SCHEDULE 1 Regulations 2(1), 4(1), 28 and 29

PART 1

ESSENTIAL REQUIREMENTS

1. The essential requirements are the relevant requirements relating to relevant instruments contained in Annex 1 and Annex M1-003 set out in this Part of this Schedule.

Definitions

2. In this Schedule—

"climatic environments" means the conditions in which relevant instruments may be used;

"critical change value" means the value at which the change in the measurement result is considered undesirable;

"disturbance" means an influence quantity having a value within the limits specified in the appropriate requirement but outside the specified rated operating conditions of the relevant instrument. An influence quantity is a disturbance if for that influence quantity the rated operating conditions are not specified;

"f" means the frequency of the voltage supplied to the relevant instrument;

"f_n" means the specified voltage reference frequency;

"I" means the electrical current flowing through the relevant instrument;

"I_{max}" means the maximum value of I for which the error lies within the MPEs;

"I_{min}" means the value of I above which the error lies within maximum permissible errors (MPEs) (polyphase relevant instruments with balanced load);

"I_n" means the specified reference current for which the transformer operated relevant instrument has been designed;

"influence quantity" means a quantity that is not the measurand but that affects the result of measurement;

"I_{st}" means the lowest declared value of I at which the relevant instrument registers active electrical energy at unity power factor (polyphase relevant instruments with balanced load);

"I_{tr}" means the value of I above which the error lies within the smallest MPE corresponding to the class index of the relevant instrument;

"measurand" means the particular quantity subject to measurement;

"MPE" means the maximum permissible error value as set out in paragraph 15;

"PF" means power factor = cosφ = the cosine of the phase difference φ between I and U;

"rated operating conditions" means the values for the measurand and influence quantities making up the normal working conditions of a relevant instrument;

"U" means the voltage of the electricity supplied to the relevant instrument; and

"U_n" means the specified reference voltage.

Allowable Errors

3.—(1) The manufacturer shall specify the climatic, mechanical and electromagnetic environments in which the relevant instrument is intended to be used, power supply and other influence quantities likely to affect its accuracy, taking account of the requirements in this Schedule.

(a) Climatic environments—

The manufacturer shall specify the upper temperature limit and the lower temperature limit from any of the values in Table 1 and indicate whether the relevant instrument is designed for condensing or non-condensing humidity as well as the intended location for the relevant instrument, i.e. open or closed.

Table 1

	Temperature Limits			
Upper temperature limit	30 °C	40 °C	55 °C	70 °C
Lower temperature limit	5 °C	–10 °C	–25 °C	–40 °C

(b) Mechanical environments—

(i) Mechanical environments are classified into classes M1 to M3 as described below—

M1: This class applies to relevant instruments used in locations with vibration and shocks of low significance, for example, instruments fastened to light supporting structures subject to negligible vibrations and shocks transmitted from, for example, local blasting or pile-driving activities or slamming doors.

M2: This class applies to relevant instruments used in locations with significant or high levels of vibration and shock, for example, transmitted from machines and passing vehicles in the vicinity, or adjacent to heavy machines or conveyor belts.

M3: This class applies to relevant instruments used in locations where the level of vibration and shock is high and very high, for example, instruments mounted directly on machines or conveyor belts.

(ii) The following influence quantities shall be considered in relation with mechanical environments—

(aa) vibration;

(bb) mechanical shock.

(c) Electromagnetic environments—

(i) Electromagnetic environments, in relation to relevant instruments that are constructed using electrical components, are classified into classes E1 and E2 as described below.

E1: This class applies to relevant instruments used in locations with electromagnetic disturbances corresponding to those likely to be found in residential, commercial and light industrial buildings.

E2: This class applies to relevant instruments used in locations with electromagnetic disturbances corresponding to those likely to be found in other industrial buildings.

(ii) The following influence quantities shall be considered in relation with electromagnetic environments—

(aa) voltage interruptions;

(bb) short voltage reductions;

(cc) voltage transients on supply lines and/or signal lines;

(dd) electrostatic discharges;

(ee) radio frequency electromagnetic fields;

(ff) conducted radio frequency electromagnetic fields on supply lines and/or signal lines;

(gg) surges on supply lines and/or signal lines.

(2) Other influence quantities to be considered, where appropriate, are—

(a) voltage variation;

(b) mains frequency variation;

(c) power frequency magnetic fields;

(d) any other quantity likely to influence in a significant way the accuracy of the relevant instrument.

(3) When carrying out the tests as envisaged in these Regulations, the following paragraphs apply to relevant instruments in relation to ambient humidity—

(a) according to the climatic operating environment in which the relevant instrument is intended to be used either the damp heat-steady state (non-condensing) or damp heat cyclic (condensing) test may be appropriate;

(b) the damp heat cyclic test is appropriate where condensation is important. In conditions where non-condensing humidity is a factor the damp-heat steady state is appropriate.

Reproducibility

4. The application of the same measurand in a different location or by a different user, all other conditions being the same, shall result in the close agreement of successive measurements. The difference between the measurement results shall be small when compared with the MPE.

Repeatability

5. The application of the same measurand under the same conditions of measurement shall result in the close agreement of successive measurements. The difference between the measurement results shall be small when compared with the MPE.

Discrimination and Sensitivity

6. A relevant instrument shall be sufficiently sensitive and the discrimination threshold shall be sufficiently low for the intended measurement task.

Durability

7. A relevant instrument shall be designed to maintain an adequate stability of its metrological characteristics over a period of time estimated by the manufacturer, provided that it is properly installed, maintained and used according to the manufacturer's instruction when in the environmental conditions for which it is intended.

Reliability

8. A relevant instrument shall be designed to reduce as far as possible the effect of a defect that would lead to an inaccurate measurement result, unless the presence of such a defect is obvious.

Protection against corruption

9.—(1) The metrological characteristics of a relevant instrument shall not be influenced in any inadmissible way by the connection to it of another device, by any feature of the connected device itself or by any remote device that communicates with the instrument.

(2) A hardware component that is critical for metrological characteristics shall be designed so that it can be secured. Security measures foreseen shall provide for evidence of an intervention.

(3) Software that is critical for metrological characteristics shall be identified as such and shall be secured.

(4) Software identification shall be easily provided by the relevant instrument.

(5) Evidence of a software intervention shall be available for a reasonable period of time.

(6) Measurement data, software that is critical for measurement characteristics and metrologically important parameters stored or transmitted shall be adequately protected against accidental or intentional corruption.

(7) The display of the total quantity supplied or the displays from which the total quantity supplied can be derived, whole or partial reference to which is the basis for payment, shall not be able to be reset during use.

Information to be borne by and to accompany the relevant instrument

10.—(1) A relevant instrument shall bear the following inscriptions—

(a) manufacturer's mark or name;

(b) information in respect of its accuracy;

(c) information in respect of the conditions of use;

(d) measuring range;

(e) identity marking;

(f) number of the EC-type examination certificate or the EC design examination certificate; and

(g) information whether or not additional devices providing metrological results comply with the provisions of these Regulations.

(2) The relevant instrument shall be accompanied by information on its operation, unless the simplicity of the relevant instrument makes this unnecessary. Information shall be easily understandable and shall include where relevant—

(a) rated operating conditions;

(b) mechanical and electromagnetic environment classes;

(c) the upper and lower temperature limit, whether condensation is possible or not, open or closed location;

(d) instructions for installation, maintenance, repairs, permissible adjustments;

(e) instructions for correct operation and any special conditions of use;

(f) conditions for compatibility with interfaces.

(3) Groups of identical relevant instruments used in the same location or used for utility measurement do not necessarily require individual instruction manuals.

(4) The units of measurement used and their symbols shall be in accordance with the provisions of Community legislation on units of measurement and their symbols.

(5) All marks and inscriptions required under any requirement shall be clear, non-erasable, unambiguous and non-transferable.

Indication of result

11.—(1) Indication of the result shall be by means of a display or hard copy.

(2) The indication of any result shall be clear and unambiguous and accompanied by such marks and inscriptions necessary to inform the user of the significance of the result. Easy reading of the presented result shall be permitted under normal conditions of use. Additional indications may be shown provided they cannot be confused with the metrologically controlled indications.

(3) In the case of hard copy the print or record shall also be easily legible and non-erasable.

(4) A relevant instrument shall be fitted with a metrologically controlled display accessible without tools to the consumer. The reading of this display is the measurement result that serves as the basis for the price to pay.

Conformity evaluation

12. A relevant instrument shall be designed so as to allow ready evaluation of its conformity with the appropriate requirements of these Regulations.

Accuracy

13. The manufacturer shall specify the class index of the relevant instrument. The class indices are A, B and C.

Rated operating conditions

14. The manufacturer shall specify the rated operating conditions of the relevant instrument, in particular—

(a) the values of f_n, U_n, I_n, I_{st}, I_{min}, I_{tr} and I_{max} that apply to the relevant instrument. For the current values specified, the relevant instrument shall satisfy the conditions given in Table 2;

Table 2

	Class A	*Class B*	*Class C*
For direct-connected relevant instruments			
I_{st}	$\leq 0.05 \cdot I_{tr}$	$\leq 0.04 \cdot I_{tr}$	$\leq 0.04 \cdot I_{tr}$
I_{min}	$\leq 0.5 \cdot I_{tr}$	$\leq 0.5 \cdot I_{tr}$	$\leq 0.3 \cdot I_{tr}$
I_{max}	$\geq 50 \cdot I_{tr}$	$\geq 50 \cdot I_{tr}$	$\geq 50 \cdot I_{tr}$
For transformer-operated relevant instruments			
I_{st}	$\leq 0.06 \cdot I_{tr}$	$\leq 0.04 \cdot I_{tr}$	$\leq 0.02 \cdot I_{tr}$
I_{min}	$\leq 0.4 \cdot I_{tr}$	$\leq 0.2 \cdot I_{tr}$ **(i)**	$\leq 0.2 \cdot I_{tr}$
I_n	$= 20 \cdot I_{tr}$	$= 20 \cdot I_{tr}$	$= 20 \cdot I_{tr}$
I_{max}	$\geq 1.2 \cdot I_n$	$\geq 1.2 \cdot I_n$	$\geq 1.2 \cdot I_n$

(i) For Class B electromechanical relevant instruments $I_{min} \leq 0.4 \cdot I_{tr}$ shall apply.

(b) the voltage, frequency and power factor ranges within which the relevant instrument shall satisfy the MPE requirements are specified in Table 3. These ranges shall recognise the typical characteristics of electricity supplied by public distribution systems;

(c) the voltage and frequency ranges shall be at least—

(i) $0.9 \cdot U_n \leq U \leq 1.1 \cdot U_n$;

(ii) $0.98 \cdot f_n \leq f \leq 1.02 \cdot f_n$;

(d) the power factor range shall be at least from $\cos\varphi = 0.5$ inductive to $\cos\varphi = 0.8$ capacitive.

Maximum permissible error (MPE)

15.—(1) Under rated operating conditions and in the absence of a disturbance, the error of measurement shall not exceed the MPE value as set out in Table 3.

(2) MPE as set out below is expressed as a bilateral value of the deviation from the true measurement value.

(3) The effects of the various measurands and influence quantities (a, b, c) are evaluated separately, all other measurands and influence quantities being kept relatively constant at their reference values. The error of measurement, that shall not exceed the MPE stated in Table 3, is calculated as—

$$\text{error of measurement} = \sqrt{a^2 + b^2 + c^2} \ \ldots$$

(4) When the relevant instrument is operating under varying-load current, the percentage errors shall not exceed the limits given in Table 3.

Table 3

MPEs in percent at rated operating conditions and defined load current levels and operating temperature

	Operating temperatures			*Operating temperatures*			*Operating temperatures*			*Operating temperatures*		
	+5 °C…+30 °C			−10 °C…+5 °C or +30 °C…+40 °C			–25 °C…−10 °C or +40 °C…+55 °C			−40 °C…–25 °C or +55 °C…+70 °C		
Relevant instrument class	A	B	C	A	B	C	A	B	C	A	B	C
Single phase relevant instrument; polyphase relevant instrument if operating with balanced loads												
$I_{min} \leq I < I_{tr}$	3.5	2	1	5	2.5	1.3	7	3.5	1.7	9	4	2
$I_{tr} \leq I \leq I_{max}$	3.5	2	0.7	4.5	2.5	1	7	3.5	1.3	9	4	1.5
Polyphase relevant instrument if operating with single phase load												
$I_{tr} \leq I \leq I_{max}$, see	4	2.5	1	5	3	1.3	7	4	1.7	9	4.5	2

exception
below

For electromechanical polyphase relevant instruments the current range for single-phase load is limited to 5 $I_{tr} \leq I \leq I_{max}$

(5) When a relevant instrument operates in different temperature ranges the relevant MPE values shall apply.

Permissible effect of disturbances — Electromagnetic environment

16.—(1) Under rated operating conditions and in the presence of a disturbance, the performance requirements shall be as set out below.

(2) Where the relevant instrument is intended to be used in a specified permanent continuous electromagnetic field the permitted performance during the radiated electromagnetic field-amplitude modulated test shall be within MPE.

(3) General

(a) As relevant instruments are directly connected to the mains supply and as mains current is also one of the measurands, a special electromagnetic environment is used for electricity meters.

(b) The relevant instrument shall comply with the electromagnetic environment E2 and the additional requirements in sub-paragraphs (4) and (5) below.

(c) The electromagnetic environment and permissible effects reflect the situation that there are disturbances of long duration which shall not affect the accuracy beyond the critical change values and transient disturbances, which may cause a temporary degradation or loss of function or performance but from which the relevant instrument shall recover and shall not affect the accuracy beyond the critical change values.

(d) When there is a foreseeable high risk due to lightning or where overhead supply networks are predominant, the metrological characteristics of the relevant instrument shall be protected.

(4) Effect of disturbances of long duration

Table 4

Critical change values for disturbances of long duration

Disturbance	*Critical change values in percent for relevant instruments of class*		
	A	B	C
Reversed phase sequence	1.5	1.5	0.3
Voltage unbalance (only applicable to polyphase relevant instruments)	4	2	1
Harmonic contents in the current circuit[(i)]	1	0.8	0.5
DC and harmonics in the current circuit[(i)]	6	3	1.5

(i) In the case of electromechanical relevant instruments, no critical change values are defined for harmonic contents in the current circuits and for DC and harmonics in the current circuit.

Disturbance	*Critical change values in percent for relevant instruments of class*		
	A	B	C
Fast transient bursts	6	4	2
Magnetic fields; HF (radiated RF) electromagnetic field; conducted disturbances introduced by radio-frequency fields; and oscillatory waves immunity	3	2	1

(i) In the case of electromechanical relevant instruments, no critical change values are defined for harmonic contents in the current circuits and for DC and harmonics in the current circuit.

(5) Permissible effect of transient electromagnetic phenomena

(a) The effect of an electromagnetic disturbance on a relevant instrument shall be such that during and immediately after a disturbance any output intended for testing the accuracy of the relevant instrument does not produce pulses or signals corresponding to an energy of more than the critical change value; and in reasonable time after the disturbance the relevant instrument shall—

(i) recover to operate within the MPE limits;

(ii) have all measurement functions safeguarded;

(iii) allow recovery of all measurement data present prior to the disturbance; and

(iv) not indicate a change in the registered energy of more than the critical change value.

(b) The critical change value in kWh is $m \cdot U_n \cdot I_{max} \cdot 10\text{-}^{6}$ (m being the number of measuring elements of the relevant instrument, U_n in Volts and I_{max} in Amps).

(c) For overcurrent the critical change value is 1.5 %.

Suitability

17.—(1) A relevant instrument shall have no feature likely to facilitate fraudulent use, whereas possibilities for unintentional misuse shall be minimal.

(2) A relevant instrument shall be suitable for its intended use taking account of the practical working conditions and shall not require unreasonable demands of the user in order to obtain a correct measurement result.

(3) The errors of a relevant instrument at voltages or currents outside the controlled range shall not be unduly biased.

(4) Where a relevant instrument is designed for the measurement of values of the measurand that are constant over time, the instrument shall be insensitive to small fluctuations of the value of the measurand, or shall take appropriate action.

(5) A relevant instrument shall be robust and its materials of construction shall be suitable for the conditions in which it is intended to be used.

(6) When a relevant instrument has associated software which provides other functions besides the measuring function, the software that is critical for the metrological characteristics shall be identifiable and shall not be inadmissibly influenced by the associated software.

(7) Below the rated operating voltage the positive error of the relevant instrument shall not exceed 10 %.

(8) The display of the total energy shall have a sufficient number of digits to ensure that when the relevant instrument is operated for 4000 hours at full load ($I = I_{max}$, $U = U_n$ and PF = 1) the indication does not return to its initial value and shall not be able to be reset during use.

(9) In the event of loss of electricity in the circuit, the amounts of electrical energy measured shall remain available for reading during a period of at least 4 months.

(10) When the voltage is applied with no current flowing in the current circuit (current circuit shall be open circuit), the relevant instrument shall not register energy at any voltage between $0.8 \cdot U_n$ and $1.1\ U_n$.

(11) The relevant instrument shall start and continue to register at U_n, PF = 1 (polyphase relevant instruments with balanced loads) and a current which is equal to I_{st}.

Units

18. The electrical energy measured shall be displayed in kilowatt-hours or in megawatt-hours.

PART 2

PUTTING INTO USE REQUIREMENTS

19.—(1) Subject to sub-paragraph (2), measurements may be performed by means of any relevant instrument provided that the temperature range to which a relevant instrument is exposed is not wider than the range specified by the manufacturer in relation to that relevant instrument in accordance with paragraph 3(1)(a) and Table 1 of this Schedule.

(2) Class A relevant instruments may not be used when operating outside the temperature range of an upper temperature limit of 30 °C to a lower temperature limit of 5 °C.

(3) The person responsible for installing the relevant instrument shall determine the correct current range and assess the climatic environment, so that the relevant instrument is appropriate for the accurate measurement of consumption that is foreseen or foreseeable.