

BS 8431:2010



BSI Standards Publication

Electrical static meters for secondary metering and sub-metering – Specification

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Foreword

Publishing information

This British Standard is published by BSI and came into effect on 31 May 2010. It was prepared by Technical Committee SEM/1, *Energy Management*. A list of organizations represented on this committee can be obtained on request to its secretary.

Supersession

This British Standard supersedes DD 8431:2005, which is withdrawn.

Information about this document

This British Standard is based on BS EN 61036 (now superseded by BS EN 62052 and BS EN 62053) and applies to all electrical energy meters for general industrial and commercial applications (such as energy management, compliance with aspects of building regulations, etc.). It provides a basis by which such meters can be specified and described, and their performance evaluated and compared with standardized specifications.

This British Standard does not apply to meters within the scope of BS EN 62052 and BS EN 62053. Those standards are specifically written to specify the requirements of utility metering while this specification applies to sub-meters for general commercial and industrial applications.

Use of this document

It has been assumed in the preparation of this British Standard that the execution of its provisions will be entrusted to appropriately qualified and experienced people, for whose use it has been produced.

Presentational conventions

The provisions of this standard are presented in roman (i.e. upright) type. Its requirements are expressed in sentences in which the principal auxiliary verb is "shall".

Commentary, explanation and general informative material is presented in smaller italic type, and does not constitute a normative element.

Contractual and legal considerations

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

Compliance with a British Standard cannot confer immunity from legal obligations.

Introduction

Energy meters, commonly kWh meters, are a common requirement of electrical control panels, in many cases as part of a multiple function unit. Energy measurement is recognized as an essential element of energy management, part of the overall drive to reduce carbon emissions and to improve the commercial efficiency of manufacturing, commercial organizations and public services.

Although the basic principles of energy management are well understood, for energy to be well managed it needs to be adequately measured. With the common use of electronic equipment, and of electronically controlled loads, the measurement techniques to measure such loads are not generally understood. The effects of incorrect measurement techniques are even less well understood. Unless energy meters are correctly specified, there is a risk that readings obtained in good faith could be incorrect and misleading.

1 Scope

This British Standard specifies requirements for newly manufactured electronic secondary meters or sub-meters which measure either electrical energies alone or electrical energies together with other electrical parameters associated with the energy. It applies to meters that measure active energy, apparent energy, reactive energy (capacitive, inductive and/or total), and ampere squared hours (A²h) and to the measurement of current, voltage, active power, apparent power, reactive power (capacitive, inductive and/or total), power factor, phase angle and frequency when measured in addition to an energy.

It applies to all secondary meters and sub-meters for indoor and outdoor applications, both portable and permanently installed, for all power frequencies including d.c. It also applies to all registers, indicators, displays and outputs, and to the operation of test outputs.

It does not apply to primary meters, to data interfaces to the meter, or to load survey analysers or load survey meters. The reliability aspect is not covered in this standard.

NOTE 1 Primary meters are covered by BS EN 62052 and BS EN 62053.

NOTE 2 Load survey analysers are instruments that might measure some or all of the parameters and estimate one or more energies but do not conform to the requirements of a meter as defined in this standard and other standards.

Where the display and/or the memory is external or where other elements are enclosed in the meter case (such as maximum demand indicators, telemetering, time switches or remote control, etc.) this standard applies only to the section of the meter concerned with measurement.

NOTE 3 Tests are included in this Standard in the following annexes:

- Annex A, Tests of mechanical requirements;
- Annex B, Tests of climatic influences;
- Annex C, Tests of electrical requirements;
- Annex D, Tests for electromagnetic compatibility (EMC);
- Annex E, Tests of accuracy requirements;
- Annex F, Tests of safety requirements.

Annex G contains a recommended test schedule.



Documents

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2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

BS EN 55022, *Information technology equipment – Radio disturbance characteristics – Limits and methods of measurement*

BS EN 60068-2-1, *Environmental testing – Part 2-1: Tests – Tests A: Cold*

BS EN 60068-2-2, *Environmental testing – Part 2-2: Tests – Test B: Dry heat*

BS EN 60068-2-5:2000, IEC 60068-2-5:1975, *Environmental testing – Part 2: Tests – Test Sa: Simulated solar radiation at ground level*

BS EN 60068-2-6, *Environmental testing – Part 2-6: Tests – Test Fc: Vibration (sinusoidal)*

BS EN 60068-2-30, *Environmental testing – Part 2-30: Tests – Test Db: Damp heat, cyclic (12 h + 12 h cycle)*

BS EN 60359, IEC 60359, *Electrical and electronic measurement equipment – Expression of performance*

BS EN 60529, *Specification for degrees of protection provided by enclosures (IP code)*

BS EN 61000-4-2, *Electromagnetic compatibility (EMC) – Part 4-2: Testing and measurement techniques – Electrostatic discharge immunity test*

BS EN 61000-4-3, *Electromagnetic compatibility (EMC) – Part 4-3: Testing and measurement techniques – Radiated, radio-frequency, electromagnetic field immunity test*

BS EN 61000-4-4, *Electromagnetic compatibility (EMC) – Part 4-4: Testing and measurement techniques – Electrical fast transient/burst immunity test*

BS EN 61000-4-5, *Electromagnetic compatibility (EMC) – Part 4-5: Testing and measurement techniques – Surge immunity test*

BS EN 61000-4-6, *Electromagnetic compatibility (EMC) – Part 4-6: Testing and measurement techniques – Immunity to conducted disturbances, induced by radio-frequency fields*

BS EN 61000-4-18, *Electromagnetic compatibility (EMC) – Part 4-18: Testing and measurement techniques – Damped oscillatory waves immunity test*

BS EN 61010-1:2010, IEC 61010-1:2010, *Safety requirements for electrical equipment for measurement, control, and laboratory use – Part 1: General requirements*¹⁾

BS EN 61010-2-030:2010, IEC 61010-2-30:2010, *Safety requirements for electrical equipment for measurement, control, and laboratory use – Part 2-030: Particular requirements for testing and measuring circuits*¹⁾

¹⁾ It is anticipated that BS EN 61010-2-030 and the revision of BS EN 61010-1 will be published in 2010. Up-to-date information can be obtained from BSI Customer Services.

ISO 7000:2004, *Graphical symbols for use on equipment – Index and synopsis*

IEC 60050 (300), *International electrotechnical vocabulary – Electrical and electronic measurements and measuring instruments – Part 311: General terms relating to measurements; Part 312: General terms relating to electrical measurements; Part 313: Types of electrical measuring instruments; Part 314: Specific terms according to the type of instrument*

3 Terms and definitions

For the purposes of this British Standard, the terms and definitions given in BS EN 60359 and IEC 60050 (300) and the following apply.

3.1 active power

NOTE Active power is measured in watts.

3.1.1 fundamental active power

product of the r.m.s. values of the fundamental frequency components of voltage and current multiplied by the cosine of the phase angle between them

NOTE The fundamental frequency is also known as the first harmonic frequency.

3.1.2 net active power

average value of the instantaneous power

NOTE 1 Instantaneous power is the product of the instantaneous values of voltage and current. This is often less than the fundamental active power, being the power supplied by the generator minus any harmonic power exported by the load. For practical purposes, the average is taken over an integral number n of cycles of period T .

NOTE 2 An alternative definition is that net active power is the arithmetic sum over all frequency components present (not necessarily only harmonics) of the power at each frequency, given by the product of the r.m.s. values of voltage and current components at that frequency times the cosine of the phase angle between them.

3.2 apparent power

NOTE 1 Apparent power is measured in VA.

NOTE 2 As apparent power is an unsigned quantity, if a sign (or direction) is to be assigned to apparent power, it is essential that this is the sign of the corresponding active power, fundamental or total as applicable.

3.2.1 fundamental apparent power

product of the r.m.s. values of the fundamental frequency components of voltage and current

3.2.2 total apparent power

product of the r.m.s. values of current and voltage

NOTE This definition applies to sinusoidal or other waveforms in a single phase circuit.

3.2.3 derived apparent power

square root of the active power squared plus the reactive power squared

NOTE 1 Derived apparent power, S , is calculated using the following equation:

$$S = \sqrt{P^2 + Q^2}$$

where P is the active power and Q is the reactive power.

NOTE 2 The term active power can refer to fundamental active power or net active power unless a specific active power is stated. Reactive power can refer to fundamental reactive power or non-active reactive power unless a specific reactive power is stated.

NOTE 3 This definition applies to sinusoidal or other waveforms in a single phase circuit.

3.3 reactive power

NOTE Reactive power is measured in var.

3.3.1 fundamental reactive power

product of the r.m.s. values of the fundamental frequency components of voltage and current multiplied by the sine of the phase angle between them

3.3.2 non-active reactive power

square root of the apparent power squared minus the total active power squared

NOTE 1 Non-active reactive power, Q , is calculated using the following equation:

$$Q = \sqrt{S^2 - P^2}$$

where S is the total apparent power and P is the net active power.

NOTE 2 Apparent power is calculated from r.m.s. values of voltage and current. Net active power includes harmonics.

NOTE 3 As non-active power is an unsigned quantity, if a sign is to be assigned, it is essential that this sign is that of the fundamental reactive power.

3.4 ampere squared power

square of the r.m.s. value of current

NOTE 1 Ampere squared power is calculated using one of the following equations:

$$A^2 = \frac{d}{dt} \int i^2 dt \text{ or } A^2 = \frac{\delta}{\delta \tau} \sum_0^t i^2$$

where i is the instantaneous value of the current and t is time.

NOTE 2 Ampere squared power is measured in A^2 .

3.5 polyphase active power

algebraic sum of the active powers of the phases

NOTE The term active power can refer to fundamental active power or net active power unless a specific active power is stated.

3.6 polyphase apparent power

sum of the apparent powers of the phases

NOTE 1 The term apparent power can refer to fundamental apparent power, total apparent power or derived apparent power unless a specific apparent power is stated.

NOTE 2 The following equations can be used to calculate the polyphase apparent power, ΣS :

$$\Sigma S = \sqrt{(\Sigma P)^2 + (\Sigma Q)^2} \quad (1)$$

$$\Sigma S = \Sigma(|S_1| + |S_2| + \dots) \quad (2)$$

$$\Sigma S = |\Sigma(S_1 + S_2 + \dots)| \quad (3)$$

$$\Sigma S = S_1 + S_2 + \dots \quad (4)$$

where P is the active power, Q is the reactive power, S is the apparent power and S_1 and S_2 are single phase values of S .

3.7 polyphase reactive power

NOTE The term reactive power can refer to fundamental reactive power or non-active reactive power unless a specific reactive power is stated.

3.7.1 fundamental polyphase reactive power

algebraic sum of the fundamental reactive powers of the individual phases

3.7.2 non-active reactive polyphase power

square root of the polyphase apparent power squared minus the polyphase total active power squared

NOTE 1 Non-active reactive polyphase power, Q , is calculated using the following equation:

$$Q = \sqrt{S^2 - P^2}$$

where S is the polyphase total apparent power and P is the polyphase net active power.

NOTE 2 Where equations (3) or (4) are used for the derivation of polyphase apparent power, and where individual phase values of VA have been assigned different signs, the value obtained for polyphase non-active power might not be valid.

3.8 polyphase ampere squared power

sum of the individual phase ampere squared values

3.9 energies

3.9.1 energy

integral of power with respect to time

NOTE 1 The term power can refer to active power, apparent power, reactive power or ampere squared power unless a specific power is referred to.

NOTE 2 Energy is integrated over one or more cycles of the supply frequency, or in the case of d.c. over a specified time.

NOTE 3 Integration might be subject to different treatment dependent on the direction of energy transfer. According to the sign of the measured quantity, a register used for its integration might increment, decrement or remain unchanged. Accordingly, for the purpose of recording energy transfers in different directions, more than one register can be used and specified.

3.9.2 active energy

NOTE Active energy is measured in watt hours (Wh).

3.9.2.1 active energy in a single phase circuit

time integral of the active power

NOTE The term active power can refer to fundamental active power or net active power unless a specific active power is stated.

3.9.2.2 active energy in a polyphase circuit

time integral of the polyphase active power

NOTE The term polyphase active power can refer to fundamental polyphase active power or net active polyphase power unless a specific polyphase active power is stated.

3.9.3 apparent energy

NOTE Apparent energy is measured in VA-hours (VAh).

3.9.3.1 apparent energy in a single phase circuit

time integral of the apparent power

NOTE The term apparent power can refer to fundamental apparent power, total apparent power or derived apparent power unless a specific apparent power is stated.

3.9.3.2 apparent energy in a polyphase circuit

time integral of the polyphase apparent power

NOTE The term polyphase apparent power can refer to fundamental polyphase apparent power, total polyphase apparent power or derived polyphase apparent power unless a specific polyphase apparent power is stated.

3.9.4 reactive energy

NOTE Reactive energy is measured in var-hours (varh).

3.9.4.1 fundamental reactive energy in a single phase circuit

time integral of the fundamental reactive power

3.9.4.2 fundamental reactive energy in a polyphase circuit

time integral of the polyphase fundamental reactive power

3.9.4.3 non-active reactive energy in a single phase circuit

time integral of the non-active reactive power

3.9.4.4 non-active reactive energy in a polyphase circuit

time integral of the polyphase non-active reactive power

3.9.5 ampere squared energy

NOTE Ampere squared energy is measured in ampere squared hours (A^2h).

3.9.5.1 ampere squared energy in a single phase circuit

time integral of the ampere squared power

3.9.5.2 ampere squared energy in a polyphase circuit

time integral of the polyphase ampere squared power

3.10 meters and meter components**3.10.1 static meter**

meter in which current and voltage act on solid state elements to produce an output or outputs proportional to one or more electrical quantities

NOTE 1 Solid state elements are also known as electronic elements.

NOTE 2 The term meter can refer to a watt-hour meter, a VA-hour meter, a var-hour meter, an ampere squared hour meter or a meter which measures multiple energies unless a specific energy meter is stated.

3.10.2 watt-hour meter

instrument measuring active energy by integrating active power with respect to time

NOTE 1 Adapted from IEC 60050:2001, IEV 301-04-17.

NOTE 2 The term active power can refer to fundamental active power or net active power, single phase or polyphase, unless a specific active power is stated.

3.10.3 VA-hour meter

instrument measuring apparent energy by integrating apparent power with respect to time

NOTE The term apparent power can refer to fundamental apparent power, total apparent power or derived apparent power, single phase or polyphase, unless a specific apparent power is stated.

3.10.4 var-hour meter

instrument measuring reactive energy by integrating reactive power with respect to time

NOTE Reactive power can refer to fundamental reactive power or non-active reactive power, single phase or polyphase, unless a specific reactive power is stated.

3.10.5 ampere squared hour meter

instrument measuring ampere squared energy by integrating ampere squared power with respect to time

3.10.6 multi-rate meter

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

[IEC 60050:2001, IEV 302-04-06]

NOTE The term energy meter can refer to a watt-hour meter, VA-hour meter, var-hour meter or ampere squared hour meter or a meter which measures multiple energies unless a specific energy meter is stated.

3.10.7 meter type

particular design of meter, manufactured by one manufacturer, having similar metrological properties, the same uniform construction of parts determining these properties and the same ratio of maximum current to basic current

NOTE 1 The meter type might have several values of basic current and reference voltage. Meters are designated by the manufacturer by one or more groups of letters or numbers, or a combination of letters and numbers. Each type has one designation only.

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

3.10.8 measuring element

part of the meter which produces an output proportional to the energy or other measured quantity

NOTE The term energy can refer to active energy (fundamental or net), apparent energy (fundamental, total or derived), fundamental reactive energy, non-active reactive energy or ampere squared energy in a single phase circuit or polyphase circuit unless a specific energy and circuit configuration is stated.

3.10.9 memory

element which stores digital information

3.10.10 non-volatile memory

memory which can retain information in the absence of power

3.10.11 display

device which displays the contents of a memory

3.10.12 register

electromechanical or electronic device comprising both memory and display which stores and displays information

NOTE A single display may be used with multiple electronic memories to form multiple registers.

3.10.13 current circuit

internal connections of the meter and part of the measuring element through which flows the current of the circuits to which the meter is connected

NOTE The current signal provided to the meter may be a voltage, in which case the current circuit is supplied with a voltage representing the current which the meter is measuring.

3.10.14 voltage circuit

internal connections of the meter, part of the measuring element, and in certain meters also the power supply for the meter, supplied with the voltage of the circuits to which the meter is connected

3.10.15 auxiliary supply

power supply for the meter if this supply is not obtained from the voltage circuit

3.10.16 auxiliary circuit

elements and connections of an auxiliary device within the meter case intended to be connected to an external device

NOTE Examples of elements include lamps and contacts. Examples of external devices include clocks, relays and impulse counters.

3.10.17 indoor meter

meter which can only be used with additional protection against environmental influences

3.10.18 outdoor meter

meter which can be used without additional protection in an exposed environment

3.10.19 base

back of the meter to which the measuring element, the terminals or the terminal block, and the cover are attached

NOTE For a flush-mounted meter, the meter base may include the sides of the case. Where the meter is built into an enclosure, the meter base may include the entire enclosure.

3.10.20 cover

enclosure on the front of the meter, made either wholly of transparent material or of opaque material provided with a window or windows through which the operation indicator, if fitted, and the display can be read

3.10.21 case

base and the cover together with any other component parts which together enclose the meter

3.10.22 terminal block

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

3.10.23 terminal cover

cover for the meter terminals and, generally, the ends of the external wires or cables connected to the terminals

3.10.24 insulating encased meter of protective class II

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 are provided, there being no provision for protective earthing or reliance upon installation conditions

NOTE Examples of safety precautions include double insulation or reinforced insulation.

3.11 output devices**3.11.1 test output**

device which can be used for testing the meter

3.11.2 operation indicator

device which gives a visible signal that the meter is in operation

3.11.3 pulse

wave that departs from an initial level for a limited duration of time and ultimately returns to its original level

3.11.4 pulse output

device for initiating or transmitting electric pulses, representing finite quantities such as energy, normally transmitted from some form of electricity meter to a receiver unit

NOTE The term energy can refer to active energy (fundamental or net), apparent energy (fundamental, total or derived), fundamental reactive energy, non-active reactive energy or ampere squared energy in a single phase circuit or polyphase circuit unless a specific energy and circuit configuration is stated.

3.11.5 analogue output

device which produces signals which are analogue functions of the measurands

3.11.6 digital output

device which produces signals which are digital functions of the measurands

3.11.7 compliance voltage

value of the voltage that can be generated by the output current while conforming to the requirements of the accuracy specification for that output

NOTE This definition applies to current analogue output signals.

3.11.8 ripple content

peak-to-peak value of the fluctuating component of the output with steady state input conditions

NOTE This definition applies to analogue output signals.

3.11.9 response time

time from the instant of application of a specific change of the measurand until the output signal reaches and remains at its final steady value or within a specified band centred on this value

3.12 meter constant

value expressing the relation between the energy registered by the meter and the corresponding value of the test output

NOTE 1 If this value is a number of pulses, the constant should be either pulses per unit of energy (implkWh, implkVAh, implkvarh, etc.) or units of energy per pulse (Whlimp, VAhlimp, varhlimp, etc.)

NOTE 2 The term energy can refer to active energy (fundamental or net), apparent energy (fundamental, total or derived), fundamental reactive energy, non-active reactive energy or ampere squared energy in a single phase circuit or polyphase circuit unless a specific energy and circuit configuration is stated.

3.13 reference current**3.13.1 basic current²⁾**

current in accordance with which the relevant performance of a direct connected meter is fixed

NOTE The symbol for basic current is I_b .

3.13.2 rated current²⁾

current in accordance with which the relevant performance of a transformer operated meter is fixed

NOTE 1 The symbol for rated current is I_n .

NOTE 2 The current signal provided to the meter may be a voltage. In this case the rated current becomes the rated current (voltage) signal.

3.13.3 maximum current²⁾

highest value of current at which the meter purports to meet the accuracy requirements of this specification

NOTE The symbol for maximum current is I_{max} .

3.14 reference voltage²⁾

value or range of the voltage at which the meter purports to meet the accuracy requirements of this specification

NOTE 1 If a voltage range is specified, and a specific reference voltage is not stated, the reference voltage can be taken as the arithmetic mean of the range.

NOTE 2 The symbol for reference voltage is U_n .

3.15 reference frequency

value or range of the frequency at which the meter purports to meet the accuracy requirements of this specification

NOTE If a frequency range is specified, and a specific reference frequency is not stated, the reference frequency can be taken as the arithmetic mean of the range.

²⁾ The terms "voltage" and "current" indicate r.m.s. values unless otherwise specified.

3.16 class index

number which gives the limits of the permissible percentage error, for all values of current between $0.1 I_b$ and I_{max} , or between $0.05 I_n$ and I_{max} , for unity phase influence function (and in the case of polyphase meters with balanced loads) when the meter is tested under reference conditions

NOTE 1 Reference conditions includes permitted tolerances on the reference values.

NOTE 2 Reference current can refer to basic current or rated current as appropriate.

3.17 phase influence function

function of the real or apparent phase angle between a measured voltage and a measured current

NOTE 1 Phase influence function expressed as a power factor refers to measurements of real and apparent powers and energies, while $\sin \phi$ refers to reactive powers and energies.

NOTE 2 For d.c. measurements the requirements for a phase influence function of 1 need to be used.

3.18 influence quantities**3.18.1 influence quantity**

any quantity, generally external to the meter, which might affect its working performance

NOTE Modified from IEC 60050:2001, IEV 301-08-09.

3.18.2 reference conditions

appropriate set of influence quantities and performance characteristics, with reference values, their tolerances and reference ranges, with respect to which the intrinsic error of the meter is specified

NOTE Modified from IEC 60050:2001, IEV 301-08-10.

3.18.3 variation of error due to the change in an influence quantity

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

3.18.4 distortion factor

ratio of the r.m.s. value of the harmonic content to the r.m.s. value of the non-sinusoidal quantity

NOTE 1 The distortion factor is usually expressed as a percentage.

NOTE 2 The harmonic content is obtained by subtracting the fundamental term from a sinusoidal alternating quantity.

3.18.5 electromagnetic disturbance

conducted or radiated electromagnetic interferences which might affect the functional or metrological operation of the meter

3.18.6 reference temperature

ambient temperature specified for reference conditions

3.18.7 mean temperature coefficient

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

3.18.8 rated operating conditions

set of specified measuring ranges for performance characteristics and specified operating ranges for influence quantities, within which the variations or operating errors of a meter are specified and determined

3.18.9 specified measuring range

set of values of a measured quantity for which the error of a meter is intended to lie within particular limits

3.18.10 specified operating range

range of values of a single influence quantity which forms a part of the rated operating conditions

3.18.11 limit range of operation

extreme conditions which an operating meter can withstand without damage and without degradation of its metrological characteristics when it is subsequently operated under its rated operating conditions

3.18.12 storage and transport conditions

extreme conditions which a non-operating meter can withstand without damage and without degradation of its metrological characteristics when it is subsequently operated under its rated operating conditions

3.18.13 normal working position

position of the meter defined by the manufacturer for normal service

3.18.14 thermal stability

state when the change in error as a consequence of thermal effects during 20 minutes is less than 0.1 times the maximum permissible error for the measurement under consideration

3.19 type test

procedure according to which the series of tests is carried out on one meter or on a small number of meters of the same type having identical characteristics, selected by the manufacturer, to verify that the respective type of meter conforms to all the requirements of this specification for the relevant class of meters

NOTE A type test for safety is defined in BS EN 61010-1. The type test referred to above is for performance purposes only.

4 Standard electrical values

4.1 Standard reference voltages

The standard reference voltage shall be specified on or with the meter [see 12.1e)].

NOTE 1 Standard reference voltages are given in Table 1. The exceptional values specified in Table 1 are not to be considered an exhaustive listing.

NOTE 2 The term meter can refer to a watt-hour meter, VA-hour meter, var-hour meter or ampere squared hour meter or a meter which measures multiple energies unless a specific meter is stated.

Table 1 Standard reference voltages

Meters	Standard values	Exceptional values
	V	V
Meters for direct connection	120-230-277-400-480 (IEC 60038)	100-127-200-220-240-380-415
Meters for connection through voltage transformers	57.7-63.5-100-110-115-120-200-230 (BS EN 60044-2)	173-190-220

4.2 Standard reference currents

The standard reference current shall be specified on or with the meter [see 12.1f)].

NOTE Standard reference currents are given in Table 2. The exceptional values specified in Table 2 are not to be considered an exhaustive listing.

Table 2 Standard reference currents

Meters	Standard values	Exceptional values
Meters for direct connection (basic current) I_b	5-10-15-20-30-40-50 Amp	80 Amp
Meters for connection through current transformers (rated current) I_n	1-2-5 Amp (BS EN 60044-1)	2.5 Amp
Meters for connection through current sensor (rated current) I_n	0.33 Vrms	

4.3 Maximum current

The maximum current shall be specified on or with the meter [see 12.1f)]. The maximum current for direct connected meters shall be an integral multiple of the basic current (e.g. four times the basic current).

NOTE 1 The maximum current for transformer connected meters should be $1.2 I_n$, $1.5 I_n$ or $2 I_n$ where I_n is the rated current. These values of maximum current are not to be considered an exhaustive listing.

NOTE 2 When the meter is operated from one or a number of current transformers, attention is drawn to the need to match the current range of the meter to that of the secondary current of the current transformers.

4.4 Standard reference frequencies

The reference frequency shall be specified either on the meter or in its accompanying documentation [see 13c)].

NOTE Meters should use the standard reference frequencies of 50 Hz or 60 Hz where possible, although other reference frequencies, or reference frequency ranges, including d.c., may be specified.

5 Mechanical requirements

NOTE Meters should be designed and constructed in such a way as to avoid introducing any danger in normal use and under normal conditions, so as to ensure especially personal safety against electric shock, against the effects of excessive temperature and against the spread of fire. All parts which are subject to corrosion under normal working conditions should be protected effectively. Any protective coating should not be liable to damage by ordinary handling nor damage due to exposure to air, under normal working conditions.

5.1 Case

The meter shall have a case which ensures that the internal parts of the meter are accessible only by the use of a tool. If the meter has a seal, the internal parts of the meter shall only be accessible by breaking the seal or seals.

If the meter is fitted with a separate cover, the cover shall be removable only with the use of a tool.

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

Meters intended to be connected to a supply mains where the voltage under reference conditions exceeds 250 V to earth, and whose case is wholly or partially made of metal, shall be provided with a protective conductor terminal.

5.2 Window

If the meter is fitted with a cover that is not transparent, one or more windows shall be provided for reading the display and observation of the operation indicator, if fitted. These windows shall be of transparent material that cannot be removed undamaged without the use of a tool. If the meter is provided with the facility to fit a seal, it shall not be possible to remove an undamaged window without breaking the seal or seals.

5.3 Terminals and terminal blocks

The terminal block used shall be suitable for the specified applied voltages to the meter under its intended measurement category as given in BS EN 61010-1, and for the maximum currents and the protective class of the meter.

The manner of fixing the conductors to the terminals shall ensure adequate and durable contact so as to minimize the risk of loosening or undue heating. Screw connections transmitting contact force and screw fixings that might be loosened and tightened several times during the life of the meter shall screw into a metal nut.

NOTE 1 Terminals may be grouped in one or a number of terminal blocks having adequate insulating properties and mechanical strength.

All parts of each terminal shall be constructed so as to minimize the risk of corrosion resulting from contact with any other metal part.

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

Current circuits intended for connection through current transformers shall be considered to be at earth potential and galvanically isolated from the voltage terminals unless specified otherwise.

NOTE 2 For current circuits of direct connected meters, the voltage is considered to be the same as for the related voltage circuit.

Terminals with different potentials which are grouped close together shall be protected against accidental short-circuiting.

NOTE 3 Protection may be obtained by insulating barriers or by separation. Terminals of one current circuit are considered to be at the same potential.

If the terminal cover is made of metal, the terminals, the conductor fixing screws, and the external and internal conductors shall be insulated from the terminal cover in accordance with BS EN 61010-1 and shall not be able to come into contact with the terminal cover while it is being fitted or removed.