltage,

d) the same ratio of the rated maximum current to the basic current, and

e) the same value of basic torque with a tolerance of ±10 percent.

They may have several values of basic current and several values of reference voltage. These metes are designated by the manufacturer by one or more groups of letters or number, or of a combination of letters and numbers. Each type has one designation only.

NOTES

1 The type is represented by the sample meter(s) intended for type tests and whose characteristics (basic currents and reference voltage) are chosen from the values given in Tables 1 and 2, proposed by the manufacturer.

2 Where the number of ampere-turns would lead to number of turns other than a whole number, the product

of the number of turns of the windings by the value of the basic current may differ from that of the sample meter(s) representative of the type. It is advisable to choose the next number immediately above or below in order to have whole number of turns. Only for this reason may be number of turns per volt of the voltage windings differ, but by not more than 20 percent from that of the sample meters representative of the type.

3 The ratio of the highest to the lowest basic speed of the rotors to each of the meters of the same type shall not exceed 1:1.5.

3.39 Type Tests

Tests carried out under prescribed conditions to verify one of the characteristics of the type of the meter.

3.39.1 *Type Approval Procedure*

The procedure according to which the series of type tests is carried out on one meter or on small number of meters of the same type having identical characteristics, selected by the manufacturer, to verify that the respective type of meter complies with all the requirements of the standard for the relevant class of meters.

3.39.2 *Qualification Procedure*

The procedure according to which type tests are carried out on one meter or on a small number of meters of the same type having identical characteristics, selected at random, to verify that the meter type has no serious systematic abnormalities . The precise tests and the number of meters to be tested are to be agreed between the parties.

NOTE — In practice, it is considered that no serious systematic abnormalities exist when two out of three meters tested comply with the relevant requirements of this standard for the considered test.

3.40 Routine Tests

Tests carried out on each meter to check conformity with the requirements of this standard in aspects which are likely to vary during production

3.41 Acceptance Tests

Tests carried out on all meters or on samples drawn from a batch for the purpose of acceptance of the batch during inspection by the purchaser.

3.42 Optional Tests

Special test to be carried out, when required, by agreement between the purchaser and the supplier.

3.43 Efficiency Factor

Mathematically defined as :

$$\frac{\text{Permanence factor}}{\text{Voltage circuit power loss}}$$

where

$$\text{Permanence factor} = \frac{\text{Driving torque} \times 100}{\text{Rotor weight} \times \text{Rotor speed}}$$

Driving torque is in g-cm;

Rotor weight is in g;

Rotor speed is in rpm; and

Voltage circuit power loss is in watts.

NOTE — Torque and speed correspond to the respective value when the meter is under reference conditions, carrying the basic current at unity power factor. Power loss in 2 voltage circuits is the average of the power loss of 2 voltage circuits for 3-wire meters and average of power loss of 3-voltage circuits for 3-phase 4-wire systems.

4 CLASSIFICATION

4.1 Meters are classified according to their respective class indices, for example, 0.5, 1 or 2.

5 RATINGS

5.1 Standard Basic Currents

The basic currents shall be as given in Table 1.

Table 1 Standard Basic Currents

(*Clauses* 3.38 *and* 5.1)

Type of Meter	Basic Current (Amps)
(1)	(2)
1-phase	2.5, 5, 10, 15, 20
3-phase	5, 10, 15, 20, 30, 40, 50
For connection through current transformer(s)	1 or 5

5.2 Rated Maximum Currents

Maximum rated current for whole current meters shall be preferably an integral multiple of the basic current (that is four times the basic current). The rated maximum current of meter shall have the same value as the rated extended secondary current of the current transformer.

5.3 Standard Reference Voltages

The reference voltage shall be as given in Table 2 (*see* IS 12360).

Table 2 Standard Reference Voltages

(*Clauses* 3.38 *and* 5.3)

Meters for	Standard Reference Voltage(V)	Exceptional Values(V)
(1)	(2)	(3)
Direct connections and through current transformer only	230(400), 240(415)	220(380), 250(433)
connection through voltage transformer	57.7(100), 63.5(110), 200	100(173)

5.4 Standard Frequency

Standard value for reference frequency is 50 Hz.

6 GENERAL AND CONSTRUCTIONAL REQUIREMENTS

6.1 General

Meters shall be designed and constructed in such a way as to avoid introducing danger in normal use and normal conditions.

— personal safety against electric shock,

— personal safety against effects of excessive temperature,

— safety against spread of fire.

6.1.1 All parts which are subject to corrosion under normal working conditions shall be effectively protected against corrosion due to atmospheric causes. Any protective coating shall not be liable to damage by ordinary handling nor injuriously affected by exposure to air, under normal working conditions.

NOTE — For meters for special use in corrosive atmosphere, additional requirements shall be fixed in the purchased contract.

6.1.2 The meter shall have adequate mechanical strength and shall withstand the fluctuations of temperature, which are likely to occur in normal working conditions.

6.1.3 The components shall be reliably fastened and secured against loosening.

6.1.4 The electrical connections shall be such as to prevent any opening of the circuit under normal conditions of use, including any overload conditions specified in this standard.

6.1.5 The construction of the meter shall be such as to minimize the risks of short-circuiting of the insulation between live parts and accessible conducting parts due to accidental loosening or unscrewing of the wiring, screws, etc.

6.1.6 The meter shall not produce appreciable noise in use.

6.2 Case

6.2.1 The meter shall have a reasonably dust/moisture-proof case, which may be sealed in such a way that the internal parts of the meter are accessible only after breaking the seals.

6.2.2 The cover shall not be removable without the use of tool, coin or any similar device.

6.2.3 The holding on and sealing screws shall be held captive in the meter cover when fixed from front.

6.2.4 The case shall be so constructed and arranged that any non-permanent deformation cannot prevent the satisfactory operation of the meter.

6.2.5 The case of a Class 0.5 meter shall be constructed so that, if mounted according to the manufacturer's instructions, the meter shall not deviate by more than 0.5° in all directions from its vertical position (*see* Note 2 in Table 8).

6.2.6 The meters, having a case wholly or partially made of metal, shall be provided with a protective earth terminal.

6.3 Windows

If the meter cover is not transparent, one or more windows shall be provided for reading the register and observation of the rotor. These windows shall be covered by plates of transparent material which cannot be removed without breaking the seals.

The glass or any other transparent cover of the window shall be replaceable from inside only. The window cover shall be dust/moisture proof and shall not be removable from outside without damage.

6.4 Terminals — Terminal Block(s) and Protective Earth Terminal

Terminals may be grouped in one or more terminal block(s) having adequate insulating properties and mechanical strength. In order to satisfy such requirements, when choosing insulating materials for the terminal block(s), adequate testing of materials should be taken into account. The material of which the terminal block is made shall be capable of passing the tests given in ISO standard 75 for temperature of 135 °C.

The holes in the insulating material which form a prolongation of the terminal holes shall be of sufficient size to accommodate the insulation of the conductors also.

NOTE — Whether the disconnecting device for the meter voltage circuit will be in the terminal compartment or inside the meter cover, shall be a matter of agreement between the manufacturer and the purchaser. However, if the test facility permits, it may also be agreed by the parties to dispense with such disconnecting device, so that voltage terminal(s) may be connected firmly to the input current terminal (s) and cannot be disconnected easily.

6.4.1 *Fixing of Conductors*

The manner of fixing the conductors to the terminals shall ensure adequate and durable contact to eliminate

risk of loosening or undue heating. All parts of every terminal shall be such that the risk of corrosion resulting from contact with any other metal part is minimized.

Screw connections transmitting contact force and screw fixings which may be loosened and tightened several times during the life of the meter shall be a metal nut.

Electrical connections shall be so designed that contact pressure is not transmitted through insulating material.

6.4.1.1 Two screws shall be provided in each current terminal for effectively clamping the external leads or thimbles. Alternatively, if an elastic pressure plate or similar effective device is provided to keep the entire length of the conductor within the terminal well pressed, one screw may be used. Each clamping screw shall engage a minimum of three threads in the terminal. The ends of screws shall be such as not to pierce and cut the conductors used.

6.4.1.2 Meters with rated maximum current 100 A and above shall be connected through soldering/crimped sockets. Meters with rated maximum current of 60 and above may be connected through soldering/ crimped sockets.

6.4.1.3 *Connections of current circuit conductors of meter current terminals*

The current circuit conductors of a meter shall be connected to its current terminals inside the meter terminal block adopting any of the recommended methods given in Annex C so as to ensure satisfactory durable and adequate contact surfaces between the conductors and the terminals.

6.4.2 *Dimensions of Terminal Holes*

The internal diameter of terminal hole shall be as specified in Table 3.

Table 3 Terminal Holes

Rated Current (A)	Internal Dia
Max	*Min* (mm)
(1)	(2)
Upto and including 40	5.5
41 to 60	8.0
61 to 120	9.5

6.4.3 *Clearances and Creepage Distance*

The clearances and creepage distance of terminal block and those between the terminals and the surrounding parts of the metal enclosure shall be not less than the values specified in Table 4 for voltages existing when operating under reference conditions.

Table 4 Clearance and Creepage Distances

(*Clauses* 6.4.3 *and* 6.4.3.6)

Voltage (V)	Clearance (mm)	Creepage Distance (mm)
(1)	(2)	(3)
Up to & including 25	1	1
26 to 60	2	2
61 to 250	3	3
251 to 450	3	4
451 to 600	4	6

6.4.3.1 For current circuits, the voltage shall be considered to be the same as for the related voltage circuit.

6.4.3.2 Clearance of minimum 3 mm shall be provided between incoming and outgoing terminals of the same phase.

6.4.3.3 A clearance of minimum 2 mm shall be provided between pressure terminal and current terminals of the same phase.

6.4.3.4 Terminals with different potentials which are grouped close together shall be protected against accidental short-circuiting. Protection may be obtained by insulating barriers. Terminals of one current circuit are considered to be at the same potential.

6.4.3.5 The terminal, the conductor fixing screws, or the external or internal conductors shall not be liable to come into contact metal terminal covers and meter terminal base. For this purpose, terminal block shall be rigidly fixed to the meter base.

6.4.3.6 The clearance between the terminal cover if made of metal, and the upper surface of the screws when screwed down to the maximum applicable to the conductor fitted shall be not less then the relevant values specified in Table 4. If the terminal cover is made of insulating material, the clearance shall be not less than 1 mm.

6.4.4 *Protective Earth Terminal*

The protective earth terminal, if any, shall:

a) be electrically bonded to accessible metal parts;

b) form part of the meter base, if possible;

c) preferably be located adjacent to its terminal block;

d) accommodate a conductor having a cross-section at least equivalent to the main current conductors but with a lower limit of 6 mm^2 and an upper limit of 16 mm^2; and

e) be clearly identified by the earth symbol.

All parts of every terminal shall be such that the risk of corrosion resulting from contact with any other metal part is minimized.

After installation, it shall not be possible to loosen the protective earth terminal without the use of a tool, coin or any similar device.

6.5 Terminal Cover(s)

Every terminal block shall be provided with a terminal cover conforming to **6.5.1** or **6.5.2**, which can be sealed independently of the meter cover.

6.5.1 *Short Terminal Cover*

The terminals, their fixing screws and the insulated compartment housing them shall be enclosed by a cover of more or less same size as that of the terminal block, such that the wiring for connection may be carried out from the bottom of the meter board.

6.5.2 *Extended Terminal Cover*

The terminals, their fixing screws, a suitable length of external insulated conductor and its insulation shall be enclosed by a cover with a provision for sealing, such that the wiring for connections can be carried out from the rear of the meter board only.

6.5.3 The fixing screws used on the terminal cover for fixing and sealing in **6.5.1** and **6.5.2** shall be held captive in the terminal cover.

6.5.4 The requirements of **6.5.1** and **6.5.2** shall not apply to portable meters provided with plug-in connections.

6.5.5 When the meter is mounted on the meter board and thereafter energised, no access to the terminals shall be possible without breaking the seal(s) of the terminal cover.

6.6 Non-Flammability

The terminal block, the terminal cover (if not of metal) and the case (if not of metal) shall be of a material which complies with the requirements of:

a) method FH1 as per IS 11731 (Part 1), and

b) the tests given in ISO 75 for a temperature of 135°C and a pressure of 1.8 MPa (Method A).

NOTE — If the materials of the terminal bock, the terminal cover and the case meet this requirement the finished meter need not be tested.

6.7 Insulating Encased Meter of Protective Class 2

A meter having a durable and substantially continuous enclosure made wholly of insulating material, including the terminal cover, which envelopes all metal parts with the exception of small parts, for example, name-plate, screws, suspensions and rivets. If such small parts are accessible by the standard test finger (*see* IS 1401) from outside the case, then they shall be additionally isolated from live parts by supplementary insulation against failure of basic insulation or loosening of liver parts. The insulating properties of lacquer, enamel, ordinary paper, cotton oxide film on metal parts, adhesive film and sealing compound or similar unsure materials, shall not be regarded as sufficient for supplementary insulation.

For the terminal block and the terminal cover of such a meter, reinforced insulation is sufficient.

6.8 Resistance to Heat and Fire

The terminal block, the terminal cover and the meter case shall ensure reasonable safety against spread of fire. They should not be ignited by thermic overload of live parts in contact with them. To comply therewith they must fulfil the test as specified in **11.23**.

6.9 Protection Against Penetration of Dust and Water

The meter shall conform to the degree of protection as given below:

Indoor meter *IP*51, but without suction in the meter.

6.10 Register (Counting Mechanism)

6.10.1 *General*

The register may be of the drum (cyclometer) or the pointer type.

6.10.1.1 The principal unit in which the register records shall be the kilowatt-hour (kWh), or megawatt-hour (MWh).

6.10.1.2 In cyclometer type registers, the principal unit in which the register records shall be marked adjacent to the set of drums and only the last drum, that is, the drum on the extreme right shall be movable continuously.

6.10.1.3 In pointer type registers, the unit in which the register records shall be marked adjacent to the units dial in the form, for example, 1 kWh/div or 1 mWh/div, and the decimal multiples may be marked adjacent to other.

For example, in a registering in terms of kWh, the units dials shall be marked, 1 kWh/div and adjacent to the other dials to the left of the units dials shall be marked 10,100,1 000 etc.

6.10.1.4 Decimal dials or drums shall be coloured, or encircled in colour, the fastest moving being graduated and numbered. The smallest division of the fastest moving drum or dial shall represent not more

than 30 revolutions of the rotor (for meters provided with decimal drums).

Drums, when continuously rotating , or dials indicating the lowest values shall be graduated and numbered in ten divisions, each division being subdivided into ten parts or any other arrangement ensuing the same reading accurately. Drums of cyclometer type registers or dials of pointer type registers which indicates a decimal fraction of the unit shall, when they are visible be encircled in different colour or be coloured.

6.10.1.5 The register shall be able to record, starting from zero, for a minimum of 1 500 h, the energy corresponding to the rated maximum current at reference voltage and unity power factor. Any higher value may be agreed upon by the manufacturer and the purchaser.

6.10.1.6 Register markings shall be indelible and easily readable.

6.10.1.7 *Self-alignment of register*

The register shall be of self-aligning type so that the register will align itself correctly with respect to the rotor when pushed into the full extent.

6.10.2 *Dimensions*

6.10.2.1 *Pointer register*

The pointers shall indicate on circular dials each divided into ten equal divisions. The radius of the circles shall be not less than 7.0 mm and the radial length of the pointer shall be less than the radius of the circles, but by not more than 0.5 mm. The height of the figures round the circles shall be not less than 2.5 mm nor more than 3 mm. The radius of the circles which indicate value lower than one kilo watthour per division may be smaller than 7.0

6.10.2.2 *Drum register*

The diameter of the drums shall be at least 14 mm .The height of the numerals on the drums shall be at least 4 mm and their width at least 2 mm.

6.10.3 The material of drums shall be metallic /special synthetic material. The later material shall withstand temperatures of boiling water for 5 min continuously without distortion or softening.

6.11 Direction of Rotation and Marking of the Rotor

The edge of the rotor nearest to an observer viewing a meter from the front shall move from left to right for positive registration. The direction of rotation shall be marked by a clearly visible indelible arrow.

The edge and upper surface of the disc shall carry an easily visible mark to facilitate revolution counting. Other marks may be added for stroboscopic or other tests, but such marks shall be so placed as not to interfere with the use of the main visible mark for photoelectric revolution counting. The circumference of the disc shall also be graduated on the upper surface into 100 division, or multiples thereof.

6.12 Recommended Guideline for Constructional Features

Meters with special constructional features as desired by the utilities may be supplied by mutual agreement. Recommended guidelines on the constructional features which should form the basis for mutual agreement is given in Annex D.

7 SPEED OF ROTATION

7.1 The speed of rotor of the single phase meters at reference voltage, unity power factor and maximum current shall not exceed 72 rpm. The speed of rotor of polyphase meters at reference voltage, unity power factor and maximum current shall not exceed 50 rpm.

7.2 Torque/Speed Ratio

[Under consideration to replace **7.1** and Annex D (18)].

8 MARKING OF METERS

8.1 Marking and Nameplates

Every meter shall bear the following information with indelible and distinct markings, readable from outside the meter:

a) Manufacturer's name or trade-mark and, if required, the place of manufacture;

b) Designation of type;

c) The nature of current, the number of phases and number of wires for which the meter is suitable (for example 1-phase — 2-wire, 3-phase — 3-wire, 3-phase — 4-wire);

d) Serial number and year of manufacture. If the serial number is marked on a plate fixed to the cover, this number is also to be marked on the base or frame;

e) Principal unit in which the meter records (for example; kWh or kVArh);

f) The reference voltage in one of the forms given in Table 5;

g) Currents in the form given as example in Table 6;

h) Reference frequency in Hertz;

j) Meter constant, for example, in the form × rev/kWh;

k) Class index, for example, Cl 0.5, Cl 1, Cl 2;

m) Reference temperature, if different from 27° C; and

n) Transformation ratio(s), if the meter register(s) energy through instrument transformer(s) of which account is taken in the meter constant.

NOTES

1 The information under (a), (b) and (c) may be marked on an external plate permanently attached to the meter cover. The information under (d) to (n) shall be marked on nameplate preferably placed within the meter and which may, for example, be attached to the meter register. The information may be marked on the meter dial.

2 If the meter is of a special type (for example, provided with a reversal preventing device or is intended for a capacitive load), this shall be indicated on the nameplate or on a separate plate.

3 Standard symbols shall also be used (*see* IEC 60387 (1992-08).

4 The sign of ⊡ shall be used for insulating encased meters of protective Class II.

Table 5 Voltage Marking

(*Clause* 8.1)

Type of Meter	No. of Element & the Voltage at the Terminals of the Voltage Circuit(s)	Normal System Voltage or Secondary Voltage V.T.
(1)	(2)	(3)
1 phase 2 wire	230 V	-/ 110 V
3 phase 3 wire 2 element	2 × 415 V	3 × 6 600/110 V
3 phase 4 wire 3 element	3 × voltage between line	3 × (132 000√3)/ (110√3) V

Table 6 Current Marking

(*Clause* 8.1)

Type of Meter	Method of Marking	Example
(1)	(2)	(3)
1 phase/3 phase direct connection	Basic current and rated max current	10-20A
1 phase/3 phase C.T. operated	Basic current	-/5 A

8.1.1 *BIS Certification Marking*

The meter may also be marked with the Standard Mark.

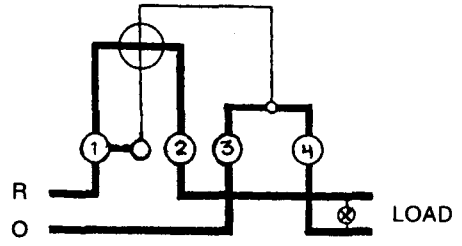
8.1.2 The use of the Standard Mark is governed by the provision of *Bureau of Indian Standards Act,* 1986 and the Rules and Regulations made thereunder. The details of conditions under which the licence for the use of Standard Mark may be granted to manufacturers or producers may be obtained from the Bureau of Indian Standards.

8.2 *Connection Diagrams and Terminal Marking*

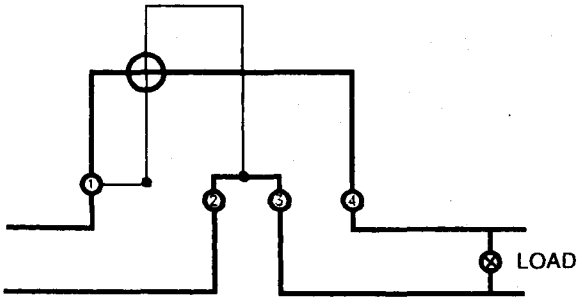
8.2.1 Every meter shall be indelibly marked with a connection diagram. For polyphase meters, this diagram shall also show the phase sequence for which it is intended.

8.2.2 If the meter terminals are marked, this marking shall appear on the diagram.

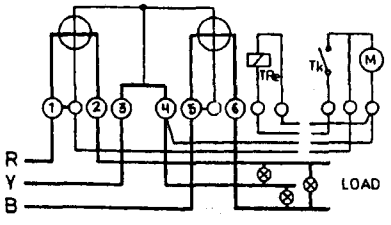
8.2.3 A standard connection diagram is shown in Fig. 1.



1 a) Single-Phase Two-Wire Meter

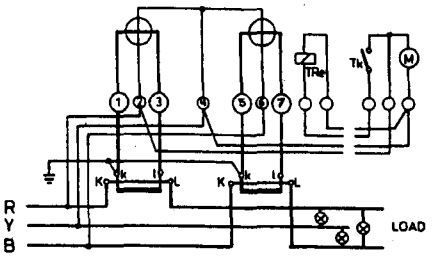


1 b) Single-Phase Two-Wire Meter Symmetrical Connections



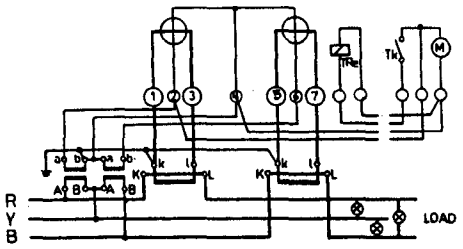
1 c) Three-Phase Three-Wire Double Tariff Meter for Direct Connection

M = Motor
Tk = Tariff Switch
TRe = Relay

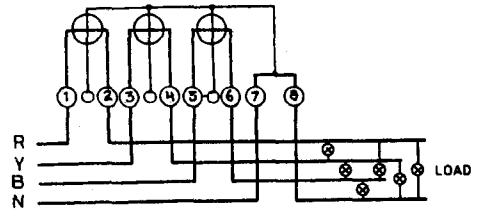


1 d) Three-Phase Three-Wire Double Tariff Meter with Current Transformers

FIG. 1 STANDARD CONNECTION DIAGRAM — *Contd.*

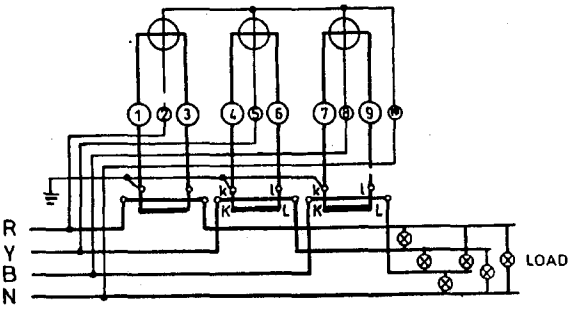


1 e) Three-Phase Three-Wire Double Tariff Meter with Current and Voltage Transformers

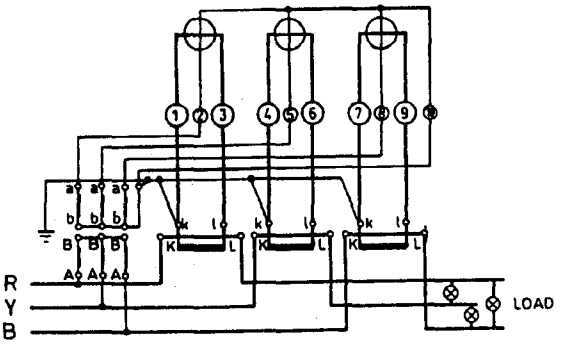


1 f) Three-Phase Four-Wire Single Tariff Meter for Direct Connection

M = Motor
Tk = Tariff Switch
TRe = Relay



1 g) Three-Phase Four-Wire Single Tariff Meter with Current Transformers



1 h) Three-Phase Four-Wire Single Tariff Meter with Current and Voltage Transformers

FIG. 1 STANDARD CONNECTION DIAGRAM

9 PACKING

9.1 Meters shall be suitably packed in order to avoid any damage or disturbance during transit or handling. General recommendations for packing of meters are given in Annex E.

10 CONDITIONS FOR TESTS

10.1 Unless otherwise specified, tests shall be carried out under the following conditions.

10.1.1 The meter cover shall be in position.

10.1.2 For drum type registers, only the most rapidly moving drum shall be turning.

10.1.3 Before any type test is performed, the voltage circuits shall have been energized for at least:

a) 4 h for Class 0.5 meters,

b) 2 h for Class 1 meters and worse, and

c) 1 h for Class 2 meters and worse,

and the measuring current shall be set progressively to increasing or decreasing values and the current circuits shall be energized at each value for a sufficient time to obtain thermal stability with corresponding constant speed of rotation.

10.1.4 In addition, for polyphase meters:

a) the phase sequence shall be as marked on the diagram of connections, and

b) the voltages and currents shall be substantially balanced (*see* Table 7).

10.1.5 The reference conditions for various influence quantities shall be as specified in Table 8.

10.1.6 Test equipment shall be as per IS12346.

11 TESTS

11.1 Classification of Tests

11.1.1 *Type Test*

Test schedule shall be as given in Table 9.

11.1.1.1 *Number of samples and criteria for conformity*

Type tests shall be applied to three test specimens, in the event of one specimen failing to comply in any respect, further three specimens shall be taken all of which shall comply with the requirement of this standard.

11.1.2 *Acceptance Tests*

Test schedule shall be as given in Table 10.

11.1.2.1 *Recommended sampling plan and criteria for acceptance*

A recommended sampling plan and the criteria for acceptance of the lot are given in Annex F.

11.1.3 *Routine Tests*

Test schedule and sequence shall be as given in Table 11.

Table 7 Voltage and Current Balance

(*Clause* 10.1.4)

Polyphase Meters	Class of Meter		
	0.5	1	2
(1)	(2)	(3)	(4)
Each of the voltage between line and neutral or between any two lines shall not differ from the average corresponding voltage by more than	±0.5 percent	±1 percent	±1 percent
Each of the currents in the conductors shall not differ from the average current by more than	±1 percent	±2 percent	±2 percent
The phase displacements of each of these currents from the corresponding line-to-neutral voltage irrespective of the power factor, shall not differ from each other by more than	2°	2°	2°

Table 8 Reference Conditions for Influence Quantities

(*Clauses* 6.2.5 *and* 10.1.5)

Influence Quantity	Reference Value	Permissible Tolerance for Meter of Class		
		0.5	1	2
(1)	(2)	(3)	(4)	(5)
Ambient temperature	Reference temperature or in its absence 27°C (*see* Note 1)	+1°C	+2°C	+2°C
Working position	Vertical working position (*see* Note 2)	+0.5°	+1°	+1°
Voltage	Reference voltage	+0.5 percent	+1 percent	+1 percent
Frequency	Reference frequency, or in its absence 50 Hz	+0.2 percent	+0.3 percent	+0.5 percent
Wave form	Sinusoidal voltage and current	Distortion factor less than		
		2 %	2 %	3 %
Magnetic Induction of external origin at the reference frequency (*see* Note 3)	Magnetic induction equal to zero	Induction value which causes variation of error not greater than		
		0.1 %	0.2 %	0.3 %

NOTES

1 If the tests are made at a temperature other than the reference temperature, including permissible tolerance, the results shall be corrected by applying appropriate temperature coefficient of the meter.

2 Determination of vertical working position (*see* **6.2**).

The construction and assembly of the meter should be such that the correct vertical position is ensured (in both the front-to-back and left-to-right vertical planes) when:

a) the base of the meter is supported against a vertical wall, and

b) a reference edge (such as the lower edge of the terminal block) or a reference line marked on meter case is horizontal.

3 The test consists of:

a) *For a single-phase meter*

Determining the errors, at first with the meter normally connected to the mains and then after inverting the connections to the current circuit as well as to the voltage circuits. Half of the difference between the two errors is the value of the variation of error. Because of the unknown phase of the external field, the test has to be made at 0.1 *Ib* at unity PF and 0.2 *Ib* at 0.5 power factor.

b) *For a three-phase meter*

Making three measurements, at 0.1 *Ib* at cos Φ 1, after each of which the connections to the current circuits to the voltage circuits are changed over 120, while the phase sequence is not altered. The greatest difference between each of the errors so determined and their average value is the value of variation of error.

11.2 Insulation Resistance

The insulation resistance test shall be carried out in accordance with Table 12. The voltage shall be applied for a minimum of one minute or more for the pointer of the insulation tester to have come practically to rest.

11.3 Running with No Load

With no current in the current circuit(s), the rotor of the meter shall not make a complete revolution at any voltage between 75 and 110 percent of the reference voltage.

For cyclometer type registers, these conditions shall apply with only one drum moving.

11.4 Starting

The rotor of the meter shall start and continue to run at the current shown in Table 13.

It shall be verified that the rotor completes at least one revolution.

For meters with drum-type registers, the test shall be made with not more than two drums moving.

11.5 Limits of Errors

11.5.1 When the meter is under the reference conditions (*see* **10.1**) the percentage errors shall not exceed the limits for the relevant accuracy class given in Table 14 and /or Table 15 as applicable.

The difference between the percentage error when the meter is carrying a single-phase load at basic current and unity power-factor and the percentage error when the meter is carrying a balanced polyphase load at basic current and unity power-factor, shall not be exceed 1 percent, 1.5 percent and 2.5 percent for meters of Class 0.5, 1 and 2 respectively.

NOTE — When testing for compliance with Table 16, the test current should be applied to each element in sequence.

11.5.2 For acceptance and routine tests, the errors shall be determined at the test points specified below:

Sl No.	*Current*	*Power Factor* (Cos Φ)
i)	5 percent *Ib*	1
ii)	*Ib*	1
iii)	200 percent *Ib*	1
iv)	*I max*	1
v)	10 percent *Ib*	0.5 lagging
vi)	*Ib*	0.5 lagging
vii)	200 percent *Ib*	0.5 lagging
viii)	*I*max	0.5 lagging

11.6 Tests of Meter Constant

It shall be verified that the ratio between the number of revolutions of the meter rotor and the indication of the register is correct.

11.7 Interpretation of Test Results and Adjustment (if Required)

Certain test results may fall outside the limits indicated in Tables 14 and 15 owing to uncertainties of measurements and other parameters capable of influencing the measurements. However, if by one displacement of the zero line parallel to itself by not more than the limits indicated in Table 16, all the test results are brought within the limits indicated in Tables 14 and 16, the meter shall be considered acceptable.

NOTE — In such a case the meter may be the readjusted with the help of break magnet at one point (say at basic current and cos Φ = 1, as applicable) to achieve the desired results.

Table 9 Schedule of Type Tests

(*Clause* 11.1.1)

Sl No.	Test	Clause Reference
(1)	(2)	(3)
1	Insulation resistance	11.2
2	Running with no load	11.3
3	Starting	11.4
4	Limits of errors	11.5
5	Interpretation of test results and adjustments (if required)	11.7
6	Test of meter constant	11.6
7	Power loss	11.8
8	Heating	11.9
9	Impulse voltage test	11.10.2
10	ac Voltage test	11.10.3
11	Effect of influence quantities	11.11
12	Effect of short-circuits	11.12
13	Effect of self-heating	11.13
14	Range of adjustment	11.14
15	Independence of adjustment	11.15
16	Sustained accuracy test	11.16
17	Running at low load	11.17
18	Repeatability of error	11.19
19	Shock	11.21
20	Vibration	11.20
21	Test for material used in dial	11.18
22	Test of protection against penetration of dust and water	11.24
23	Mechanical test of meter case	11.25

Table 10 Schedule of Acceptance Tests

(*Clause* 11.1.2)

Sl No.	Test	Clause Reference
(1)	(2)	(3)
1	Insulation resistance	11.2
2	Running with no load	11.3
3	Starting	11.4
4	Limits of errors	11.5
5	Interpretation of test results and adjustments (if required)	11.7
6	Test of meter constant	11.6
7	Power loss (voltage circuit)	11.8
8	Shock	11.21.1
9	Repeatability of error	11.19.1

Table 11 Schedule of Routine Tests

(*Clause* 11.1.3)

Sl No.	Test	Clause Reference
(1)	(2)	(3)
1	Insulation resistance	11.2
2	ac voltage test	11.10.3
3	Running with no load	11.3
4	Starting	11.4
5	Limits of error	11.5

Table 12 Insulation Resistance Test

(*Clause* 11.2)

Test Voltages	Point of Application of Test Voltage	Insulation Resistance
(1)	(2)	(3)
500 + 50V DC	a) Between frame and current circuits, voltage circuits, if any, all connected together	5 Mohms
	b) Between each current circuit (or voltage circuit) and each and every other circuit	50 Mohms

NOTE — Where two or more voltage circuits are permanently joined together, the combination may be treated as one circuit for this test.

Table 13 Starting Current

(*Clause* 11.4)

	Accuracy Class of Meters		
	0.5	1	2
Percentage of Basic Current	0.4	0.4	0.5
Power Factor	1	1	1

Table 14 Percentage Error Limits (Single-Phase Meters) and Polyphase Meters with Balanced Loads

(*Clauses* 11.5.1 *and* 11.7)

Value of Current	PF	Percentage Error Limits of Meters for Class		
		0.5	1.0	2
(1)	(2)	(3)	(4)	(5)
0.05 *Ib*	1	± 1.0	± 1.5	± 2.5
From 0.1 *Ib* to *Imax*	1	± 0.5	± 1.0	± 2.0
0.1 *Ib*	0.5 lag	± 1.3	± 1.5	± 2.5
	0.8 lead	± 1.3	± 1.5	
From 0.2 *Ib* to *Imax*	0.5 lag	± 0.8	± 1.0	± 2.0
	0.8 lead	± 0.8	± 1.0	
When specially requested by user from 0.2 *Ib* to *Ib*	0.25 lag	± 2.5	± 3.5	—
	0.5 lead	± 1.5	± 2.5	—

Table 15 Percentage Error Limits (Polyphase Meters Carrying a Single-Phase Load, but with Balanced Polyphase Voltage Applied to Voltage Circuits)

(*Clauses* 11.5.1 *and* 11.7)

Value of Current	PF of the Relevant Element	Percentage Error Limits for Meters of Class		
		0.5	1	2
(1)	(2)	(3)	(4)	(5)
From 0.2 *Ib* to *Ib*	1	± 1.5	± 2	± 3
0.5 *Ib*	0.5 lagging	± 1.5	± 2.0	—
Ib	0.5 lagging	± 1.5	± 2.0	± 3.0
Above *Ib* to *I* max	1	—	—	± 4.0

Table 16 Interpretation of Test Results

(*Clauses* 11.5.1 *and* 11.7)

	Class of Meter		
	0.5	1	2
Permissible displacement of the zero line (percent)	0.3	0.5	1.0

11.8 Power Loss

a) *Voltage Circuits* — The active and apparent power loss in each voltage circuit of a meter at reference voltage , reference temperature and reference frequency shall not exceed the values shown in Table 17.

b) *Current Circuits* – The apparent power taken by each current circuit of a directly connected

meter at basic current, reference frequency and reference temperature shall not exceed the values shown in Table 18 for meters with basic current less than 30 A.

The apparent power, taken by each current circuit of a meter connected through a current transformer, shall not exceed the value shown in Table 18 at a current of the corresponding transformer at reference temperature and reference frequency of the meter.

Table 17 Power Loss

Meters	Class of Meter	
	0.5	1 and 2
Single-phase	2 W and 8 VA	1.2 W and 6 VA
Polyphase	2 W and 10 VA	1.2 W and 6 VA

Table 18 Apparent Power Loss

(*Clause* 11.8)

Meters	Class of Meter		
	0.5	1	2
Single-phase and polyphase	6.0 VA	4.0 VA	2.5 VA

NOTE — The rated secondary current is the value of the secondary current of a current transformer on which the performance of the transformer is based. Standard values of rated extended secondary current are 120 percent, 150 percent and 200 percent of the rated current.

11.9 Heating

Under normal conditions of use, windings and insulation shall not reach a temperature which might adversely affect the operation of the meter. With each current circuit of the meter carrying rated maximum current and with each voltage circuit (and with these auxiliary voltage circuits which are energized for periods of longer duration than their thermal time constants) carrying 1.25 times the reference voltage, the temperature rise of the respective parts shall not exceed the values given in Table 19 with an ambient temperature not exceeding 40°C.

During the test, the duration of which shall be 2 h, the meter shall not be exposed to draught or direct solar radiation.

Table 19 Heating

(*Clause* 11.9)

Part of Meter	Temperature Rise, °C
Windings	60
External surfaces of the case	25

After the test, the meter shall show no damage and shall comply with the voltage tests as specified in **11.10.2** and **11.10.3**.

Except for the requirements relating to the temperature rise of the windings specified in Table 19, the insulation materials shall comply with the appropriate requirements of **11.2**.

The temperature rise of the windings shall be determined by the variation of resistance methods. The measurement shall be carried out at the point of connection between the current windings and the respective terminal.

For the measurement of circuit resistance, the cable to be used for energizing the meter shall have a length of about 1 m and a cross-section such that the current density is less than 4 A/mm^2.

11.10 Test of Dielectric Properties

11.10.1 *General Test Conditions*

The test shall be carried out only on a complete meter with its cover (except when indicated hereafter) and terminal cover, the terminal screws being screwed down to the maximum applicable conductor fitted in the terminals. Test procedure shall be in accordance with IS 2071 (Part 1).

After these tests, there shall be no change at reference conditions in the percentage error of the meter greater than 50 percent of the class index of the meter. These tests shall be carried out only in meter.

During type tests, the dielectric property tests are considered to be valid only for the terminal arrangement of the meter which has undergone the test. When the terminal arrangements differ, all the dielectric property tests shall be carried for each arrangement.

For the purpose of these tests, the earth has the following meaning:

a) When the meter case is made of metal, the earth is the case itself placed on a flat conducting surface;

b) When the meter case or only a part of it is made of insulating material, the earth is a conductive foil wrapped around the meter and connected to the flat conducting surface on which the meter base is placed. Where the terminal cover makes it possible, the conductive foil shall approach the terminals and the holes for the conductors within a distance of not more than 2 cm.

During the impulse and the ac voltage tests, the circuits which are not under test are connected to the earth as indicated hereafter. A flashover (capacitance

discharge) is not necessarily a criterion of failure as this may occur in a position that does not damage and the manufacturer shall decide whether or not to eliminate the cause, provided other criteria of acceptance are met.

After these tests, there shall be no change at reference conditions in the percentage error of the meter greater than the uncertainty of the measurement.

In this sub-clause, the expression 'all the terminals' means the whole set of the terminals of the current circuits, voltage circuits and, if any, auxiliary circuits having a reference voltage over 40 V.

These tests shall be made in normal conditions of use. During the test, the quality of the insulation shall not be impaired by dust or abnormal humidity.

Unless otherwise specified, the normal conditions for insulation tests are :

a) ambient temperature 15 to 45°C,

b) relative humidity 45 to 95 percent, and

c) atmospheric pressure 86 to 106 kFa (860 to 1 060 mbar).

NOTE — If the ac voltage test is to be repeated, the applied voltage shall be 80 percent of the specified voltage.

11.10.2 *Impulse Voltage Test*

The impulse voltage tests are intended to determine the capability of the meter to withstand, without damage short-time over voltages of high values.

The waveform and the generator characteristics shall be in accordance with IEC 61000-4-5 and its peak value shall be 6 kV. For each test, the impulse voltage is applied ten times with one polarity and then repeated with the other polarity. The minimum time between impulses shall be 3 s.

NOTES

1 For areas where overhead supply networks are predominant, higher peak value than 6 kV of the test voltage may be required.

2 The aim of the test in **11.10.2.1** is essentially to ensure, on the one hand, the quality of insulation of the voltage windings between turns or between layers and , on the other hand, the insulation between different circuits of the meter which in normal service are connected to conductors of different phases of the network and between which overvoltage may occur.

3 The test in **11.10.2.2** is intended to provide overall verification of the behaviour of the insulation of all the electrical circuits in the meter relative to earth. This insulation represents as essential safety factor for personnel in the event of overvoltage on the network. The waveform of the impulse is the standardized 1.2/ 50 and its peak value is 6 kV.

11.10.2.1 *Tests of insulation for circuits and for insulation between the circuits*

The test shall be made independently on each circuit (or assembly of circuits) which are insulated from the other circuits of the meter in normal use. The terminals of the circuits which are not subjected to impulse voltage shall be connected to earth.

Thus, when in normal use the voltage and the current circuits of a driving element are connected together, the test shall be made on the whole. The other end of the voltage circuit shall be connected to earth and the impulse voltage shall be applied between the terminal of the current circuit and earth. When several voltage circuits of a meter have a common point, this point shall be connected to earth and the impulse voltage successively applied between each of the free ends of the connections (or the current circuits connected to it) and earth. When in normal use, the voltage and the current circuit, of the same driving element are separated and appropriately insulated (for example, each circuit connected to a measuring transformer), the test shall be made separately on each circuit.

During the test of a current circuit, the terminals of the other circuits shall be connected to earth and the impulse voltage shall be applied between one of the terminals of the current circuit and earth. During the test of a voltage circuit, the terminals of the voltage circuit under test shall be connected to earth, and impulse voltage shall be applied between the other terminal of the voltage circuit and earth. The auxiliary circuits intended to be connected either directly to the mains or to the same voltage transformers as the meter circuits and with a reference voltage over 40 V, shall be subjected to the impulse voltage test in the same conditions as those already given for voltage circuits. The other auxiliary circuits shall not be tested.

11.10.2.2 *Test of insulation of electric circuits relative to earth*

All the terminals of the electric circuits of the meter, including those of the auxiliary circuits with a reference voltage over 40 V, shall be connected together. The auxiliary circuits with a reference voltage below or equal to 40 V shall be connected to earth. The impulse voltage shall be applied between all the electric circuits and earth.

11.10.3 *ac Voltage Test*

The ac voltage tests shall be carried out in accordance with Table 20.

The test voltage shall be substantially sinusoidal, having a frequency between 45 Hz and 65 Hz, and applied for one minute. The power source shall be

capable of supplying at least 500 VA.

During the tests relative to earth the auxiliary circuits with reference voltage equal to or below 40 V shall be connected to earth.

11.11 Effect of Influence Quantities (Table 22)

When determining the effect of an individual influence quantity, the conditions and the values of all other influence quantities shall be as stated in **10.1.5**.

The following influence quantities taken into consideration for fixing the above reference conditions and evaluating their effect on the results of various tests are given in clause **11.11.1** and Table 22:

a) Ambient temperature,

b) Oblique suspension,

c) Voltage,

d) Frequency,

e) Magnetic induction of external origin, 0.5 mT (*see* Note 1),

f) Waveform, (*see* Note 2),

g) Reversed phase sequence (*see* Note 3),

h) Magnetic field of an accessory (*see* Note 4), and

i) Mechanical load of register (*see* Note 5).

11.11.1 *Influence of Ambient Temperature*

The determination of the mean temperature coefficient for a given temperature shall be made over a temperature range 0, 20°C, 10° C above and 10°C below that temperature, but in no case shall the temperature be lower than 0°C or higher than 40°C.

The mean temperature coefficient shall in all cases be determined at least for the reference temperature and shall not exceed the limit given in Table 21.

11.11.2 Other influence quantities shall be as given in Table 22.

11.12 Short-Time Over Currents

The test circuit shall be practically non-inductive. After the application of the short-time over current with the voltage maintained at the terminals, the meter shall be allowed to return to the initial temperature with the voltage circuits energized for one hour individually.

The meter shall be able to carry for 0.5 second, a current equal to:

a) 30 *Ib* for direct connection up to 10A,

b) 20 *Ib* for direct connection above 10 A, and

c) 10 *Ib* for meters connected by current transformer(s).

After this test, the variation of the error shall not exceed the value shown in Table 23.

Table 20 ac Voltage Tests

(*Clause* 11.10.3)

Test Voltage (rms)	Points of Application of the Test Voltage
2 kV	a) Test to be carried out with the case closed, and terminal cover in place:
	1) On the one hand all the current and voltage circuits as well as the auxiliary circuits whose reference voltage is over 40 V, connected together, and, on the other hand, earth
	2) Between circuits not intended to be connected together in service.
	b) Additional tests for insulating encased meters of protective Class 2 between:
4 kV	1) on the one hand all the [for test (a)] current and voltage circuits as well as the auxiliary circuits whose reference voltage is over 40 V, connected together, and on the other hand, earth (*see* Note 1).
40 V	2) a visual inspection for [for test (c)] compliance with the conditions of **6.7** between
	3) on the one hand all conductive parts inside the meter, connected together and, on the other hand, all conductive parts outside the meter case that are accessible with the test finger, connected together (*see* Note 2).

NOTES

1 The test in (b)(1) is to be carried out, with the case closed, the cover and terminal cover in place.

2 The test in (b)(3) is not necessary, if test in item (b)(2) leaves no doubt.

Table 21 Temperature Coefficient

(*Clause* 11.11.1)

Value of Current	Power Factor	Mean Temperature Coefficient (Percentage/°C) for Meters of Class		
		0.5	1	2
(1)	(2)	(3)	(4)	(5)
From 0.1 *Ib* to *Imax*	1	0.03	0.05	0.10
From 0.2 *Ib* to *Imax*	0.5 lag	0.05	0.07	0.15

Table 22 Influence Quantities

(*Clauses* 11.11 *and* 11.11.2)

Change in the Value of the Influence Quantities with Respect to Reference Conditions	Value of Current (Balance Load Unless Otherwise Stated)	Power Factor	Limits of Variation in Percentage Error for Meters of Class		
			0.5	1	2
(1)	(2)	(3)	(4)	(5)	(6)
Oblique suspension 3	0.05 *Ib*	1	1.5	2.0	3.0
	Ib and *Imax*	1	0.3	0.4	0.5
Voltage 10 percent	0.1 *Ib*	1	0.8	1.0	1.5
	0.5 *Imax*	1	0.5	0.7	1.0
	0.5 *Imax*	0.5 lag	0.7	1.0	1.5
Frequency 5 percent	0.1 *Ib*	1	0.7	1.0	1.5
	0.5 *Imax*	1	0.6	0.8	1.3
	0.5 *Imax*	0.5 lag	0.8	1.0	1.5
Magnetic induction of external Origin 0.5 mT (1)	*Ib*	1	1.5	2.0	3.0
Wavefrom 10 percent of third harmonic in *Ib* the current (2)	*Ib*	1	0.5	0.6	0.8
Reversed phase sequence (3)	0.5 *Ib* to *Imax*	1	1.5	1.5	1.5
	0.5 *Ib* (Single phase load)	1	2.0	2.0	2.0
Magnetic field of an accessory (4)	0.05 *Ib*	1	0.3	0.5	1.0
Mechanical load of either single- or multi-rate register (5)	0.05 *Ib*	1	0.8	1.5	2.0

NOTES

1 A magnetic induction of external of 0.5 mT produced by a current of the same frequency as that of the voltage applied to the meter and under the most unfavourable conditions of phase and direction shall not cause a variation in the percentage error of the meter exceeding the values shown in the table.

The magnetic induction may be obtained by placing the meter in the center of a circular coil, 1 m in mean diameter, of square section and of small radial thickness relative to the diameter, and having 400 ampere turns.

When being tested, the meter shall be placed in the center of the coil, and the plane of the coil shall be vertical and perpendicular to the back of the meter case.

2 The distortion factor of the voltage shall be less than 1percent. The variation in percentage error shall be measured under the most unfavourable phase displacement of the third harmonic in the current compared with the fundamental current.

3 Such an accessory, enclosed in the meter case, is energized intermittently, for example, the electromagnet of a multi-rate register.

It is preferable that the connection to the auxiliary device(s) be marked to indicate the current method of connection. When these connections are made by means of plugs and sockets, these connections should be irreversible.

However, in the absence of those markings or irreversible connections, the variations of errors shall not exceed those indicated in the table if the meter is tested with the connections giving the most unfavourable condition.

4 The effect is compensated when calibrating the meter.

5 The effect of mechanical load of register is determined by determining the percentage errors, with and without the register mechanism.

Table 23 Variation Due to Short-Time Over Currents

(*Clause* 11.12)

Variation in Error	Value of Current	Power Factor	Limits of Percentage for Meters of Class		
			0.5	1	2
Direct connection	*Ib*	1	—	1.5	1.5
Current through current transformers	*Ib*	1	0.3	0.5	1.0

11.13 Effect of Self-Heating

After the voltage circuits have been energized at reference voltage for at least 4 h, 2 h and 1 h for Classes 0.5, 1 and 2 respectively, without any current in the current circuits, the rated maximum current shall be applied to the current circuits. The meter error shall be measured at unity power-factor immediately after the current is applied and then at intervals short enough to allow a correct drawing of the curve of error variation as a function of time. The test shall be carried out for at least 1 h and in any event until the variation of error during 20 min test duration does not exceed 0.2 percent.

The same test shall then be carried out at 0.5 (lagging) power factor. The variation of error, measured as specified, shall not exceed the values given in Table 24.

Table 24 Variation Due to Self-Heating

Value of Current	Power Factor	Limits of Current Variation in Percentage Error for Meters of Class		
		0.5	1	2
Imax	1	0.5	0.7	1.0
Imax	0.5 lag	0.7	1.0	1.5

11.14 Range of Adjustment

Generally, suitable means of adjustment are provided. By agreement between user and manufacturer, the later may produce meters without means of further adjustment.

A meter provided with means of adjustment and which has been adjusted satisfactorily according to this standard shall be capable of being further adjusted at least to the extent shown in Table 25. Test shall be made under the conditions stated in **10**.

11.15 Independence of Adjustment

11.15.1 *Low Load Adjustment*

A total adjustment of 4 percent made under the provisions of Table 25 shall not effect the rotor speed at 50 percent of rated maximum current, 0.5 power factor lagging by more than 0.8 percent for single-phase meters and 2 percent for three-phase direct connection and transformer operated meters of Class 2.

11.15.2 *Inductive Load Adjustment*

A total adjustment of 1 percent made under the provisions of Table 25 shall not effect the rotor speed at 5 percent of the basic current, unity power factor, by more then 1.0 percent.

11.16 Sustained Accuracy Test

11.16.1 An initial test of accuracy shall be carried out at the rated voltage and frequency at the following loads and percentage error noted:

a) Rated maximum current, unity power factor;

b) At basic current, unity power factor; and

c) 5 percent basic current, unity power factor.

11.16.2 After initial test, the meter shall be run preferably continuously at approximately rated maximum current, rated voltage and unity power factor, up to a registration in kWh numerically equivalent to 1 000 h. On completion of this run the meter shall be retested as in **11.16.1** and the percentage error shall not differ by more than 50 percent of class index from the error of the meter under initial test condition **11.16.1**(a) and (b) and 100 percent of class index for test condition **11.16.1** (c).

11.16.3 After this test, the condition of bottom bearing (except magnetic suspension bearing) shall not show any undue wear when examined under microscope.

11.17 Running at Low Load

The meter shall pass low load run test. The counter shall be set at 9 999.8 or 99 999.8 as the case may be. At 10 percent *Ib* and UPF, the counter should run smoothly up to 0000.1 or 00000.1 as the case may be.

11.18 Test on Material Used in the Dial

In case the material used for dial is synthetic material then it shall be tested with particular reference to boiling water test as follows:

The accuracy of the meter shall be recorded at 10 percent *Ib* UPF and then the counter of the meter removed and suspended in boiling water for 5 min and again replaced in the meter, after it has attained the ambient temperature. The meter shall again be checked for accuracy at 5 percent *Ib* UPF, and change in error thus observed shall not be more than 1 percent and the error should also be within limits as specified in this standard. There should not be any visual change in the material of the dial.

Table 25 Minimum Range of Adjustment

(*Clause* 11.14)

Adjustment of Speed of Rotation of the Rotor	Value of Current	Power Factor	Minimum Range of Adjustment of Percentage for Meters of Class		
			0.5	1	2
Braking Element	0.5 *I*max	1	± 2	± 2	± 4
Low load	0.05 *I*b	2	± 2	± 2	± 4
Inductive load	0.5 *I*b	0.5 lag	± 1	± 1	—
	0.5 *I*max	0.5 lag	—	—	± 1

NOTE — For polyphase meters, the verification of the range of adjustment for inductive load should be made on each driving element and should be determined when the current circuit of each element is carrying half the basic current lagging 60 behind the voltage at the terminals of that element, all the voltage circuits of all driving elements carrying balanced polyphase voltage, whose rms value is equal to the reference voltage in the phase-sequence as indicated on the connection diagram.

11.19 Repeatability of Error Test (Type Test)

The test shall be carried out under the rated voltage, rated frequency and unity power factor with the following load currents:

a) 5 percent basic current, and

b) Rated maximum continuous current.

In each of the above load conditions, 20 error tests are to be successively carried out at intervals of at least half an hour. The variation in error expressed by the difference between the maximum and minimum of the errors so obtained in 20 error tests shall not exceed 50 percent of class index of meter.

11.19.1 As an acceptance test, the test shall be carried out under the rated voltage, rated frequency and unity power factor at 5 percent basic current.

Six error tests are to be successively carried out in the above load condition at intervals of 5 min. The variation in meter error as expressed by the difference between the maximum and the minimum of the errors so obtained shall not exceed 50 percent, of class index of meter.

11.20 Vibration Test (Type Test)

The meter shall be subjected by the method specified in IS 9000 (Part 8) to vibrations as detailed below:

a) Range and sweep frequency : 10-150-10 Hz,

b) Cut-off frequency : 16.7 Hz,

c) Amplitude (between 10 Hz and 16.7 Hz) : 4 mm peak to peak,

d) Acceleration (between 16.7 Hz : 2.2 g) = acceleration due to gravity,

e) Sweep rate : one octave per minute, and

f) Duration: Along three mutually perpendicular axes (in the directions of upper and lower, right and left, back and forth).

The test shall be conducted on a different specimen for each direction of vibration.

After conclusion of the test, the variation of meter error shall not exceed 50 percent of accuracy class index at basic current, 5 percent basic current and maximum current at unity PF and shall satisfy the limits of error, starting, non-registration with voltage alone and repeatability of error test.

11.21 Shock Test (Type Test)

The meter shall be subjected to shock test by method specified in Section 1 of IS 9000 (Part 7) to shocks as described below:

a) Peak acceleration 400 m/s^2 (40 g)

b) Pulse shape Half sine wave

c) Pulse duration 18 ms

d) Number of shocks: two in both directions of three mutually perpendicular axes including the rotor axes.
{ (Total of 12 shocks)

This test shall be conducted on a different test specimen for each direction of shock (also on a specimen different from one to be used for the vibration test). After conclusion of test, the variation of meter error shall not exceed 50 percent of accuracy class index at basic current, 5 percent basic current and maximum current and shall satisfy the limits of error, starting, non-registration with voltage alone and repeatability of error test.

11.21.1 *Shock Test (Acceptance Test)*

When determined in accordance with the following method, the meter shall show no signs of internal physical change ,and the variation in percentage error due to shock shall not exceed the limits specified in Table 26:

a) Determine the percentage error of the meter

under the load conditions specified in Table 26;

b) Suspend the meter alone on a cord in an upright position;

c) Strike the meter six times, twice on the left side, twice on the right, and twice on the back; each time on a solid part of the meter base in the horizontal line of the disc (or a disc), with a rawhide hammer of 300 g allowed, to swing under gravity through 90 degrees at 300 mm radius;

NOTE — Damage at the case is not a criterion of failure.

d) Again determine the percentage error of the meter under load conditions specified in Table 26, and

e) Calculate the variation in percentage error for each load condition.

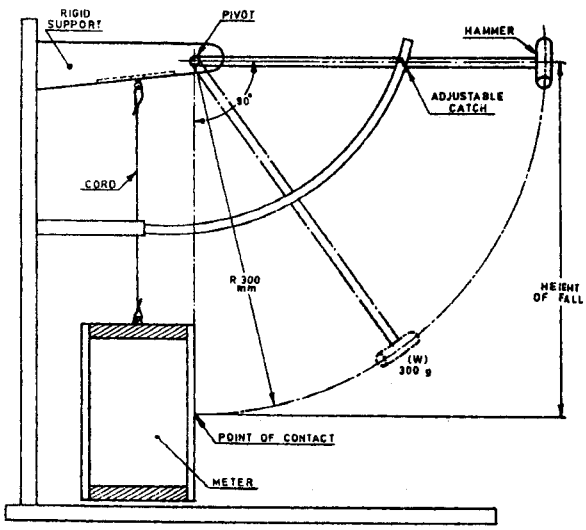


FIG. 2 APPARATUS FOR SHOCK TEST

Table 26 Effect of Shock

(*Clause* 11.21.1)

Load Conditions[1] (for Each Current Circuit)	Max Variation in Percentage Error
5 percent *Ib* (PF = 1)	50 percent of class index of meters
Ib (PF = 1)	
Ib (PF = 0.5 lag)	

[1]Polyphase meter with balanced load.

11.22 Driving Torque Measurement Test

The driving torque of a meter at basic current and unity power factor shall be measured for at least five samples in accordance with the method given in **11.10** of IS 9792 (Part 1). The average value of torque from five samples shall be considered as the nominal torque for the purpose of determining efficiency/permanence factor specified in Annex D. However, the individual torque values shall not differ from the nominal value so obtained by more than 10 percent.

11.23 Test of Resistance to Heat and Fire

The test shall be carried out according to IS : 11000 (Parts 1 and 2) with the following temperature:

a) terminal block : 960 + 15°C;

b) terminal cover and meter case : 650 + 10°C; and

c) duration of application : 30 ± 1 sec.

11.24 Test of Protection Against Penetration of Dust and Water

The test shall be carried out according to IS 12063 under the following conditions:

a) Protection against penetration of dust:

— Meter in non-operating condition and mounted on an artificial wall.

— The test should be conducted with sample lengths of cable (exposed and sealed) of the types specified by the manufacturers in place.

— 1st characteristic digit : 5 (*IP* 5X) resp.

Any ingress of dust only be in a quantity not impairing the operation of the meter, and not impairing its dielectric strength (insulating strength). For testing, *see* clause **11.2.**

b) Protection against penetration of water: Meter in non-operating condition second characteristic digit : 1 (*IP*XI) Any ingress of water must only be in a quantity not impairing the operation of the meter and not impairing its dielectric strength (insulating strength). For testing, *see* **11.2.**

11.25 Mechanical Strength of Meter Case

The mechanical strength of the meter case shall be tested with a spring hammer (IEC 60068-2-75).

The meter shall be mounted in its normal working position and the spring hammer shall act on the outer surfaces of the meter cover (including windows) and on the terminal cover with a kinetic energy of 0.2 *J* ± 0.02 J.

The result of the test is satisfactory if the meter case and terminal cover do not sustain damage which could affect the function of the meter and it is not possible to touch live parts. Slight damage which does not impair the protection against indirect contact or the penetration of solid objects, dust and water is acceptable.

ANNEX A

(*Foreword*)

NOTE ON CLASS 0.5 ac ELECTRICITY METERS

A-0 GENERAL

A-0.1 Class 0.5 alternating current watthour meters are employed chiefly for measurement of large amounts of energy but where the load is very small.

A-0.2 This class of meters constitutes a particular category which is not entirely in line with the series Class 1 and Class 2.

A-1 EFFECT OF INFLUENCE FACTORS

A-1.1 The effect of influence factors (frequency, voltage, etc) is generally less than that for Class 1 and Class 2, but not necessarily in strict proportion to the class indices.

A-2 TESTING

A-2.1 The testing of this class of meters requires the use of reference standards of high accuracy, low distortion supply sources and highly qualified and experienced personnel for its operation.

A-2.2 Owing to large quantities of energy to be measured with Class 0.5 alternating current to watthour meters, it is necessary for them to be verified more frequently than Class 1 and Class 2 meters.

A-3 INSTALLATION

A-3.1 The installation of these meters should be carried out with great care, eliminating or reducing to a minimum, external influence factors such as magnetic fields, non-verticality and the range of ambient temperature.

ANNEX B

(*Clause* 2.1)

LIST OF REFERRED INDIAN STANDARDS

IS No.	*Title*
1401 : 1970	Accessibility test probes (*first revision*)
8530 : 1977	Maximum demand indicators, Class 1
9000 (Part 7/ Sec 1) : 1979	Basic environmental testing procedures for electronic and electrical items : Part 7 Impact test, Section 1 Shock
9000 (Part 8) : 1981	Basic environmental testing procedures for electronic and electrical items : Part 8 Vibration (sinusoidal) test
9792 (Part 1) : 1987	Guide for testing, calibration and maintenance of AC electricity meters : Part 1 Single phase whole current watthour meters, Class 2.0 (*first revision*)
11000 (Part 1/ Sec 1) : 1988	Fire hazard testing: Part 1 Guidance for the preparation of requirements and test specifications for assessing fire hazard of electronic and electrical items, Section 1 General guidance
11000 (Part 1/ Sec 2) : 1988	Fire hazard testing: Part 1 Guidance for preparation of requirements and test specifications for assessing fire hazard of electronic and electrical items, Section 2 Guidance for electronic items
11426 : 1985	Specification for alternating current precision kilowatt-hour meters of Class 0.5 for testing purposes
11731 (Part 1) : 1986	Methods of test for determination of flammability of solid electrical insulating materials when exposed to an igniting source: Part 1 Horizontal specimen method
12063 : 1987	Classification of degrees of protection provided by enclosures of electrical equipment.
12346 : 1999	Testing equipment for ac electrical energy meters (*first revision*)

IS No.	*Title*	*IS No.*	*Title*
12360 : 1988	Voltage bands, for electrical installations including preferred voltages and frequency	14451 (Part 1) : 1998	Telemetering of consumption and demand : Part 1 Inpulse transmitting and receiving devices

ANNEX C

(*Clause* 6.4.1.3)

RECOMMENDED METHODS OF CONNECTION OF CURRENT CIRCUIT CONDUCTORS TO METER TERMINALS

C-0 The current circuit conductors of a meter shall be connected to its current terminals inside the meter base adopting any of the following recommended methods so as to ensure satisfactory, durable and adequate contact surfaces between the conductors and the terminals.

C-1 The ends of current coils, would form round section wire or flat strip shall be formed into loops. Each complete loop shall be accommodated between a flat section of the top end of a current terminal and a flat rectangular or circular washer plate having central hole, the three being pressed together by a screw having sufficiently large head to cover the loop. The current terminal shall have thread for fixing of the screw. The washer plate shall be of good conducting material and shall have spring action.

C-2 Current coils having rectangular section conductors of sufficient width shall have flattened ends. Each end shall be accommodated between a flat section of the top end of a current terminal and a flat rectangular or circular washer plate, the three being pressed together by a screw having sufficiently large head to cover the flattened end of the current coil. The washer plate shall have holes for clear passage of the screw and the current terminal shall have thread for fixing of the screw. The washer plate shall be of good conducting material and shall have spring action. In order to ensure proper gripping of the screw head, the central hole of the washer plate and the corresponding part of the screw head may be countersunk.

C-3 In case where methods given in **C-1** and **C-2** cannot be satisfactorily adopted, specially where a number of rectangular section conductors or strips or wires have been used, the ends of current coils shall be terminated into elongated soldering-cum-crimping sockets having machined flat bottom ends which shall then be connected to meter current terminals by adopting method given in **C-2**. The soldering socket shall be of the same material as that of the current terminal.

ANNEX D

(*Clauses* 6.12 *and* 11.22)

RECOMMENDED GUIDELINES FOR CONSTRUCTIONAL FEATURES

1)	Meter frame Mono block Design	a) Die cast aluminium alloy, or b) Rigid CRC steel frame	
2)	Terminal block (*see* **6.4** and Annex C)	a) Moulded with terminals in phenol formaldehyde b) Replaceable terminal c) Moulded in tough moulding compound as above	
3)	Meter fixing		2 or 3 points fixing for single-phase meters and 3 points fixing for three phase meters
4)	Meter cover and base, terminal cover		D. D. Grade steel/ bakelite/ polycarbonate, with water/ dustproof groove
5)	Counter frame		Sheet brass/sheet aluminium/ diecast aluminium

6)	Anti-creep device	Adjustable, attraction type or anti-creep holes on the rotor disc
7)	Terminal cover	Short or extended cover, sealing with one or two screws with sealing hole
8)	Window glass	Preferably toughened glass
9)	Earth terminal(s)	As specified in **6.4.4**
10)	Reverse stop device	The reverse running stop device shall be moulded paul and cam type provided for the rotor
11)	Brake magnet	Material of the Brake Magnet — The material of the brake magnet shall be of ALNICO Grade V or ALNICO Grade VI Number of Poles of magnet — The number of poles of the brake magnet shall be preferably 4
12)	Electromagnet	Cold-rolled non-grain oriented silicon steel core. Winding made of EC grade copper conductors
13)	Air gap in magnetic path (with disc removed)	The air gap of electro-magnets and brake magnet shall be minimum 2.2 mm and the gap shall be uniform
14)	Clear gap above and below rotor disc in the electromagnet	Not less than 0.5 mm
15)	Registering mechanism	As specified in **6.10** and **11.8**
16)	Lower bearing	Lower bearing shall be either double jewel or magnetic suspension bearing. The quality of meter should be assured with the type of bearing used
17)	Top bearing	The upper bearing shall be hardened and highly polished rust-resisting stainless steel pin. Top bearing pin should be centered properly and should have proper strength so that rotor disc can move freely
18)	Permanence factor	Minimum 1.2
19)	Efficiency factor	Minimum 1.2
20)	Material for screws washers and other fastness	All electrically live screw shall be brass/nickel or tinplated and all other steel galvanized or plated
21)	Current density at Imax	6.2 A/mm^2 maximum subject to maximum temperature rise specified
22)	a) Minimum clearance between window glass and rotor disc	8 mm
	ii) Minimum clearance for single piece transparent moulded cover	8 mm
23)	Noise	So small as to be inaudible at a distance about 1 m from the meter located in a silent place
24)	Provision for sealing and pilfer-proof arrangement	Shall be provided

NOTE — Where more than one alternative has been indicated for a constructional feature, the utilities may indicate their specific preference between the alternatives.

ANNEX E

(*Clause* 9.1)

RECOMMENDATIONS FOR PACKING OF METERS

E-1 SINGLE-PHASE AND POLYPHASE METERS

E-1.1 Adequate provisions may be made to suitably immobilize the rotor to avoid any damage or disturbance to the movement during transit.

E-1.2 Each meter may be suitably packed in the first instance to prevent ingress of moisture and dust, and then placed in a cushioned carton of a suitable material to prevent damage due to shocks during transit. The lid of the carton may be suitably sealed.

E-1.3 A suitable number of sealed cartons may be packed in a case of adequate strength with extra cushioning, if considered necessary. The cases may then be properly sealed against accidental opening in transit.

E-1.4 The packing cases should be marked to indicate the fragile nature of the contents.

ANNEX F

(*Clause* 11.1.2.1)

RECOMMENDED SAMPLING PLAN

F-1 LOT

F-1.1 In any consignment, all the meters of the same type and rating manufactured by the same factory during the same period shall be grouped together to constitute a lot.

F-1.2 Sample shall be tested from each lot for ascertaining the conformity of the meters to the requirements of specified acceptance test.

F-2 SCALE OF SAMPLING

F-2.1 The number of meters to be selected from the lot depends upon the size of the lot and shall be in accordance with Table 27.

Table 27 Sampling Plan

(*Clauses* F-2.1 *and* F-3.1)

Lot Size	N1[1)]	N2[2)]	(N1+N2)	C1	C2
(1)	(2)	(3)	(4)	(5)	(6)
Up to 300	8	—	8	0	—
301 to 500	13	13	26	0	2
501 to 1 000	20	20	40	0	3
1001 and above	32	32	64	1	4

[1)] Size of first sample.
[2)] Size of second sample.

F-2.2 The meters shall be taken at random from the lot. The procedure given in IS 4905 may be adopted.

F-3 NUMBER OF TESTS AND CRITERIA FOR ACCEPTANCE

F-3.1 Tests for Running with No Load, Starting

A sample of N1 meters selected according to col 2 of Table 27 shall be tested for the above tests. Any meter failing in any one of these tests shall be considered defective. If the number of defectives found in the sample is less than or equal to C1, the lot shall be considered to be conforming to these tests. If the number of defectives is greater than or equal to C2, the lot shall be considered as not conforming to these tests. If the number of defectives is between C1 and C2, a further sample of N2 meters shall be taken according to col 3 of Table 27 and subjected to these tests. If the number of defectives in two samples combined is less than C2, the lot shall be considered as conforming to these tests, otherwise it may be rejected.

F-3.2 Tests for Insulation Resistance, Limits of Error and Interpretation of Tests Results and Adjustment (If Required)

From the sample of meters which have been drawn according to **F-3.1** and those that have passed all tests of **F-3.1**, a sample of 8 meters shall be tested, all of which shall pass for conformity to these tests. If any one of the meters fails in any of these tests, the whole lot shall be declared not conforming to the requirements of these tests.

F-3.2.1 From sample of meters which has been drawn according to **F-3.1**, three additional samples shall be drawn for each of the remaining acceptance tests.

F-3.3 The lot shall be considered as conforming to this standard, if provisions of both **F-3.1** and **F-3.2** are satisfied.

Bureau of Indian Standards

BIS is a statutory institution established under the *Bureau of Indian Standards Act,* 1986 to promote harmonious development of the activities of standardization, marking and quality certification of goods and attending to connected matters in the country.

Review of Indian Standards

Amendments are issued to standards as the need arises on the basis of comments. Standards are also reviewed periodically; a standard along with amendments is reaffirmed when such review indicates that no changes are needed; if the review indicates that changes are needed, it is taken up for revision. Users of Indian Standards should ascertain that they are in possession of the latest amendments or edition by referring to the latest issue of 'BIS Catalogue' and 'Standards : Monthly Additions'.

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TO
IS 13010 : 2002 ac WATTHOUR METERS, CLASS 0.5, 1 AND 2 — SPECIFICATION

(First Revision)

(*Page* 5, *clause* **6.2.1**) — Substitute the following for the existing:

'The meter shall have a reasonably dust/moisture-proof case, which shall be sealed by the manufacturer in such a way that the internal parts of the meter are accessible only after breaking such distinctive seal(s).'

(*Page* 7, *clause* **6.6**) — Substitute the following for the existing:

'The terminal block, the terminal cover (if not of metal) and the case (if not of metal) shall be of a material which complies with the requirement of the test given in ISO 75 for a temperature of 135°C and a pressure of 1.8 MPa (Method A).

NOTE — If the materials of the terminal block, the terminal cover and the case meet this requirement the finished meter need not be tested.'

(ETD 13)

Reprography Unit, BIS, New Delhi, India

AMENDMENT NO. 2 JANUARY 2009
TO
IS 13010 : 2002 ac WATTHOUR METERS, CLASS 0.5, 1 AND 2 — SPECIFICATION

(First Revision)

(*Page* 4, *clause* **3.43**) — Delete.

(*Page* 4, *clause* **5.2**, *line* 3) — Substitute 'for example' *for* 'that is'.

[*Page* 7, *clause* **6.6**(a)] — Delete and renumber item 'b)' as 'a)'.

(*Page* 8, *clause* **6.11**, *Title*) — Substitute the following for the existing:

'**Direction of Rotation, Marking of the Rotor and Reverse Running Stop**'

(*Page* 8, *clause* **6.11**) — Insert the following new para after para 2:

'When reverse running stop is provided to prevent rotation of the rotor contrary to the specified direction, the device shall be capable of restricting such rotation to less than one revolution when maximum current at unity power factor is applied 180° out of phase in each of the metering elements simultaneously. Moreover, as soon as such currents cease to exist, the rotor shall fulfil the requirements of starting in the specified direction.'

(*Page* 8, *clause* 7) — Substitute '**TORQUE/SPEED RATIO**' for the existing title.

(*Page* 8, *clauses* **7.1** *and* **7.2**) — Substitute the following for the existing clauses:

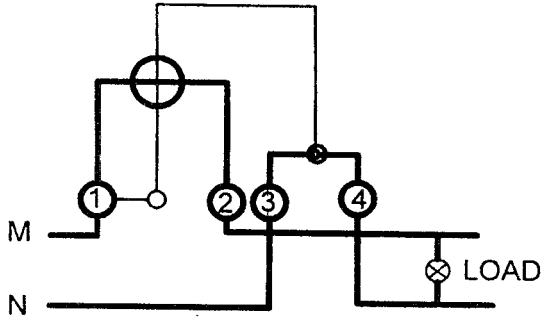
'**7.1** The nominal torque (Tb) of a meter at reference voltage, unity power factor and basic current expressed in gm-cm (*see* **11.22**), and its speed (Sm), determined from meter constant, at reference voltage, unity power factor and maximum current, expressed in rpm, shall satisfy the following relationship:

$$Tb \times 100/Sm \quad \geq 5.0 \text{ for single-phase 2-wire}$$
$$\geq 13.75 \text{ for three-phase 4-wire}$$

NOTE — 1 gm-cm=9.80665 × 10^{-5}newton-meter.

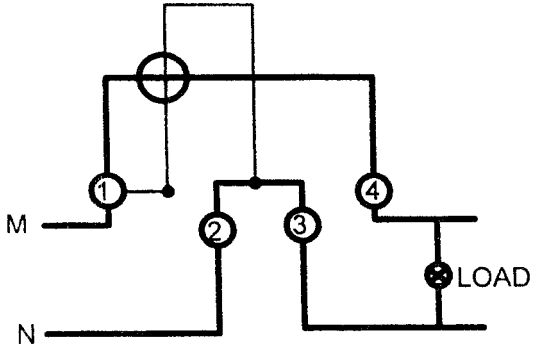
(*Page* 9, *clause* **8.1**, *Note* 4, *line* 1) — Substitute '' *for* ''.

[*Page* 9, *clause* **8.2.3**, *Fig.* 1(a)] — Substitute the following diagram for the existing diagram:



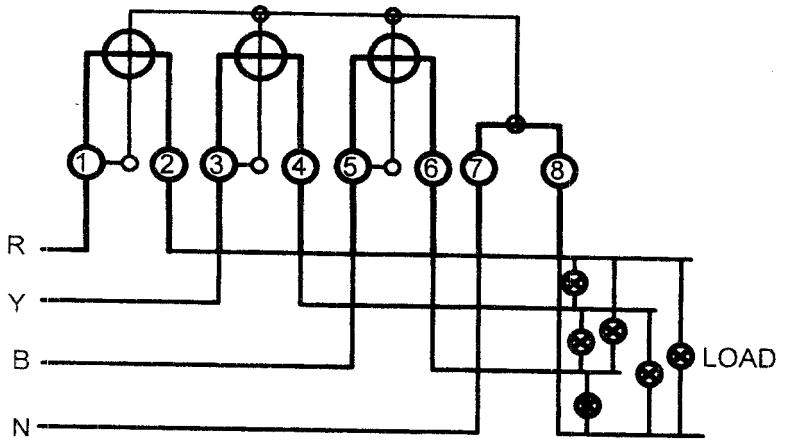
1a) Single-Phase Two-Wire Meter

[*Page* 9, *clause* **8.2.3**, *Fig.* 1(b)] — Substitute the following for the existing diagram:



1b) Single-Phase Two-Wire Meter Symmetrical Connections

[*Page* 10, *clause* **8.2.3**, *Fig.* 1(f)] — Substitute the following for the existing diagram:



1f) Three-Phase Four-Wire Single Tariff Meter for Direct Connection

(*Page* 11, *Table* 8, *col* 3, 4 *and* 5) — Substitute '+/-' *for* '+' wherever appears.

(*Page* 12, *Table* 9) — Add the following row after Sl No. 2 and renumber the subsequent Sl No.:

Sl No. (1)	Test (2)	Clause Reference (3)
3	Requirement of prevention of reverse rotation (if provided)	6.11

(*Page* 12, *Table* 9) — Add the following row after renumbered Sl No. 22 and renumber the subsequent Sl No.:

Sl No. (1)	Test (2)	Clause Reference (3)
23	Torque/Speed Ratio	11.22

(*Page* 12, *Table* 9) — Add the following row after renumbered Sl No. 25:

Sl No. (1)	Test (2)	Clause Reference (3)
26	Verification of general requirements and markings	6 and 8

(*Page* 13, *Table* 10) — Add the following row after Sl No. 2 and renumber the subsequent Sl No.:

Sl No.	Test	Clause Reference
(1)	(2)	(3)
3	Requirement of prevention of reverse rotation (if provided)	6.11

(*Page* 13, *Table* 10) — Add the following row after renumbered Sl No. 10:

Sl No.	Test	Clause Reference
(1)	(2)	(3)
11	Verification of general requirements and markings	6 and 8

(*Page* 18, *clause* **11.18**, *para* 2, *line* 6) — Substitute '10 percent *l*b UPF,' *for* '5 percent *l*b UPF,'.

(*Page* 19, *Table* 25, *col* 3) — Substitute '1' *for* '2'.

[*Page* 19, *clause* **11.20**(d)] — Substitute the following for the existing:

'd) Acceleration (between 16.7 Hz and 150 Hz) : 2.2 g (g = acceleration due to gravity)'.

[*Page* 19, *clause* **11.20**(f)] — Substitute the following for the existing:

'f) Duration : One hour in each direction.

'g) Direction : Along three mutually perpendicular axes (in the directions of upper and lower, right and left, back and forth)'.

(*Page* 20, *clause* **11.22**, *line* 6) — Substitute 'torque/speed ratio as specified in clause 7' *for* 'efficiency/permanence factor specified in Annex D'.

(*Page* 23, *Annex* D, *Items* 18 *and* 19) — Delete.

(ET 13)

Reprography Unit, BIS, New Delhi, India