PUBLIC DECREE

As the authority with substantive and territorial jurisdiction in the matter of laying down metrological and technical requirements for specified measuring instruments and stipulating test methods for type approval and verification of specified measuring instruments pursuant to § 14(1) of Act No 505/1990, on metrology, as amended (hereinafter the ‘Metrology Act’), and in accordance with the provisions of § 172 et seq. of Act No 500/2004, the Administrative Code (hereinafter the ‘AC’), the Czech Metrology Institute (hereinafter the ‘CMI’) commenced ex officio proceedings on 15 September 2023 pursuant to § 46 of the AC, and, based on supporting documents, issues the following:

I.

DRAFT GENERAL MEASURE

number: 0111-OOP-C022-24

laying down the metrological and technical requirements for specified instruments, including test methods for type-approval, verification and checking of specified measuring instruments:

‘electricity meters’

In the light of the relevant EU legislation and national legislation in the Czech Republic, electricity meters are types of measuring instruments where placing them on the market or putting them into circulation or into service, in terms of the scope of this legislation, is divided into two groups, namely:

a) class A, B and C electricity meters for measuring active energy intended for use in commercial, residential and light industrial environments;

b) electricity meters for measuring active energy intended for applications other than residential, commercial and light industry environments, and the functions that the electricity meters pursuant to this paragraph and paragraph (a) possess in addition to measuring active electrical energy, e.g. measurement of reactive energy.

In the case of meters pursuant to point (a), the process of placing them on the market and putting them into service, including the technical and metrological requirements for measuring instruments and the methods used to test them, is regulated by special legislation[1]. For these electricity meters, this measure of a general nature sets out the metrological and technical requirements and lays down the test methods to be applied for the verification of these meters after they have been put into service, i.e. for subsequent verification pursuant to Chapter 7.

In the case of electricity meters and electricity meter functions pursuant to point (b) that are not covered by the scope of special legislation[1]this measure lays down both the metrological and technical requirements and the test methods to be applied when putting into circulation, i.e. type-approval pursuant to Chapter 5 and initial verification pursuant to Chapter 6, and the metrological and technical requirements and methods of testing for post-marketing verifications pursuant to Chapter 7. These

[1] Act No 90/2016 on conformity assessment of specified products when making them available on the market.

Government Regulation No 120/2016 on conformity assessment of measuring instruments when making them available on the market, incorporating Directive 2014/32/EU of the European Parliament and of the Council of 26 February 2014 on measuring instruments (MID) into Czech law.

activities are not covered by European legislation and are governed by Act No 505/1990 on metrology, as amended.

1 Basic definitions

For the purposes of this Measure of a General Nature, the terms and definitions pursuant to VIM and VIML[2] and the following shall apply:

1.1
electricity meter for measuring energy

an instrument for measuring electrical energy by integrating power over time

1.1.1
active electricity meter, watt-hour electricity meter

an instrument for measuring active energy by integrating active power over time

1.1.2
reactive electricity meter, var-hour electricity meter

an instrument for measuring reactive electrical energy by integrating reactive power over time

1.2
electromechanical electricity meter, induction-type electricity meter

an electricity meter in which currents in fixed coils react with currents induced in the conductive moving rotor(s), which causes its (their) movement proportional to the energy to be measured

1.3
static electricity meter

an electricity meter in which current and voltage act on solid state (electronic) elements to produce an output signal proportional to the energy to be measured

1.4
direct-connected electricity meter

an electricity meter intended for use by direct connection to the electrical grid

1.5
transformer-operated electricity meter

an electricity meter intended to be used while connected to the electrical grid via one or more external instrument transformers

NOTE This type of meter connection is also referred to as 'indirect'.

1.6
multi-tariff electricity meter

an electricity meter equipped with multiple registers, each of which operates during specified intervals corresponding to different tariffs

1.7
electricity meter class

[2] TNI 01 0115 International Vocabulary of Metrology – Basic and General Concepts and Associated Terms (VIM) and International Vocabulary of Terms in Legal Metrology (VIML) are part of the technical harmonisation compendium 'Terminology in the Area of Metrology', which is publicly accessible at www.unmz.cz.

designation of the quality of electricity meters that satisfy the technical and metrological requirements specified for a given class of electricity meters

1.7.1
electricity meter accuracy classes 0.5; 1; 2; 3; 0.1 S; 0.2 S; 0.5 S and 1 S

designation of the quality of electricity meters that satisfy the technical and metrological requirements specified by the relevant technical standards and whose type has been approved pursuant to the Metrology Act; the number in the class designation represents the electricity meter's accuracy class

1.7.2
class A, B and C electricity meters

quality marking for electricity meters meeting the technical and metrological requirements for placing on the market and putting into service laid down in special legislation[1].

1.8
current, I

electrical current flowing through the electricity meter

1.8.1
inrush current, I_{st}

the lowest declared value of current at which the electricity meter registers electrical energy at unity power factor (for three-phase electricity meters, with balanced load)

1.8.2
minimum current, I_{min}

the lowest value of current for which accuracy requirements are specified by this regulation; from I_{min} to I_{tr} less stringent accuracy requirements apply

1.8.3
transitional current, I_{tr}

the value of current at and above which the accuracy requirements under this regulation fully apply up to I_{max}

1.8.4
maximum current, I_{max}

the highest value of current at which the electricity meter still meets the accuracy requirements laid down by this regulation

1.8.5
nominal current, I_n

value of the current to which the relevant characteristics of the meter are related

1.8.6
base current, I_b

value of the current to which the relevant characteristics of a directly connected electromechanical meter are related

1.8.7
reference current, I_{ref}

for direct-connected electricity meters, this is 10 times the transition current

NOTE 1 This value is the same as the nominal current I_n or base current I_b.

for transformer-operated electricity meters, this is 20 times the transitional current

NOTE 2 This value is the same as the nominal current I_n.

1.9
reference voltage, U_n

the voltage value to which the relevant characteristics of the meter are related

NOTE The reference voltage may be more than one value or a stipulated range.

1.10
reference frequency, f_n

the frequency value to which the relevant characteristics of the meter are related

1.11
relative error

relative error in % is given by:

$$\text{relative error (in \%)} = \frac{\text{energy registered by the electricity meter} - \text{actual energy}}{\text{actual energy}} \times 100 \qquad (1)$$

1.12
maximum permissible error (MPE)

maximum permissible error under specified working conditions and in the absence of interference

1.13
software

electricity meter software that performs other functions in addition to measurement. Software is divided into legally relevant software and legally non-relevant software

1.13.1
legally relevant software

the part of the measuring instrument software that is critical for metrological characteristics and is subject to the principles applicable to specified measuring instruments during type approval and verification (hereinafter 'LRSW')

1.13.2
legally non-relevant software

the part of the instrument software that can coexist in the device together with the LRSW. Unlike LRSW, legally non-relevant software ('LNRSW') is not subject to the requirements of this Regulation; a LNRSW update does not cause validation to expire

1.14
ancillary devices

communication and tariff devices that are components of or directly connected to the meter

2 Metrological requirements

During verification, measuring instruments are subject to the metrological requirements applicable at the time they were placed on the market or into circulation.

In the case of measuring instruments placed on the market in accordance with special legislation[1], the requirements laid down in this special legislation shall apply.

Where metrological requirements are laid down in special legislation[1], the requirements set out in this Chapter apply only for the purpose of ex-post verification.

2.1 Rated operating conditions

2.1.1 Voltage range

Electricity meters must measure electrical energy within the limits of the maximum permissible errors across a range of voltages within ±10 % of the nominal voltage.

2.1.2 Frequency range

Electricity meters must measure energy within the limits of the maximum permissible errors within the frequency range of ± 2% of the nominal frequency.

2.1.3 Current range

Electricity meters must measure energy within the limits of the maximum permissible errors in the range of currents from I_{min} to I_{max} at $\cos \varphi = 0.5$ inductive to $\cos\varphi = 0.8$ capacitive, or $\sin \varphi = 0.5$ inductive to $\sin \varphi = 0.5$ capacitive in both the input and output direction.

2.1.4 Ambient temperature range

Electricity meters must measure electrical energy within the limits of the maximum permissible errors across the range of ambient temperatures specified by the manufacturer.

2.2 Maximum permissible errors

2.2.1 Maximum permissible errors for electromechanical active electricity meters of accuracy class 0.5 at the time of type approval

The maximum permissible errors for type approval specified below apply only to active electromechanical meters of accuracy class 0.5 (these meters are not covered by the scope of special legislation[1] as they are not intended for use in residential and commercial premises and in light industry).

Under reference conditions, the relative errors of the electricity meters must not exceed the maximum permissible errors given in Tables 1 and 2.

If the electricity meter is designed for bi-directional measurement of electrical energy, the values given in Tables 1 and 2 apply to both directions of energy flow.

Table 1 – Maximum permissible errors for single-phase and three-phase electricity meters of accuracy class 0.5 with symmetrical load

Current		Power factor	Maximum permissible error (%)
for direct-connected electricity meters	for transformer-operated electricity meters		
$0.05\ I_b \le I < 0.1\ I_b$	$0.02\ I_n \le I < 0.05\ I_n$	1	±1.0
$0.1\ I_b \le I \le I_{max}$	$0.05\ I_n \le I \le I_{max}$	1	±0.5
$0.1\ I_b \le I < 0.2\ I_b$	$0.05\ I_n \le I < 0.1\ I_n$	0.5 inductive 0.8 capacitive	±1.3 ±1.3
$0.2\ I_b \le I \le I_{max}$	$0.1\ I_n \le I \le I_{max}$	0.5 inductive 0.8 capacitive	±0.8 ±0.8

Table 2 – Maximum permissible errors for three-phase electricity meters of accuracy class 0.5 with single-phase load, but with voltage circuits energised with symmetrical three-phase voltage

Current		Power factor	Maximum permissible error (%)
for direct-connected electricity meters	for transformer-operated electricity meters		
$0.2\ I_b \le I < I_b$	$0.1\ I_n \le I \le I_n$	1	±1.5
$0.5\ I_b$	$0.2\ I_n$	0.5 inductive	±1.5
I_b	I_n	0.5 inductive	±1.5
$I_b \le I \le I_{max}$	$I_n \le I \le I_{max}$	1	–

2.2.2 Maximum permissible errors for active static electricity meters of accuracy class 0.1 S; 0.2 S and 0.5 S at type approval

The maximum permissible errors for type approval given below apply only to static electricity meters of accuracy class 0.1 S; 0.2 S and 0.5 S (these meters are not covered by the scope of special legislation[1] as they are not intended for use in residential and commercial premises and in light industry).

Under reference conditions, the relative errors of the electricity meters must not exceed the maximum permissible errors given in Table 3. If the electricity meter is designed for bi-directional measurement of electrical energy, the values given in Table 3 apply to both directions of energy flow.

Table 3 – Maximum permissible errors for single-phase and three-phase active electricity meters of accuracy class 0.1 S; 0.2 S and 0.5 S with symmetrical or single-phase loads

Current	Power factor	Maximum permissible errors in % for electricity meters of accuracy class		
		0.1 S	0.2 S	0.5 S
$I_{min} \le I < 0.05\ I_n$	1	±0.2	±0.4	±1.0
$0.05\ I_n \le I \le I_{max}$	1	±0.1	±0.2	±0.5
$0.02\ I_n \le I < 0.1\ I_n$	0.5 inductive 0.8 capacitive	±0.25 ±0.25	±0.5 ±0.5	±1.0 ±1.0
$0.1\ I_n \le I \le I_{max}$	0.5 inductive 0.8 capacitive	±0.15 ±0.15	±0.3 ±0.3	±0.6 ±0.6
$0.1\ I_n \le I \le I_{max}$ *)	0.25 inductive 0.5 capacitive 0.25 capacitive	±0.25 ±0.25 ±0.25	±0.5 ±0.5 ---	±1.0 ±1.0 ---
*) if specifically requested by the user				

2.2.3 Maximum permissible errors for static electricity meters when measuring reactive energy

The maximum permissible errors in the measurement of reactive energy apply only to accuracy tests carried out at the time of type approval of static electricity meters intended to measure this type of energy and not covered by the scope of special legislation[1].

Under reference conditions, the relative errors of electricity meters must not exceed the maximum permissible errors given in Table 4.

Table 4 – Maximum permissible errors for single-phase and three-phase reactive meters with symmetrical or single phase load

Current		sin φ (inductive or capacitive)	Maximum permissible errors in % for electricity meters of accuracy class			
for direct-connected electricity meters	for transformer-operated electricity meters		0.5 S	1 and 1 S	2	3
$I_{min} \le I < 0.1\ I_n$	$I_{min} \le I < 0.05\ I_n$	1	±1.0	±1.5	±2.5	±4.0
$0.1\ I_n \le I \le I_{max}$	$0.05\ I_n \le I \le I_{max}$	1	±0.5	±1.0	±2.0	±3.0
$0.1\ I_n \le I < 0.2\ I_n$	$0.05\ I_n \le I < 0.1\ I_n$	0.5	±1.0	±1.5	±2.5	±4.0
$0.2\ I_n \le I \le I_{max}$	$0.1\ I_n \le I \le I_{max}$	0.5	±0.5	±1.0	±2.0	±3.0
$0.2\ I_n \le I \le I_{max}$	$0.1\ I_n \le I \le I_{max}$	0.25	±1.0	±2.0	±2.5	±4.0

Table 5 – Minimum currents for accuracy classes 0.1 S; 0.2 S; 0.5 S; 1 S; 0.5; 1; 2 and 3

Electricity meter	Accuracy class	
	0.1 S; 0.2 S; 0.5 S and 1 S	0.5; 1; 2 and 3
Static, direct-connected	–	$0.05\ I_n$
Static, transformer-operated	$0.01\ I_n$	$0.02\ I_n$

2.2.4 Maximum permissible errors during verification

When verified under reference conditions, electricity meters must not exceed the error limits for the individual types of electricity meters and the currents given in Tables 30 to 37.

2.3 No-load operation

When there is no current flowing through the electricity meter, it must not register any energy.

2.4 Electricity meter inrush

2.4.1 Inrush of active electricity meters

The electricity meter must start measuring active energy and continue recording it at reference voltage $U_N$power factor cos $\varphi = 1$ and the stipulated current in accordance with the relevant Tables 6, 7a and 7b, if applicable.

Table 6 – Inrush currents for accuracy classes 0.1 S; 0.2 S; 0.5 S; 0.5; 1 and 2

Electricity meter	Accuracy class					
	0.1 S	0.2 S	0.5 S	0.5	1	2
Electromechanical, direct-connected	–	–	–	$0.003\ I_b$	$0.004\ I_b$	$0.005\ I_b$
Electromechanical, transformer-operated	–	–	–	$0.002\ I_n$	$0.002\ I_n$	$0.003\ I_n$
Static, direct-connected	–	–	$0.001\ I_n$	–	$0.004\ I_n$	$0.005\ I_n$
Static, transformer-operated	$0.001\ I_n$	$0.001\ I_n$	$0.001\ I_n$	–	$0.002\ I_n$	$0.003\ I_n$

Table 7a – Inrush currents for classes A, B and C determined from transitional current

Electricity meter	Class		
	A	B	C
Electromechanical, direct-connected	0.05 I_{tr}	0.04 I_{tr}	–
Electromechanical, transformer-operated	0.06 I_{tr}	0.04 I_{tr}	–
Static, direct-connected	0.05 I_{tr}	0.04 I_{tr}	0.04 I_{tr}
Static, transformer-operated	0.06 I_{tr}	0.04 I_{tr}	0.02 I_{tr}

Table 7b – Inrush currents for classes A, B and C determined from reference or nominal current

Electricity meter	Class		
	A	B	C
Electromechanical, direct-connected	0.005 I_{ref}	0.004 I_{ref}	–
Electromechanical, transformer-operated	0.003 I_n	0.002 I_n	–
Static, direct-connected	0.005 I_{ref}	0.004 I_{ref}	0.004 I_{ref}
Static, transformer-operated	0.003 I_n	0.002 I_n	0.001 I_n

2.4.2 Inrush of reactive electricity meters

The electricity meter must start to measure and continue to register reactive energy at nominal voltage U_n, power factor sin $\varphi = 1$ and the current given in Table 8.

Table 8 – Inrush currents for accuracy classes 0.5 S; 1; 1 S; 2 and 3

Electricity meters for	Accuracy class			
	0.5 S	1 and 1 S	2	3
Direct connection	–	0.004 I_n	0.005 I_n	0.010 I_n
Transformer-operated	0.001 I_n	0.002 I_n	0.003 I_n	0.005 I_n

3 Technical requirements

During verification, measuring instruments are subject to the technical requirements that were applicable when they were placed on the market or into circulation.

In the case of measuring instruments placed on the market in accordance with special legislation[1] the requirements laid down in this special legislation shall apply.

Where technical requirements are laid down in special legislation[1] the requirements set out in this Chapter apply only for the purpose of ex-post verification.

3.1 Electricity meter design

Electricity meters must be designed to maintain adequate stability of their metrological characteristics throughout the intended period of use (this period is estimated by the manufacturer), provided that they are properly installed, maintained and used according to the manufacturer’s instructions when in the ambient conditions for which they are intended.

3.2 Housing

The electricity meter must have a housing that can be secured so that the inner parts of the meter are not accessible without damaging an official mark.

The top cover must not be removable without using a tool.

The mechanical strength of the electricity meter's housing must be such that any temporary deformation does not prevent the meter from operating correctly.

3.3 Counter

Electricity meters must be equipped with a metrologically checked counter. This may be a mechanical device in the form of discs or an electronic display.

Electricity meters intended for measuring multiple types of energy must indicate which energy is currently being measured.

Multi-tariff electricity meters must indicate which rate is currently in effect.

The counter reading must correspond to rotor revolutions or the number of pulses of the test diode or the number of impulses for remote measurement. This relationship is given by a constant indicated on the electricity meter’s label.

The total electrical energy counter must have a sufficient number of digits to ensure that the reading does not return to its initial value if the meter is operated for 4000 hours at full load ($I = I_{max}$, $U = U_n$ and cos φ [or sin φ] = 1). It must not be possible to reset the counter, whether total or tariff, without removing the official mark.

In the case of an electronic counter with an energy-independent memory, the minimum storage period must be four months.

3.4 Software

For software, a distinction is made between legally relevant software (LRSW) or legally non-relevant software (LNRSW). The LNRSW must be clearly separated and a change in LNRSW must not affect the LRSW and metrologically relevant measured data.

3.4.1 Legally relevant software

Legally relevant software that is essential for metrological characteristics must be identifiable. LRSW identification and demonstration of LRSW integrity (e.g. using a check sum or an alternative method, e.g. a hash function) must be enabled in a simple manner without the use of additional devices. The LRSW must be secured against accidental, unintentional or intentional changes through individual communication or user interfaces. During the lifetime of the meter, the LRSW may be changed to another approved LRSW type only breaching the manufacturer’s or official marks and subsequent verification. If the electricity meter has a functionality that allows the LRSW to be changed without breaching official or security marks, the manufacturer must ensure that measures are taken to prevent the use of that functionality. Evidence of any interference with the LRSW must be available.

For electricity meters where it is not possible to electronically read the LRSW version and prove LRSW integrity (no electronic display and no communication interface), these data must be marked on the meter.

The LRSW domain covers all parts (programme units, sub-programmes, processes, libraries, etc.) involved in:

- calculation of measured values or influence them;
- ancillary functions such as data display, data security, data storage, software identification, software integrity, transmission or storage of data in the meter, authentication of received and stored data in the meter, etc., in the case of legally relevant data;
- a protective interface between LRSW and LNRSW.

All variables, temporary files and parameters that affect or may affect the measured data or on the LRSW also belong to the LRSW. The LRSW also includes parts of software ensuring or contributing to the security of parameters.

In the case of parameter settings, a distinction must be made between:

Type A security: May only be modified after breach of official or security marks and any change in the position of the relevant hardware switch or, where appropriate, by means of authentication, authorisation methods such as passwords, cryptographic keys, certificates.

Type B security: May be modified using user authentication by means of authorisation methods without breaching official or security marks and, where appropriate, changing the position of the relevant switch.

In the case of use of user authentication by an authorisation method, an event logger must be applied in order to protect significant metrological characteristics according to Type A, which must not be rewritable and must be impossible to delete or change without breaching an official mark or security mark. Reading event logger logs must be possible using LRSW.

In order to protect characteristics defined by Type B, an event logger must be applied, which, after logging a sufficient number of records, can overwrite the oldest record. The event logger for Type B must contain a sufficient number of records and it must not be possible to delete or overwrite an arbitrary record.

Type A: transformation ratio, constants, and other parameters that influence the measured values and the data required for their legally relevant use.

Type B: tariff settings (TOU tables), real time (RTC), password management, etc.

Measurement data stored in the electricity meter or transmitted for later use for legally relevant purposes must be complete, contain all the information needed to reconstruct their origin and be secured against accidental, unintentional or intentional changes.

3.4.2 Legally non-relevant software (LNRSW)

LNRSW must not affect the LRSW, the metrological characteristics of the electricity meter and the measured data for legally relevant purposes. LNRSW must be clearly distinguishable from LRSW. Data that are generated or provided by LNRSW and can be viewed by LRSW must be clearly distinguishable from data generated or provided by LRSW. Such data cannot be used for legally relevant purposes. If an electricity meter has LNRSW, the requirements of WELMEC Guide 7.2, as amended, extension S (Software Separation) must be fulfilled.

3.5 Ancillary devices

The metrological characteristics of the meter may not be affected in any way by connecting an ancillary device to it, by a property of the connected ancillary device or a remotely connected ancillary device that communicates with the meter.

3.6 Mechanical requirements

The mechanical environment for which the electricity meter is intended must be specified by the manufacturer. The manufacturer must also specify whether the electricity meter is intended for indoor or outdoor use.

3.7 Climatic condition

The manufacturer must specify the upper and lower temperature limits for the rated operating range, limit operating range and for storage and transport.

3.8 Electrical requirements

3.8.1 Warming

Under nominal operating conditions, the electrical circuits and insulation must not reach a temperature that could negatively affect the operation of the electricity meter.

3.8.2 Insulation

The electricity meter and its built-in ancillary devices, if any, must maintain adequate insulation properties under normal conditions, taking into account the influences of the external environment and the different voltages that they are subjected to under normal conditions.

3.8.3 Influence of short-circuit overcurrents

Transient overcurrents must not damage the electricity meter. After the original operating conditions are restored, the meter must operate correctly and the change in error in the reference current and unit power factor must not exceed the values in Table 12.

3.9 Electromagnetic compatibility

The electricity meter must conform to a class E2 electromagnetic environment and also meet the following requirements.

During and immediately after an electromagnetic disturbance,

a) any output intended for testing the accuracy of the electricity meter must not produce pulses or signals corresponding to an energy of more than the critical change value;

b) and within reasonable time after the effects of the fault the electricity meter must:
   - recover to operate within the limits of the maximum permissible error (MPE);
   - provide all measurement functions,
   - allow recovery of all measurement data present before the effects of the fault started,
   - not indicate a change in the registered electrical energy of more than the critical change value.

   The critical change value x, in kWh, is given by the equation:

$$x = m \cdot U_n \cdot I_{max} \cdot 10^{-6}, \quad (2)$$

   where m is the number of measuring elements of the meter; U_n is in volts, and I_{max} in amperes.

3.10 Resistance to tampering

The electricity meter must be designed so that any mechanical tampering with the housing, window or terminal cover that can affect measurement accuracy causes visible permanent damage to the meter or the official or security markings, thus providing evidence of tampering.

The LRSW and metrologically relevant data that could be unduly changed via a communication or user interface must be protected as required by the current version of WELMEC Guide 7.2.

LNRSW may be changed without breaching the official or trade mark (see WELMEC Guide 7.2, extension S), and a change to LNRSW must not affect LRSW.

Software security must comply with point 3.4 and any changes to the LRSW must be recorded in the event logger.

Modification of LRSW without breaching official or security marks is not permitted. If the meter contains this function, it must be deactivated using a hardware-based method.

4 Marking of measuring instruments

During verification, measuring instruments are subject to the requirements that were applicable when they were placed on the market or into circulation.

In the case of measuring instruments put into circulation in accordance with special legislation[1] the requirements laid down in this special legislation shall apply.

4.1 Position of markings on measuring instruments

At least the following information must be visible and legible on the electricity meter in its installed position:

a) the manufacturer’s name or trademark; for electricity meters placed on the market with conformity assessment pursuant to special legislation,[1] also the address of the manufacturer;
b) identification of the kind and type of instrument;
c) the serial number and year of manufacture;
d) designation of the electricity meter’s class;
e) reference voltage;
f) reference (or base or nominal) current;
g) maximum current;
h) minimum current;
i) reference frequency;
j) the electricity meter’s constant;
k) the stipulated operating temperature range;
l) type of transmission grid (graphic symbol);
m) a square-in-square symbol for fully insulated protective class II electricity meters (if applicable);
n) a circuit diagram for connecting the electricity meter to the grid (it need not be provided on the identification label, but can, for example, be on the terminal cover);
o) the type approval mark or the conformity marking;
p) nominal pulse voltage;
q) the categories of use for which the meter has been approved (UC1 to UC4); this applies only to direct-connected meters;
r) reference to the standards in accordance with which the meter has been type-approved;
s) the nominal value and range of ancillary supply voltage and frequency;
t) identification of power terminals and auxiliary terminals, if any;
u) a fire hazard warning if the electricity meter contains a battery;
v) transformation ratio (may also be on the display).

4.2 Official mark placement

Placement of official marks is stipulated in the type approval certificate or the EC (EU) type-examination certificate or other document applied within the context of conformity assessment when placing the device on the market and into operation.

5 Measuring instrument type approval

In the case of measuring instruments placed on the market with conformity assessment pursuant to special legislation,[1] the provisions on type-approval under the Metrology Act do not apply.

For the type approval of a meter for measuring the active component of electrical energy intended for use other than in residential, commercial and light industrial applications, the same requirements shall be applied as for measuring instruments placed on the market with conformity assessment in accordance with special legislation.[1].

Type approval of an electricity meter for measuring the reactive component of electrical energy shall be carried out in accordance with the provisions of this Chapter.

5.1 In general

The type approval process for electricity meters comprises the following tests:

a) an external inspection;
b) tests of resistance of the electricity meter to mechanical influences;
c) tests of resistance to environmental influences;
d) tests of the influence of electrical properties;
e) electromagnetic compatibility (EMC) tests;
f) functional tests;
g) software tests.

5.2 External inspection

The following is assessed during external inspection of the electricity meter:

- that the prescribed technical documentation is complete and correct;
- that metrological and technical characteristics specified by the manufacturer in documentation comply with the requirements of this legislation specified in articles 2 and 3;
- that the electricity meter is complete and complies with prescribed technical documentation.

5.3 Performance of tests for type approval

5.3.1 Test equipment requirements

Measuring stations for testing electricity meters must be equipped with a reference electricity meter with valid metrological traceability. The measuring station as a whole must be checked by what is termed a station functional test.

The test equipment must allow for electricity meter errors to be determined with an uncertainty of at most 1/5 of the relative error limits given in Tables 1 to 5. When testing class 0.1 S electricity meters, 1/3 of the error limit is sufficient.

5.3.2 Reference conditions for tests

The tests must be performed under reference conditions with the electricity meter cover in place and the meter connected to test equipment according to the schematic diagram provided by the manufacturer.

The reference conditions are subject to the values given in Tables 27 to 29.

In addition to the conditions specified above, there must be no disruptive mechanical vibrations in the laboratory.

5.3.3 Preparation of electricity meters for testing

Prior to testing, electricity meters must be allowed to thermally stabilise for a period of at least 6 hours in a room at a temperature of (23 ±5) °C.

Before each test is performed, the voltage circuits of the meters shall be connected to a reference voltage of at least:

30 minutes for electromechanical meters;

5 minutes for static meters.

5.4 Tests of resistance of the electricity meter to mechanical influences

5.4.1 Spring hammer test

The test of mechanical strength of the electricity meter’s housing must be performed using a spring-actuated hammer on the electricity meter mounted in its normal operating position.

The spring hammer must impact the outer surface of the top cover of the meter (including windows) and the terminal cover with a kinetic energy of 0.2 J ± 0.02 J.

The meter will pass this test if its housing and terminal cover is not damaged to an extent that could affect the functionality of the electricity meter and allow contact with live parts. Minor damage that does not reduce the meter's protection from indirect contact or from ingress of solid objects, dust and water is permitted.

5.4.2 Mechanical shock test

The shock resistance test must be performed using half-sine pulses with a peak acceleration of $30 g_n$ (300 m/s^2) and pulse duration of 18 ms with the electricity meter in a non-operating state. The shocks must be applied to the electricity meter fastened to the test device in all three axes and in both directions.

After this test, the electricity meter must not exhibit any damage or changes in data, and must operate correctly in accordance with requirements.

5.4.3 Vibration (sinusoidal) test

The test of resistance to sinusoidal vibrations must be performed by subjecting an electricity meter in non-operating state to sinusoidal vibrations at a frequency of 10 Hz to 150 Hz with a transient frequency of 60 Hz, where for:

$f < 60$ Hz, the constant movement amplitude is 0.075 mm;

$f > 60$ Hz, constant acceleration is 9.8 m/s^2..

The test is performed at a single check point using ten repeating cycles per axis.

After this test, the electricity meter must not exhibit any damage or changes in data, and must operate correctly in accordance with requirements.

5.4.4 Heat and fire resistance test

The electricity meter’s terminal block, terminal cover and housing must provide sufficient protection against propagation of fire. They should not ignite if the live parts that are in contact with them become excessively hot.

The heat and fire resistance test must be carried out by means of a glow wire on the terminal block at 960 °C ± 15 °C and on the terminal cover and housing of the electricity meter at 650 °C ± 10 °C. The glow wire is applied for 30 seconds ± 1 s.

Contact with the glow wire may occur at an arbitrary location. If the terminal block is an integral part of the meter housing, it is sufficient to carry out this test only on the terminal block.

5.4.5 Test of resistance to ingress of dust and water

The tests of resistance to ingress of dust and water must be performed with the electricity meter in a non-operating state, mounted on an artificial wall. The supply cables are connected to the electricity meter's terminals and the terminal block cover is fitted.

The electricity meter must meet IP51 requirements for indoor use and IP54 requirements for outdoor use.

5.4.5.1 Test of resistance to ingress of dust

For indoor electricity meters, the same atmospheric pressure is maintained both inside and outside the electricity meter (neither negative nor positive pressure).

Dust may enter the electricity meter only in quantities that do not compromise its operation. The electricity meter must subsequently pass the electrical insulation strength test referred to in Article 5.6.2.

5.4.5.2 Test of resistance to ingress of water

Water may enter the electricity meter only in quantities that do not compromise its operation. The electricity meter must subsequently pass the electrical insulation test pursuant to in Article 5.6.2.

5.5 Tests of resistance to climatic influences

5.5.1 Dry heat test

The dry heat test must be carried out on the meter in non-operational state by a method with a gradual change in temperature to an ambient temperature of + 70 °C ± 2 °C and exposure to that temperature for 72 h. After completion of the test, the meter must show no data damage or change and must operate correctly.

5.5.2 Cold test

The cold test must be carried out on the meter in non-operational state with a gradual change of temperature.

Indoor electricity meters are exposed to an ambient temperature of −25 °C ±3 °C for 72 hours, while outdoor electricity meters are exposed to an ambient temperature of −40 °C ±3 °C for 16 hours. After the test is completed, the electricity meter must not exhibit any damage or changes in data and must function properly.

5.5.3 Cyclic damp heat test

The cyclic damp heat test must be performed on the electricity meter without current, but with voltage and auxiliary circuits connected to a reference voltage.

Indoor electricity meters are exposed to an ambient temperature of + 40 °C ± 2 °C and outdoor electricity meters are exposed an ambient temperature of + 55 °C ± 2 °C, both for 12 hours, and then for an additional 12 h at an ambient temperature of + 25 °C ± 3 °C (cycle 12 h + 12 h cycle). In both cases, relative humidity is 95 %. The test duration is six cycles.

After 24 hours have passed after completing the test, the electricity meter must be subjected to the following tests:

a) the test of electrical insulation strength pursuant to Article 5.6.2, with impulse voltage multiplied by a factor of 0.8;
b) a functional test; the electricity meter must not exhibit any damage or changes in data, and must operate properly.

The damp heat test also serves as a corrosion test. The result is assessed visually. There must be no visible signs of corrosion that could affect the functional characteristics of the electricity meter.

5.5.4 Sunlight resistance test

The sunlight resistance test is performed only on outdoor electricity meters in a non-operating state. The electricity meter is exposed to light for 8 hours and then kept in the dark for 16 hours (8 h + 16 h cycle). The upper ambient temperature is maintained at + 55 °C. The test lasts three cycles. The total irradiance in this procedure is 8.96 kWh/m^2 for a one-day cycle.

Table 9 – Spectral energy distribution

Spectral area	Ultraviolet B *	Ultraviolet A	Visible	Infrared	Total

					radiation
Bandwidth	300 nm to 320 nm	320 nm to 400 nm	400 nm to 800 nm	800 nm to 2450 nm	300 nm to 2450 nm
Irradiation	4.06 W/m^2	70.5 W/m^2	604.26 W/m^2	411.2 W/m^2	1,090 W/m^2
Approximate share of total radiation	0.4%	6.4 %	55.4 %	37.8 %	100 %
* Radiation with a shorter wavelength than 300 nm reaching the Earth's surface is insignificant.					

After the test, the external appearance and especially the legibility of markings must not be changed. The operation of the electricity meter must not be impaired.

5.6 Tests of the influence of electrical properties

5.6.1 Warming tests

The warming test is carried out at maximum current I_{max} for each current circuit and for each voltage circuit at $1.15U_N$ for 2 hours. The maximum temperature reached is corrected to the nominal maximum ambient temperature of the meter by adding the difference between the ambient temperature achieved during the test and the nominal maximum ambient temperature. No corrected temperature may exceed the nominal temperature of the material or component being measured.

After the test, the electricity meter must not exhibit any damage and must pass the electrical insulation tests pursuant to Article 5.6.2.

5.6.2 Electrical insulation tests

5.6.2.1 In general

The tests are performed on complete electricity meters, with the top cover of the terminal block in place and with terminal screws screwed into the core of a conductor with the maximum usable diameter.

During the voltage impulse tests and alternating voltage tests, circuits not under test must be grounded.

No penetration or flashover may occur during the test. After this test, the meter must not show, under reference conditions, a change in relative error greater than the repeatability of the measurement and no mechanical damage to the device may occur.

5.6.2.2 Impulse voltage test

Electrical insulation tests are performed using impulse voltage in individual circuits, between circuits and relative to ground.

The impulse source must be capable of generating a normalised voltage impulse of 1.2/50 µs with rise time ±30 % and fall time ±20 % with energy of 0.5 J ± 0.05 J, with an impedance of 500 Ω ± 50 Ω.

Table 10 – Nominal voltages and nominal impulse voltages

Three-phase four-wire networks	Single-phase two-wire networks	Nominal impulse voltage (V)	
		Basic and supplementary insulation	Reinforced insulation
57.7/100 63.5/110 66.5/115	---	1,500	2,500

69/120			
120/208 127/220	100 110, 120, 127	2,500	4,000
220/380 230/400 240/415 277/480	230 240	4,000	6,000
347/600 380/660 400/690	480	6,000	8,000

For each test, the impulse voltage is always applied ten times with one polarity and then ten times for the other polarity. The minimum time between impulses must be 3 seconds.

5.6.2.3 AC voltage test

The AC voltage test is performed using voltage at a frequency of 45 Hz to 65 Hz for one minute. The voltage is applied between

a) all voltage, current and auxiliary circuits connected together and the ground;
b) circuits that are not interconnected while the electricity meter is in use.

Table 11 – Test voltage for fixed insulation of network circuits

Conductor-to-ground voltage derived from nominal voltages (V)	Test voltage rms (V)	
	Basic insulation and additional insulation	Reinforced insulation
≤150	1,350	2,700
> 150 ≤ 300	1,500	3,000
> 300 ≤ 600	1,800	3,600

5.6.3 Short-circuit test

The short-circuit test is performed using the currents in Table 12, applied for the specified period.

Table 12 – Short-circuit currents

Electricity meter	Accuracy class	Short-circuit current	Application period	Permissible change in error
Electromechanical transformer-operated active electricity meter	0.5	20 I_{max}	0.5 s	±0.3%
Static direct-connected active electricity meter	1 and 2	30 I_{max}	½ cycle	±1.5 %
Static direct-connected active electricity meter	0.5	30 I_{max}	½ cycle	±1.0 %
Static transformer-operated active electricity meter	2	20 I_{max}	0.5 s	±1.0 %
Static transformer-operated active electricity meter	1	20 I_{max}	0.5 s	±0.5 %

Static transformer-operated active electricity meter	0.5 S	20 I_{max}	0.5 s	±0.2 %
Static transformer-operated active electricity meter	0.2 S	20 I_{max}	0.5 s	±0.1 %
Static transformer-operated active electricity meter	0.1 S	20 I_{max}	0.5 s	±0.05 %
Static direct-connected reactive electricity meter	1, 2 and 3	30 I_{max}	½ cycle	±1.5 %
Static transformer-operated reactive electricity meter	3	20 I_{max}	0.5 s	±1.5 %
Static transformer-operated reactive electricity meter	2	20 I_{max}	0.5 s	±1.0 %
Static transformer-operated reactive electricity meter	1 and 1 S	20 I_{max}	0.5 s	±0.5 %
Static transformer-operated reactive electricity meter	0.5 S	20 I_{max}	0.5 s	±0.2 %

After short-term application of short-circuit overcurrents and thermal stabilisation, the error at nominal current and unity power factor is measured. The change in error from the pre-test value must be less than the permissible change of error values given in Table 12.

In addition, direct-connected meters are tested with simulated short-circuit currents according to Table 13.

Table 13 – short circuit currents of direct-connected electricity meters

	Category of use			
	UC1	UC2	UC3	UC4
Nominal operating current, equal to maximum meter current	≤ 63 A	≤ 100 A	≤ 125 A	≤ 200 A
Nominal safe short-circuit current	3,000 A	4,500 A	6,000 A	10,000 A

The meter may be damaged, but no dangerous live parts may be exposed, no fire may occur, or if it does occur, it must be confined to the meter.

5.7 Electromagnetic compatibility tests

5.7.1 Tests of immunity to voltage dips and short interruptions

The tests of immunity to voltage dips and short interruptions must be performed on the electricity meter with voltage and auxiliary circuits connected to reference voltage and without any current in the current circuits.

The test shall be conducted:

a) three times by a voltage interruption $\Delta U = 100\ \%\ U_n$ for one second with a recovery time of 50 ms between the interruptions;
b) once by a voltage interruption $\Delta U = 100\ \%\ U_n$ for one cycle at the reference frequency;
c) by one short-term voltage dip $\Delta U = 50\ \%\ U_n$ for one minute.

The application of voltage dips and short interruptions must not cause a change in the counter greater than x units and test output must not transmit a signal corresponding to more than x units for each (for the definition of x see Chapter 3.9).

5.7.2 Electrostatic discharge immunity tests

Electrostatic discharge immunity tests must be carried out with a reference voltage connected to the electricity meter's voltage and auxiliary circuits, with no current in current circuits. The meter is tested as a table-top instrument.

Ten contact discharges of 8 kV are applied to the metal part of the housing or ten air discharges of 15 kV are applied to a part of the housing made of insulating material (for protective class II electricity meters).

The application of all electrostatic discharges must not cause a change in the counter greater than *x* units and test output must not transmit a signal corresponding to more than *x* units (for the definition of *x* see Chapter 3.9).

Temporary impairment or loss of function or performance is permitted during the test.

5.7.3 Tests of immunity to radiated, radio-frequency electromagnetic fields

This test is not performed on electromechanical electricity meters.

The test must be performed for interference in the frequency range of 80 MHz to 2000 MHz with 80 % amplitude modulation of a 1 kHz sine wave. The meter is tested as a table-top instrument.

5.7.3.1 Current test

A reference voltage is connected to voltage and auxiliary circuits, the current circuits are connected to a reference (or nominal, base) current, cos φ (or sin φ) = 1. The strength of the non-modulated test field is 10 V/m. During the test, the operation of the electricity meter must not be subject to any disturbance. The additional error must not exceed the values shown in Table 14.

Table 14 – Critical change values for tests of immunity to radio-frequency electromagnetic fields

Electricity meter	Accuracy class	Critical change value
Active static	2	±3.0 %
Active static	1	±2.0 %
Active static	0.5 S	±2.0 %
Active static	0.2 S	±1.0 %
Active static	0.1 S	±0.5 %
Reactive static	2 and 3	±3.0 %
Reactive static	1 and 1 S	±2.0 %
Reactive static	0.5 S	±2.0 %

continued

Table 14 – completion

5.7.3.2 No-current test

Voltage and auxiliary circuits are connected to a reference voltage, current circuits are without current (open circuit). The intensity of the non-modulated test field is 30 V/m.

The application of the radio-frequency field must not result in a change in the counter greater than *x* units and test output must not transmit a signal corresponding to more than *x* units (for the definition of *x* see Chapter 3.9).

Temporary impairment or loss of function or performance is permitted during the test.

5.7.4 Tests of immunity to electrical fast transient/burst disturbances

The tests of immunity to electrical fast transient/burst disturbances must be performed on the electricity meter with voltage and auxiliary circuits connected to reference voltage. Current circuits are connected to reference current, cos φ (or sin φ) = 1. The meter is tested as a table-top instrument.

The length of the cable between the switchgear and the electrical meter is 1 metre. The repetition frequency is 5 kHz and the duration of the test is 60 seconds for each polarity.

A test voltage of 4 kV must be applied to voltage circuits and current circuits; if separated from voltage circuits in normal operation. A test voltage of 2 kV must be applied to auxiliary circuits with a reference voltage greater than 40 V.

Temporary impairment or loss of function or performance is permitted during the test. The additional error must not exceed the values shown in Table 15.

Table 15 – Critical change values for tests of immunity to electrical fast transient/burst disturbances

Electricity meter	**Accuracy class**	**Critical change value**
Active static	2	±6.0 %
Active static	1	±4.0 %
Active static	0.5 S	±2.0 %
Active static	0.2 S	±1.0 %
Active static	0.1 S	±0.5 %
Reactive static	2 and 3	±6.0 %
Reactive static	1 and 1 S	±4.0 %
Reactive static	0.5 S	±2.0 %

5.7.5 Tests of immunity to conducted disturbances induced by radio-frequency fields

The tests of immunity to conducted disturbances induced by radio-frequency fields must be performed on the electricity meter with voltage and auxiliary circuits connected to reference voltage. Current circuits are connected to reference current, cos φ (or sin φ) = 1. The meter is tested as a table-top instrument. The frequency range of the disturbances is 150 kHz to 80 MHz and the disturbance voltage is 10 V.

During the test, the function of the electricity meter must not be impaired and the additional relative error must not exceed the critical change values in Table 16.

Table 16 – Critical change values for tests of immunity to conducted disturbances induced by radio-frequency fields

Electricity meter	**Accuracy class**	**Critical change value**
Active static	2	±3.0 %
Active static	1	±2.0 %
Active static	0.5 S	±2.0 %
Active static	0.2 S	±1.0 %
Active static	0.1 S	±0.5 %
Reactive static	2 and 3	±3.0 %
Reactive static	1 and 1 S	±2.0 %
Reactive static	0.5 S	±2.0 %

5.7.6 Surge immunity tests

Surge immunity tests must be performed on the electricity meter with voltage and auxiliary circuits connected to reference voltage and without any current in the current circuits.

The length of the cable between the surge generator and the electricity meter is 1 metre and is tested in differential mode (phase-phase).

Surges with a phase shift of 60° and 240° relative to the AC zero crossing point are applied. A test voltage of 4 kV is used when testing current and voltage circuits, 1 kV for the test of auxiliary circuits with a reference voltage greater than 40 V.

Five positive and five negative impulses are applied at a repetition rate of at most 1/min.

The application of a voltage surge must not cause a change in the counter greater than x units and test output must not transmit a signal corresponding to more than x units (for the definition of x see Chapter 3.9).

Temporary impairment or loss of function or performance is permitted during the test.

5.7.7 Tests of immunity to damped oscillatory waves

The tests of immunity to damped oscillatory waves are performed only for transformer-operated electricity meters intended for use in electrical power plants and high-voltage substations.

The tests must be carried out on a meter with associated reference voltage on voltage and auxiliary circuits with a reference voltage > 40 V. φ (or sin φ) = 1. The meter is tested as a table-top instrument.

Damped oscillatory waves with a frequency of 100 kHz (repetition rate of 40 Hz) and 1 MHz (repetition rate of 400 Hz) are applied to voltage and auxiliary circuits with a common-mode voltage of 2.5 kV and a differential voltage of 1.0 kV.

The test duration is 60 seconds (15 cycles with 2 s on, 2 s off, for each frequency).

During the test, the function of the electricity meter must not be impaired and the additional relative error must not exceed the critical change values in Table 17.

Table 17 – Critical change value during test of immunity to damped oscillatory waves

Electricity meter	Accuracy class	Critical change value
Active static	2	±3.0 %
Active static	1	±2.0 %
Active static	0.5 S	±2.0 %
Active static	0.2 S	±1.0 %
Active static	0.1 S	±0.5 %
Reactive static	3	±4.0 %
Reactive static	2	±3.0 %
Reactive static	0.5 S and 1 S	±2.0 %

continued

Table 17 – continued

5.7.8 Tests of immunity to alternating magnetic fields of external origin

The tests of immunity to alternating magnetic fields of external origin must be performed on the electricity meter connected to a reference voltage and reference current, cos φ (or sin φ) = 1. The meter is tested as a table-top instrument.

An alternating magnetic field of 0.5 mT at the reference frequency is applied to the electricity meter in three perpendicular planes.

During the test, the function of the electricity meter must not be impaired and the additional relative error must not exceed the critical change values in Table 18.

Table 18 – Critical change value during the test of immunity to alternating magnetic fields of external origin

Electricity meter	Accuracy class	Critical change value
Active static	2 or A	±3.0 %
Active static	1 or B	±2.0 %
Active static	0.5 S or C	±1.0 %
Active static	0.2 S	±0.5 %
Active static	0.1 S	±0.25 %
Reactive static	3	±4.0 %
Reactive static	2	±3.0 %
Reactive static	1 and 1 S	±2.0 %
Reactive static	0.5 S	±2.0 %

5.7.9 Immunity to DC magnetic fields of external origin

The tests of immunity to DC magnetic fields of external origin must be performed on the electricity meter connected to a reference voltage and reference current, cos φ (or sin φ) = 1. A direct-current magnetic field with a magnetomotive force of F_m = 1,000 A·t (ampere-turns) is applied successively to all accessible surfaces of the meter.

During the test, the function of the electricity meter must not be impaired and the additional relative error must not exceed the critical change values in Table 19.

Table 19 – Critical change value during the test of immunity to DC magnetic fields of external origin

Electricity meter	Accuracy class	Critical change value
Active static	2 or A	±3 %
Active static	1 or B	±2 %
Active static	0.5 S, 0,2 S and 0,1 S	±2 %
Active static	C	±1 %
Reactive static	2 and 3	±3 %
Reactive static	1; 1 S and 0.5 S	±2 %

5.7.10 Suppression of radio-frequency interference

Radio-frequency interference suppression tests must be carried out on a meter with associated reference voltage at voltage and auxiliary terminals and with a current between $0.1I_{ref}$ and $0.2I_{ref}$ (or nominal or base current) at cos φ (or sin φ) = 1. It is tested as Class B desktop equipment. For the connection of voltage circuits, an unshielded cable of 1 m length must be used for each terminal.

The emissions of radio-frequency interference conducted in the 0.15 MHz to 30 MHz frequency range and radiated in the 30 MHz to 1 GHz frequency range is measured.

The test results must not exceed the limits for electromagnetic interference given in the following tables.

Table 20 – Requirements for conducted emissions from AC power supply inputs/outputs (ports) – Class B devices

Frequency range (MHz)	**dB limits (µµ)**	
	Detector type/Bandwidth	
	Quasi-peak/9 kHz	**Mean values/9 kHz**
0.15 to 0.5	66 to 56	56 to 46
0.5 to 5	56	46
5 to 30	60	50
NOTE 1 Lower limits apply to band edge frequencies. NOTE 2 In the 0.15 MHz to 0.50 MHz band the limit decreases in a linear manner with the logarithm of frequency.		

Table 21 – Requirements for radiated emissions up to 1 GHz for Class B equipment

Frequency range (MHz)	**Quasi-peak limits** dB (µV/m) Detector type: quasi-peak/120 kHz
30 to 230	30
230 to 1000	37

Table 22 – Requirements for radiated emissions at frequencies above 1 GHz for Class B equipment

Frequency range (MHz)	**Quasi-peak limits** dB (µV/m)	
	Detector type/Bandwidth	
	Peak/1 MHz	Mean values/1 MHz
1000 to 3000	70	50
3000 to 6000	74	54

5.7.11 Test of immunity to conducted interference in the 2 kHz to 150 kHz band

The test of immunity to this interference must be carried out on the meter with the associated reference voltage and with reference current I_{ref} and frequency 50 Hz. The interference current (2–150) kHz of a magnitude according to Table 23 must be supplied from a separate source. The additional error of the electricity meter caused by the interference is measured. This error must be less than the maximum permissible additional errors listed in Table 23.

Table 23 – Maximum permissible additional errors for direct and transformer-connected electricity meters

Maximum permissible additional errors for direct-connected electricity meters

Frequency range (kHz)	Interference current value	Current 50 Hz	cos φ 50 Hz	Class A	Class B	Class C
2 to 30	2 A	I_{ref}	> 0.9	±6 %	±4 %	±2 %
30 to 150	1 A	I_{ref}	> 0.9	±6 %	±4 %	±2 %
2 to 30	2 %·I_{max}	I_{ref}	> 0.9	±6 %	±4 %	±2 %
30 to 150	1%·I_{max}	I_{ref}	> 0.9	±6 %	±4 %	±2 %

5.8 Functional tests

5.8.1 No-load test

The no-load test is performed in accordance with Article 7.4.

5.8.2 Inrush test

The inrush test is performed in accordance with Article 7.5.

5.8.3 Accuracy test

The accuracy test is performed in accordance with Article 7.6.

5.8.4 Ambient temperature influence test

The additional error due to temperature change (within the rated operating range of the electricity meter) relative to the error under reference conditions must not exceed the limits for the given accuracy class. These limits are given in Table 24 in the form of thermal coefficient limits in %/K.

Table 24 – Maximum permissible errors of the temperature coefficient in %/K in the test for the influence of ambient temperature on the meter

Grid connection	Load		Active electricity meters – Static				
	Current	Power factor	Accuracy class				
			2	1	0.5 S	0.2 S	0.1 S
direct	I_{min} to I_{max} 0.2 I_n to I_{max}	1 0.5 ind.	±0.10 ±0.15	±0.05 ±0.07	±0.03 ±0.05	– –	– –
transformer-operated	I_{min} to I_{max} 0.1 I_n to I_{max}	1 0.5 ind.	±0.10 ±0.15	±0.05 ±0.07	±0.03 ±0.05	±0.01 ±0.02	±0.005 ±0.01

continued

Table 24 – continued

Grid connection	Load		Active electricity meters – Electromechanical		
	Current	Power factor	Accuracy class		
			2	1	0.5
direct	0.1 I_b to I_{max} 0.2 I_b to I_{max}	1 0.5 ind.	±0.10 ±0.15	±0.05 ±0.07	±0.03 ±0.05
transformer-operated	0.05 I_n to I_{max}	1	±1.5	±1.0	±0.8

	0.1 I_n to I_{max}	0.5 ind.	±1.0	±0.7	±0.5

Grid connection	Load		Reactive energy meters (static)			
	Current	Power factor	Accuracy class			
			3	2	1 and 1 S	0.5 S
direct	I_{min} to I_{max}	1	±0.15	±0.10	±0.05	–
	0.2 I_n to I_{max}	0.5 ind.	±0.25	±0.15	±0.07	–
transformer-operated	I_{min} to I_{max}	1	±0.15	±0.10	±0.05	±0.03
	0.1 I_n to I_{max}	0.5 ind.	±0.25	0.15	±0.07	±0.05

5.8.5 Voltage change test

The additional error due to voltage change ± 10 % U_n due to an error in the reference conditions must not exceed the maximum permissible values given in Table 25 for a given accuracy class.

Table 25 – Maximum allowable additional errors in % in the voltage change test ± 10 % U_n

Grid connection	Load		Active electricity meters – static				
	Current	Power factor	Accuracy class				
			2	1	0.5 S	0.2 S	0.1 S
direct	I_{min} to I_{max}	1	±1.0	±0.5	±0.25	–	–
	0.10 I_n to I_{max}	0.5 ind.	±1.5	±1.0	±0.5	–	–
transformer-operated	I_{min} to I_{max}	1	±1.0	±0.5	±0.25	±0.1	±0.05
	0.05 I_n to I_{max}	0.5 ind.	±1.5	±1.0	±0.5	±0.2	±0.1

Grid connection	Load		Active electricity meters – electromechanical		
	Current	Power factor	Accuracy class		
			2	1	0.5
direct	0.1 I_b	1	±1.5	±1.0	±0.8
	0.5 I_{max}	1	±1.0	±0.7	±0.5
	0.5 I_{max}	0.5 ind.	±1.5	±1.0	±0.7
transformer-operated	0.1 I_n	1	±1.5	±1.0	±0.8
	0.5 I_{max}	1	±1.0	±0.7	±0.5
	0.5 I_{max}	0.5 ind.	±1.5	±1.0	±0.7

continued

Table 25 – continued

Grid connection	Load		Reactive energy meters (static)			
	Current	Power factor	Accuracy class			
			3	2	1 and 1 S	0.5 S
direct	I_{min} to I_{max}	1	±2.0	±1.0	±0.5	–
	0.1 I_n to I_{max}	0.5 ind.	±3.0	±1.5	±1.0	–
transformer-	I_{min} to I_{max}	1	±2.0	±1.0	±0.5	±0.25

operated	0.05 I_n to I_{max}	0.5 ind.	±3.0	±1.5	±1.0	±0.5

5.8.6 Frequency change test

The additional error due to change of frequency ± 2 %·f_n due to an error in the reference conditions shall not exceed the maximum permissible error for the given accuracy class in Table 26.

Table 26 – Maximum allowable additional errors in % in the frequency change test ± 2 %·fn

Grid connection	Load		Active electricity meters – static				
	Current	Power factor	Accuracy class				
			2	1	0.5 S	0.2 S	0.1 S
direct	I_{min} to I_{max} 0.10 I_n to I_{max}	1 0.5 ind.	±0.8 ±1.0	±0.5 ±0.7	±0.2 ±0.2	– –	– –
transformer-operated	I_{min} to I_{max} 0.05 I_n to I_{max}	1 0.5 ind.	±0.8 ±1.0	±0.5 ±0.7	±0.2 ±0.2	±0.1 ±0.1	±0.05 ±0.05

Grid connection	Load		Active electricity meters – electromechanical		
	Current	Power factor	Accuracy class		
			2	1	0.5
direct	0.1 I_b 0.5 I_{max} 0.5 I_{max}	1 1 0.5 ind.	±1.5 ±1.3 ±1.5	±1.0 ±0.8 ±1.0	±0.7 ±0.6 ±0.8
transformer-operated	0.1 I_n 0.5 I_{max} 0.5 I_{max}	1 1 0.5 ind.	±1.5 ±1.3 ±1.5	±1.0 ±0.8 ±1.0	±0.7 ±0.6 ±0.8

Grid connection	Load		Reactive energy meters (static)			
	Current	Power factor	Accuracy class			
			3	2	1 and 1 S	0.5 S
direct	I_{min} to I_{max} 0.10 I_n to I_{max}	1 0.5 ind.	±3.0 ±3.0	±2.0 ±2.0	±1.0 ±1.0	±0.5 ±0.5
transformer-operated	I_{min} to I_{max} 0.05 I_n to I_{max}	1 0.5 ind.	±3.0 ±3.0	±2.0 ±2.0	±1.0 ±1.0	±0.5 ±0.5

5.8.7 Counter test

The counter test is performed in accordance with Article 7.7.

5.9 Software test

Software testing is carried out on the basis of the documentation submitted and functional checks.

5.9.1 Documentation

It shall be assessed whether the documentation contains the following information, including that referred to in subsequent paragraphs:

- a description of the software in terms of its function and instrument function;
- a description of the accuracy of the computational algorithms;
- a description of the user interface, menus and dialogs;
- unambiguous identification of the software;
- description of hardware components (e.g. block diagram, description of PCBs if not included in the software manual);
- operating and user manual for electricity meter software.

5.9.2 Identification

a) Documentation check:

An assessment is conducted whether the identification creation algorithm is described in the documentation and includes a dynamic part that is generated in operation.

b) Functional check - to ensure that:

– the identification corresponds to the manufacturer's data.

– the identification can be displayed while the device is in operation. If the device has multiple modes in which identification can be displayed, all are tested.

5.9.3 Functionality

a) Documentation check:

The documentation is assessed to determine whether it includes a basic description of the instrument's function and, where applicable, a description of the computational algorithms and data flow.

b) Functional check:

The instrument is checked to ensure it is functioning in accordance with the documentation. A test is performed using the black box method and comparing inputs and outputs with simulated or independently read inputs and outputs. This test may be replaced by further type-approval testing.

5.9.4 Influence through the user and communication interface

a) Documentation check – a check is performed to determine whether the documentation contains:

- a description of the implementation of the user and communication interface;
- a description of the physical construction (where applicable, physical interface security);
- a complete list of all commands of the user and communication interface with sufficient description and assignment to functions or data operations;
- a declaration that the list of all commands is complete.

b) Functional check - the following is tested:

– randomly selected user interface commands (e.g. display menu items). The manufacturer must supply all necessary accessories to make it possible to test the selected communication instructions in laboratory conditions.

– reaction to requirements outside the manufacturer's specification – other commands, other value ranges, interruption of communication, replacement of apparatus during communication.

5.9.5 Protection against changes

a) Documentation check:

The documentation is assessed to determine if it includes a description of the protection against both accidental and intentional changes and the suitability of the design of such protection is assessed.

b) Functional check - the following is tested:
   – the response of the device to power outages and outages of means of communication (if used);
   – whether all user interface dialogues modifying the data in the device, if any, are implemented in such a way that the user is required to confirm the choice.

5.9.6 Protection of transmitted data *(if required)*

a) Documentation check – a check is performed to determine whether the documentation contains:
   - the list of items to be transmitted;
   - information needed to reconstruct the transmitted data;
   - a description of the protection against accidental and deliberate changes during transmission;
   - a description of the communication interfaces and communication protocols;
   - proof of authenticity of transmitted data;
   - a description of the detection of erroneous data generated during the transmission;
   - a description of the protection in the event of delay or transmission through communication interfaces.

b) Functional check - the following is tested:
   – data transmission in view of its potential outages – reaction to communication interruptions and response to damaged data.
   – whether data blocks contain all the data necessary for their identification. If a custom protocol is created for communication, its implementation is tested. If a standard protocol is used (a routine protocol using standard libraries), its correct use is checked with respect to the data flow in software.

5.9.7 Protection of stored data *(if required)*

a) Documentation check – a check is performed to determine whether the documentation contains:
   - a list of items to be stored;
   - a description of the protection against accidental and deliberate changes to stored data;
   - proof of the authenticity of the stored data;
   - a description of the display of the stored data;
   - a description of the operation for writing stored data;
   - description of the capacity and management for data storage.

b) Functional check - the following is tested:
   – system response to power failure with respect to storage of relevant data;
   – whether the memory is physically protected against substitution or reset by the user;
   – display of stored data.

5.9.8 Software separation *(if required)*

a) Documentation check – the documentation is assessed to see whether it contains:
   - a list of items that are part of the LRSW;
   - a description of how the indication of legally relevant information is protected from confusion with information generated by LNRSW;
   - a description of the protective interface and its implementation.

b) Functional check:

   A test is performed whether the display of data generated from LRSW is sufficiently distinguishable from the data on the display generated from LNRSW.

6 Initial verification

In the case of measuring instruments placed on the market in accordance with special legislation,[1] the provisions of the Metrology Act on initial verification shall not apply.

The provisions of this Chapter shall apply to electricity meters that are subject to type approval under the Metrology Act.

At the time of initial verification, a procedure identical to the subsequent verification referred to in Chapter 7 shall be applied.

7 Subsequent verification

During verification, measuring instruments are subject to the requirements that were applicable when they were placed on the market or into circulation.

Subsequent verification of electricity meters must comprise the following tests:

a) an external inspection;
b) a functional test;
c) a no-load test;
a) an inrush test;
e) an accuracy test;
f) a counter test.

7.1 External inspection

Checks shall be performed to ensure that:

- the electricity meter conforms to the approved type or to the design of a measuring instrument for which conformity has been declared when placed on the market;
- the accuracy and legibility of markings complies with Article 4.1;
- the meter is not mechanically damaged.

Electricity meters that fail to meet the requirements of the external inspection shall not be tested further.

7.2 Functionality test

Checks shall be performed to ensure that:

– for a meter with an electronic display, all characters are visible on the display when connected to the grid;
– the data in meter registers read via optical or other interfaces, as appropriate, match those displayed on the meter display;
– the serial number of the meter in the relevant register corresponds to the serial number shown on the meter’s label;
– the software version and integrity conform to the data contained in the type approval certificate;
– any additional features of the meter are functional.

Electricity meters that fail the functionality test shall not be tested further.

7.3 Test conditions

7.3.1 Test equipment requirements

Measuring stations for testing electricity meters must be equipped with a reference electricity meter with a valid calibration sheet. The measuring station must be validated by a functional test of the station as a whole.

The test equipment must allow electricity meter errors to be determined with an uncertainty less than or equal to 1/4 of the error limits in Tables 30 to 37. A ratio of 1/3 of these error limits is sufficient for the testing of Class 0,1 S and 0.2 S electricity meters.

The equipment must also allow for clear verification of compliance with the requirements under 2.2, 2.3 and 2.4.

7.3.2 Reference conditions for tests

The tests must be performed under reference conditions with the electricity meter cover in place and the meter connected to test equipment according to the schematic diagram provided by the manufacturer.

The reference conditions specified in Tables 27 to 29 apply to the verification of electricity meters.

In addition to the conditions specified above, there must be no disruptive mechanical vibrations in the laboratory.

Table 27 – Reference conditions for electromechanical active electricity meters

Influencing quantity	**Reference value**	**Permissible tolerances for electricity meters of accuracy class**			**Permissible tolerances for electricity meters of class**	
		0.5	**1**	**2**	**A**	**B**
Ambient temperature	Reference temperature or, if not specified, 23 °C	±1 °C	±2 °C	±2 °C	±2 °C	±2 °C
Voltage	Reference voltage	±0.5 %	±1.0 %	±1.0 %	±1.0 %	±1.0 %
Frequency	Reference frequency	±0.2 %	±0.3%	±0.5 %	±0.5 %	±0.3 %
Phase sequence	L1 – L2 – L3	–	–	–	–	–
Voltage asymmetry	All phases connected	–	–	–	–	–
Waveform	Sine voltage and currents	Distortion factor less than:				
		2 %	2 %	3 %	3 %	2 %
DC magnetic field of external origin	Equal to zero	–	–	–	–	–
AC magnetic field of external origin at grid frequency	Equal to zero	Induction value causing a change in error not greater than:				
		±0.1 %	±0.2 %	±0.3%	±0.3 %	±0.2 %
Operation of ancillary devices	Ancillary device not in operation	–	–	–	–	–
Operating position	Vertical operating position [c]	±0.5 º	±0.5 º	±0.5 º	±0.5 °	±0.5 °
Conducted disturbances induced by radio-frequency electromagnetic fields, 150 kHz to 80 MHz	Equal to zero	< 1 V	< 1 V	< 1 V	< 1 V	< 1 V

Table 28 – Reference conditions for static active electricity meters

Influencing quantity	Reference value	Permissible tolerances for electricity meters of accuracy class				Permissible tolerances for electricity meters of class		
		0.1 S and 0.2 S	**0.5 S**	**1**	**2**	**A**	**B**	**C**
Ambient temperature	Reference temperature or, if not specified, 23 °C	±2 °C	±2 °C	±2 °C	±2 °C	±2 °C	±2 °C	±2 °C
Voltage	Reference voltage	±1.0 %	±1.0 %	±1.0 %	±1.0 %	±1.0 %	±1.0 %	±1.0 %
Frequency	Reference frequency	±0.3%	±0.3%	±0.3%	±0.5 %	±0.5 %	±0.3 %	±0.3 %
Phase sequence	L1 – L2 – L3	–	–	–	–	–	–	–
Voltage asymmetry	All phases connected	–	–	–	–	–	–	–
Waveform	Sine voltages and currents	Distortion factor less than:						
		2 %	2 %	2 %	3 %	3 %	2 %	2 %
DC magnetic field of external origin	Equal to zero	–	–	–	–	–	–	–
AC magnetic field of external origin at grid frequency	Equal to zero	Induction value causing a change in error not greater than:						
		±0.1 % or <0.05 mT	±0.1 % or <0.05 mT	±0.2 %	±3 %	±0.3 %	±0.2 %	±0.1 %
Electromagnetic radio-frequency fields, 30 kHz to 2 GHz	Equal to zero	<1 V/m	<1 V/m	<1 V/m	<1 V/m	<1 V/m	<1 V/m	<1 V/m
Operation of ancillary devices	Ancillary device not in operation	–	–	–	–	–	–	–
Conducted disturbances induced by radio-frequency electromagnetic fields, 150 kHz to 80 MHz	Equal to zero	<1 V	<1 V	<1 V	<1 V	<1 V	<1 V	<1 V

Table 29 – Reference conditions for static reactive electricity meters

Influencing quantity	Reference value	Permissible tolerances for electricity meters of accuracy class			
		0.5 S	**1 and 1 S**	**2**	**3**
Ambient temperature	Reference temperature or, if not indicated, 23 °C	±2 °C	±2 °C	±2 °C	±2 °C
Voltage	Reference voltage	±1.0 %	±1.0 %	±1.0 %	±1.0 %
Frequency	Reference frequency	±0.3%	±0.3%	±0.5 %	±0.5 %
Phase sequence	L1 – L2 – L3	–	–	–	–
Voltage asymmetry	All phases connected	–	–	–	–
Waveform	Sine voltages and currents	Non-linear distortion factor less than			
		2 %	2 %	2 %	3 %
DC magnetic induction of external origin	Equal to zero	–	–	–	–
AC magnetic induction of external origin at reference frequency	Equal to zero	Induction value causing a change in error not greater than:			
		±0.3%	±0.3%	±0.3%	±0.3%
Electromagnetic radio-frequency fields, 30 kHz to 2 GHz	Equal to zero	<1 V/m	<1 V/m	<1 V/m	<1 V/m
Operation of ancillary devices	Ancillary device not in operation	–	–	–	–
Faults induced by radio-frequency electromagnetic fields, 150 kHz to 80 MHz and conducted	Equal to zero	<1 V	<1 V	<1 V	<1 V

7.3.3 Preparation of electricity meters for testing

Prior to the metrological tests, electricity meters must be allowed to thermally stabilise for at least 6 hours in a room with a temperature of (23 ± 5) °C.

In order to reach operating temperature, prior to performing the individual verification tests, the voltage circuits of the electricity meter must first be connected to reference voltage for at least:

30 minutes, in the case electromechanical electricity meters;

5 minutes, in the case of static electricity meters.

7.4 No-load test

A voltage of 115 % of reference voltage is connected to the voltage circuits of the electricity meter, the current circuits of the meter are not energised. The minimum test time in minutes is calculated using the equation:

$$t = \frac{240 \cdot 10^3}{k \cdot m \cdot U_{test} \cdot I_{st}} \quad (3)$$

where ....k is the meter constant (imp/kWh or imp/kVARh) for static meters or meter constant X (r/kWh or r/kVARh) for electromechanical electricity meters;

m........... is the number of measuring elements,

U_{test} .... is the test voltage in volts;

I_{st} .... is the inrush current according to Tables 6, 7a, 7b or 8 in amperes.

The test period for static electricity meters must be at least 15 minutes, even if the calculated time t is shorter.

The meter passes the test if the test LED or pulse output for remote measurement has sent no impulse or at most one impulse.

7.5 Inrush test

During the inrush test, the meter must start measuring energy after connection of reference voltage $U_n \cos \varphi$ (or $\sin \varphi$) = 1 and conduction of current according to the corresponding Tables 6, 7a, 7b or 8 to the current circuits. The revolution of the rotor or the pulses sent to the test output are observed.

Different types of electricity meters are tested under additional conditions:

- electromechanical meters with a mechanical counter: no more than two discs may be engaged;
- electromechanical electricity meters with a mechanical maximum meter: the maximum indicator may not be engaged;
- electricity meter with multiple reference voltages: for electricity meters with multiple reference voltages or with the full range of reference voltages, the inrush test is performed at the maximum and minimum voltages specified on the label;
- electricity meters with two base currents: the inrush test is performed at a starting current calculated from the smaller base current.

Electromechanical electricity meters pass the test if the rotor has started rotating and made at least one revolution. The test is performed until the described conditions are met, but for no longer than the period it would theoretically take the rotor of the tested electricity meter to make three revolutions (provided that it measures without errors at the starting current).

The static meter passes if the test LED or the impulse output for remote measurement has transmitted at least 2 impulses. The test shall be carried out until the described conditions are met, but no longer than for the period of time during which the test diode of the meter under test or the outlet of the remote measurement impulses would transmit 4 impulses during inrush current.

The test time in minutes is calculated using the equation:

$$\Delta t = 3 \cdot \frac{6 \cdot 10^4}{k \cdot m \cdot U_n \cdot I_{st}} \qquad (4)$$

7.6 Accuracy test

7.6.1 In general

During the accuracy test, the electricity meter’s errors at the currents given in Tables 30 to 37 are established. The accuracy test must be carried out either:

a) the method of recording the number of disc revolutions or pulses of the tested electricity meter, or
b) the method of reading the data from the counter of the tested electricity meter.

Prior to measuring the error at the given current settings, it is necessary to wait for at least 5 seconds.

7.6.2 Measurement uncertainties

The measurement error of electricity meters must be established with uncertainties smaller than 1/4 of the permissible error limits given in Tables 30 to 37. Static meters of accuracy classes 0.1 S and 0.2 S are excepted; their measurement uncertainties must be less than 1/3 of the permissible error limits given in Table 32.

7.6.3 Special test requirements

For electricity meters with a mechanical counter, only the lowest-order disc may be engaged during tests performed using the method of recording wheel revolutions or impulses of the tested electricity meter. For the counter reading method, at most the last two discs may be engaged.

Electricity meters with and without ancillary devices are subject to the same test conditions and the same error limits. One exception are electricity meters with a mechanical ancillary device for measuring maximum values, where the driver may not drive the maximum indicator directly.

For specially designed electricity meters, the accuracy tests are performed under the following conditions:

a) electricity meters with several reference voltages:
for meters with multiple reference voltages or with the full range of reference voltages, the test is carried out at the maximum and minimum voltage indicated on the label;

b) electricity meters with two base currents:
the test shall be carried out at the lowest test point at the lower base current. At all other test points, it shall be performed at the higher base current;

c) electricity meters with data interface:
instead of visually reading data, the contents of the relevant registers may be read by instruments for test purposes. However, the values read by the instrument and those indicated on the display must be identical (at least to the extent of the digits visible on the display). This comparison must be made at least once during the accuracy test;

d) data transmission electricity meters:
in the case of electricity meters equipped with terminals with impulse output for remote energy measurement, an additional test of this output must be carried out in addition to all the above tests. The test station used must be equipped with an electronic device capable of receiving the type of impulses that are transmitted by the electricity meter. The remote measurement impulse outlet test shall be carried out at the reference voltage, base current and power factor at which the power value will be maximum;

e) electricity meters with a maximum demand metering:
the test is carried out only at a station equipped for this measurement. The test is carried out at reference voltage, any current from base to maximum and power factor = 1. A measuring period according to the meter setting is used (e.g.: 5 or 15 minutes). Prior to the start of the test, the register of the mean power shall be summed. The test equipment shall use the communication interface to read the registers before and after the test. The error of the measured mean power value in the measurement period must be less than the permissible errors in Tables 1 to 6. The test must be performed for active and reactive energy, both for demand and supply;

f) multi-tariff electricity meter:
all tests according to Chapter 7 shall be performed at the default rate setting and:
   - in addition, for electromechanical meters, the counter is tested at the second or, if applicable, each additional tariff set, and the accuracy test pursuant to 7.6 is performed only at the lowest defined current in the precision measurement table;
   - in addition, for static meters with mechanical counters, the counter is tested at the second and each additional tariff set;
   - for static meters with an electronic display, the counter is also tested for at least one of the other tariffs;

g) instrument transformer-connected electricity meter showing energy on the primary side:
tested for a transformer with a suitably selected conversion ratio (the ratio may be chosen to achieve maximum resolution in the code list test; the ratio must then be changed to the value of the transformer to be used at the measuring point);

h) electricity meter for energy consumption and supply:
all tests pursuant to Chapter 7 for the ‘consumption’ energy flow direction are carried out. For the ‘supply’ energy flow direction, only an inrush test is performed (for static meters the inrush test for the ‘supply’ direction is omitted), a single rate counter test and an accuracy test, which is reduced to only the test at base current and power factor cos(sin) $\varphi = 1$;

i) a meter for simultaneous measurement of active and reactive energy:
is tested as if it were two separate meters. One for active energy and the other for reactive energy;

j) reactive electricity meter with separate capacitance and inductive load counters:
all tests pursuant to Chapter 7 are carried out and the counter test is carried out at $\sin\varphi = 0.99k$, $\sin\varphi = 0.99i$, $\sin\varphi = -0.99k$, $sin\ \varphi = -0.99i$;

k) an electricity meter with reverse operation braking
is tested at nominal current and reverse energy flow direction. The meter passes if, for electromechanical meters, the meter wheel does not turn and, in the case of static meters, the metrological diode sent no impulse;

l) verification of the total energy calculation algorithm:
the test equipment must make it possible to evaluate the measurement according to the selected calculation of registered energy by the meter. During the test, it is ascertained whether the meter correctly registers the aggregated energy according to the calculation method. The meter is supplied with rated voltage and current in the range of nominal (or base) to maximum, with one of the phases connected in the direction of electricity supply and the other two phases in the direction of electricity consumption:
- vector sum (Ferraris): the meter is compliant if 1/3 of the total energy is recorded in the consumption register and there is zero increase in the supply register;
- two separate consumption and supply totals: the meter is compliant if 2/3 of the total amount of energy was registered in the consumption register and 1/3 of the total amount in the supply register.
- sum of absolute values: the meter passes if the total amount of energy is recorded in the consumption register.

7.6.4 Assessment of the accuracy test

The meter passes if the measurement errors of the meter are less than the maximum permissible errors given in Tables 30 to 37 (the measurement uncertainty of the test apparatus is not taken into account when determining meter error).

Table 30 – Maximum permissible errors for single-phase active electromechanical and static meters of accuracy classes 0.5, 1 and 2

Measurement number	Current [1)]	cos φ	Accuracy class for direct connected meters			Accuracy class for transformer operated meters		
			0.5	1	2	0.5	1	2
1 [2)]	I_{min} (5 % I_b)	1	±1.0 %	±1.5 %	±2.5 %	±1.0 %	±1.5 %	±2.5 %
2	100 % I_n	1	±0.5 %	±1.0 %	±2.0 %	±0.5 %	±1.0 %	±2.0 %
3	100 % I_n	0.5 ind.	±0.6 %	±1.0 %	±2.0 %	±0.6 %	±1.0 %	±2.0 %

4	$I_{max.}$	1	±0.5 %	±1.0 %	±2.0 %	±0.5 %	±1.0 %	±2.0 %

[1] For electromechanical meters, applies for current I_b

[2] Electromechanical meters manufactured up to the end of 1993 are tested at a current of 10 % I_b.

Table 31 – Maximum permissible errors for single-phase reactive electromechanical and static meters of accuracy classes 0.5 S, 1 S, 1, 2 and 3

Measurement number	Current [1]	Sin φ	Accuracy class for direct connected meters				Accuracy class for transformer-operated meters		
			0.5	1	2	3	0.5 S	1 and 1 S	2
1 [2]	I_{min}	1	±1.0 %	±1.5 %	±2.5 %	±4.0 %	±1.0 %	±1.5 %	±2.5 %
2	100 % I_n	1	±0.5 %	±1.0 %	±2.0 %	±3.0 %	±0.5 %	±1.0 %	±2.0 %
3	100 % I_n	0.5 ind.	±0.5 %	±1.0 %	±2.0 %	±3.0 %	±0.5 %	±1.0 %	±2.0 %
4	$I_{max.}$	1	±0.5 %	±1.0 %	±2.0 %	±3.0 %	±0.5 %	±1.0 %	±2.0 %

[1] For electromechanical meters, applies for current I_b

[2] Electromechanical meters manufactured up to the end of 1993 are tested at a current of 10 % I_b.

Table 32 – Maximum permissible errors for three-phase active electromechanical and static electricity meters of accuracy classes 0.5, 1 and 2

Measurement number	Current	Current in phases	cos φ	Accuracy class for direct connected meters		Accuracy class for transformer operated meters		
				1	2	0.5 [1]	1 and 1 S	2
1 [2]	I_{min} (5 % I_b)	L1-L2-L3	1	±1.5 %	±2.5 %	±1.0 %	±1.5 %	±2.5 %
2	50 % I_n	L1	1	±2.0 %	±3.0 %	±1.5 %	±2.0 %	±3.0 %
3 [3]	50 % I_n	L2	1	±2.0 %	±3.0 %	±1.5 %	±2.0 %	±3.0 %
4	50 % I_n	L3	1	±2.0 %	±3.0 %	±1.5 %	±2.0 %	±3.0 %
5	50 % I_n	L1	0.5 ind.	–	–	±1.5 %	±2.0 %	–
6 [3]	50 % I_n	L2	0.5 ind.	–	–	±1.5 %	±2.0 %	–
7	50 % I_n	L3	0.5 ind.	–	–	±1.5 %	±2.0 %	–
8	100 % I_n	L1-L2-L3	1	±1.0 %	±2.0 %	±0.5 %	±1.0 %	±2.0 %
9	100 % I_n	L1-L2-L3	0.5 ind.	±1.0 %	±2.0 %	±0.8 %	±1.0 %	±2.0 %
10	$I_{max.}$	L1-L2-L3	1	±1.0 %	±2.0 %	±0.5 %	±1.0 %	±2.0 %

[1] Accuracy class 0.5 applies only to electromechanical electricity meters.

[2] Electromechanical meters manufactured up to the end of 1993 are tested at a current of 10 % I_b.

[3] Measurements No 3 and No 6 are omitted for three-wire electricity meters.

Table 33 – Maximum permissible errors for three-phase active static meters of accuracy class 0.1 S, 0.2 S and 0.5 S

Measurement	Current	Current	cos φ	Accuracy class for direct	Accuracy class for transformer-operated

numbe r		in phases		connected meters	meters		
				0.5 S	0.1 S	0.2 S	0.5 S
1	I_{min}	L1-L2-L3	1	–	±0.2 %	±0.4 %	±1.0 %
3	2 % I_n	L1-L2-L3	0.5 ind.	±1.0 %	±0.25 %	±0.5 %	±1.0 %
4	2 % I_n	L1-L2-L3	0.8 cap.	±1.0 %	±0.25 %	±0.5 %	±1.0 %

continued

Table 33 – continued

Measu rement numbe r	Current	Current in phases	cos φ	Accuracy class for direct connected meters	Accuracy class for transformer-operated meters		
				0.5 S	0.1 S	0.2 S	0.5 S
2	5 % I_n	L1-L2-L3	1	±0.5 %	±0.1 %	±0.2 %	±0.5 %
5	5 % I_n	L1	1	±0.6 %	±0.1 %	±0.2 %	±0.5 %
6 [1)]	5 % I_n	L2	1	±0.6 %	±0.1 %	±0.2 %	±0.5 %
7	5 % I_n	L3	1	±0.6 %	±0.1 %	±0.2 %	±0.5 %
8	10 % I_n	L1-L2-L3	1	±0.5 %	±0.1 %	±0.2 %	±0.5 %
9	50 % I_n	L1	1	±0.6 %	±0.1 %	±0.2 %	±0.5 %
10 [1)]	50 % I_n	L2	1	±0.6 %	±0.1 %	±0.2 %	±0.5 %
11	50 % I_n	L3	1	±0.6 %	±0.1 %	±0.2 %	±0.5 %
12	50 % I_n	L1	0.5 ind.	–	±0.15 %	±0.3 %	±0.6 %
13 [1)]	50 % I_n	L2	0.5 ind.	–	±0.15 %	±0.3 %	±0.6 %
14	50 % I_n	L3	0.5 ind.	–	±0.15 %	±0.3 %	±0.6 %
15	100 % I_n	L1-L2-L3	1	±0.5 %	±0.1 %	±0.2 %	±0.5 %
16	100 % I_n	L1-L2-L3	0.5 ind.	±0.6 %	±0.15 %	±0.3 %	±0.6 %
17	100 % I_n	L1-L2-L3	0.8 cap.	±0.6 %	±0.15 %	±0.3 %	±0.6 %
18	$I_{max.}$	L1-L2-L3	1	±0.5 %	±0.1 %	±0.2 %	±0.5 %

[1)] For three-wire meters, measurements Nos 6, 10 and 13 are not performed.

Table 34 – Maximum permissible errors for single-phase active electromechanical and active static meters of Classes A, B and C

Measure ment number	Current	cos φ	Class A	Class B	Class C [1)]
1	I_{min}	1	±2.5%	±1.5%	±1.0%
2	I_{tr}	1	±2.0%	±1.0%	±0.5%
3	I_{tr}	0.5 ind.	±2.0%	±1.0%	±0.5%
4	I_{ref}	1	±2.0%	±1.0%	±0.5%

5	I_{ref}	0.5 ind.	±2.0%	±1.0%	±0.5%
6	I_{ref}	0.8 cap.	±2.0%	±1.0%	±0.5%
7	I_{max}	1	±2.0%	±1.0%	±0.5%

1) Class C applies only to static electricity meters.

NOTE I_{tr} = 10% I_{ref} for direct-connected electricity meters;
I_{tr} = 5% I_n for transformer-operated electricity meters

Table 35 – Maximum permissible errors for Classes A, B and C three-phase active electromechanical and active static meters

Measurement number	Current	cos φ	Current in phases	Class A	Class B	Class C 1)
1	I_{min}	1	L1-L2-L3	±2.5%	±1.5%	±1.0%
2	I_{tr}	1	L1-L2-L3	±2.0%	±1.0%	±0.5%
3	I_{tr}	0.5 ind.	L1-L2-L3	±2.0%	±1.0%	±0.5%
4	50 % I_{ref}	1	L1	±3.0%	±2.0%	±1.0%
5	50 % I_{ref}	1	L2	±3.0%	±2.0%	±1.0%
6	50 % I_{ref}	1	L3	±3.0%	±2.0%	±1.0%
7	50 % I_{ref}	0.5 ind.	L1	–	±2.0%	±1.0%
8	50 % I_{ref}	0.5 ind.	L2	–	±2.0%	±1.0%
9	50 % I_{ref}	0.5 ind.	L3	–	±2.0%	±1.0%
10	I_{ref}	1	L1-L2-L3	±2.0%	±1.0%	±0.5%
11	I_{ref}	0.5 ind.	L1-L2-L3	±2.0%	±1.0%	±0.5%
12	I_{ref}	0.8 cap.	L1-L2-L3	±2.0%	±1.0%	±0.5%
13	I_{max}	1	L1-L2-L3	±2.0%	±1.0%	±0.5%

1) Class C applies only to static electricity meters.

NOTE I_{tr} = 10% I_{ref} for direct-connected electricity meters;
I_{tr} = 5% I_n for transformer-operated electricity meters

Table 36 – Maximum permissible errors for three-phase reactive static meters of accuracy class 0.5 S, 1 and 1 S

Measurement number	Current in phases	sin φ	Current for electricity meter		Accuracy class	
			for direct-connected	for transformer-operated	0.5 S	1 and 1 S
1	L1-L2-L3	1	I_{min}	I_{min}	±1.0 %	±1.5 %
2	L1-L2-L3	1	10 % I_n	5 % I_n	±0.5 %	±1.0 %
3	L1-L2-L3	0.5 ind.	10 % I_n	5 % I_n	±1.0 %	±1.5 %
4	L1-L2-L3	0.5 cap.	10 % I_n	5 % I_n	±1.0 %	±1.5 %
5	L1	1	50 % I_n	50 % I_n	±0.5 %	±1.0 %

6 [1)]	L2	1	50 % I_n	50 % I_n	±0.5 %	±1.0 %
7	L3	1	50 % I_n	50 % I_n	±0.5 %	±1.0 %
8	L1-L2-L3	1	100 % I_n	100 % I_n	±0.5 %	±1.0 %
9	L1-L2-L3	0.5 ind.	100 % I_n	100 % I_n	±0.5 %	±1.0 %
10	L1-L2-L3	0.5 cap.	100 % I_n	100 % I_n	±0.5 %	±1.0 %
11	L1-L2-L3	1	I_{max}	I_{max}	±0.5 %	±1.0 %

[1)] Measurement No 6 is omitted for three-wire electricity meters.

Table 37 – Maximum permissible errors for three-phase reactive meters of accuracy classes 2 and 3

Measurement number	Current in phases	sin φ	Current for electricity meter		Maximum permissible errors	
			for direct-connected	for transformer-operated	2	3
1	L1-L2-L3	1	I_{min}	I_{min}	±2.5 %	±4.0 %
2	L1-L2-L3	1	10 % I_n	5 % I_n	±2.0 %	±3.0 %
3	L1-L2-L3	0.5 ind.	10 % I_n	5 % I_n	±2.5 %	±4.0 %
4	L1-L2-L3	0.5 cap.	10 % I_n	5 % I_n	±2.5 %	±4.0 %
5	L1	1	50 % I_n	50 % I_n	±2.0 %	±3.0 %
6 [1)]	L2	1	50 % I_n	50 % I_n	±2.0 %	±3.0 %
7	L3	1	50 % I_n	50 % I_n	±2.0 %	±3.0 %
8	L1-L2-L3	1	100 % I_n	100 % I_n	±2.0 %	±3.0 %
9	L1-L2-L3	0.5 ind.	100 % I_n	100 % I_n	±2.0 %	±3.0 %
10	L1-L2-L3	0.5 cap.	100 % I_n	100 % I_n	±2.0 %	±3.0 %
11	L1-L2-L3	1	I_{max}	I_{max}	±2.0 %	±3.0 %

[1)] Measurement No 6 is omitted for three-wire electricity meters.

7.7 Counter test

The counter test is performed only if the accuracy test was performed pursuant to Article 7.6.1(a), using the method of recording rotor revolutions or impulses from the tested electricity meter.

The counter test shall be carried out with power factor cos φ (sin φ) = 1 and any current from reference (basic, nominal) current to maximum current.

NOTE If the maximum current I_{max} is not indicated on the meter label, for the purposes of this regulation it is then equal to 1.2 times the nominal (base) current indicated on the label.

The electricity meter passes the test if the observed difference between the error when using the method of recording rotor revolutions or pulses from the tested electricity meter and that when using the method of reading data on the counter of the tested meter at the same current is less than 1/10 of the error limit at reference conditions. In the case of electricity meters with a mechanical counter, this ratio is increased to 1/4 of the error limit.

For meters of accuracy class 0.1 S, this ratio is increased to 0.02% of the maximum permissible error.

7.8 Verification renewal based on a statistical sample test

The verification of the population of electricity meters installed in the distribution network is renewed if it passes a statistical sample test.

7.8.1 Population for the statistical sample test

The population may only comprise electricity meters from a single manufacturer that are of the same type and have the same reference voltage and reference and maximum currents. Once created, this population may not be changed and the electricity meters it contains may not be included in another population for further renewal using a statistical sample test.

The most recent valid verification of the electricity meters or conformity assessment of the electricity meters in the population when put into operation must have been performed at a time interval no greater than two consecutive years.

7.8.2 The statistical method used

The statistical sample test may be performed by making one or two selections from the population of electricity meters according to recognised statistical methods. The sample may include a specified set of substitute meters to supplement the tested sample during the tests.

Logistical and other details of the statistical sample test, including acceptance plans, are specified in an internal regulation of the metrological body performing the verification.

7.8.3 Tests to be performed

All meters in the submitted sample are subjected in full to the tests prescribed for subsequent verification of meters pursuant to Articles 7.1, 7.2 and 7.4 to 7.7. If a meter does not pass the external examination pursuant to Article 7.1 or the functionality test pursuant to Article 7.2, it may be replaced by an electricity meter from the set of substitute meters.

An electricity meter is classified as non-compliant if it fails the no-load test pursuant to Article 7.4 and the inrush test pursuant to Article 7.5, and if the error found during the accuracy test pursuant to Article 7.6 is greater than the error limits given for the individual meter types in Tables 25 to 31.

7.8.4 Assessment of the results of the statistical sample test

The control sample of electricity meters is assessed as compliant if the acceptance requirements under the sampling plan for the selective check agreed to in advance have been met. Otherwise, the result is 'non-compliant'.

If the sample check is non-compliant, all electricity meters in the lot are assessed as non-compliant.

8 Measuring instrument examination

When examining measuring instruments pursuant to § 11a of the Metrology Act at the request of a person who may be affected by incorrect measurement, all the relevant tests under Chapter 7 that are technically feasible will be performed; The last sentence of Article 7.1 and the last sentence of Article 7.2 shall not apply.

The maximum permissible errors shall be double the maximum permissible errors indicated for each type of electricity meter in Tables 30 to 37. The requirements for inrush, no-load operation and the counter remain unchanged when carrying out this examination.

9 Notified standards

For the purposes of specifying the metrological and technical requirements for measuring instruments and specifying the testing methods for their type approval and verification arising from this General Measure, the CMI shall notify Czech technical standards, other technical standards or technical documents of international or foreign organisations, or other technical documents containing more detailed technical requirements (hereinafter ‘notified standards’). The CMI shall publish a list of these notified standards attached to the relevant measures, together with the general measure, in a manner accessible to the public (at www.cmi.cz).

Compliance with notified standards or parts thereof is considered, to the extent and under the conditions stipulated by a general measure, to be compliance with the requirements stipulated by this measure to which these standards or parts thereof apply.

Compliance with a notified standard is one of the ways to demonstrate compliance. These requirements may also be met by using another technical solution guaranteeing an equivalent or higher level of protection of legitimate interests.

II.

JUSTIFICATION

Pursuant to § 14(1)(j) of the Metrology Act, the CMI has issued this Measure of a General Nature toward the implementation of § 6(2), § 9(1) and (9), and § 11a(3) of the Metrology Act, laying down metrological and technical requirements for specified measuring instruments and tests for type approval and verification of specified measuring instruments – ‘electricity meters’.

Decree No 345/2002 *stipulating measuring instruments for mandatory verification and measuring instruments subject to type approval, as amended*, classifies the measuring instruments under items 4.1.1, 4.1.2 a 4.1.3 in the annex entitled ‘List of specified measuring instruments’ as measuring instruments subject to type approval and mandatory verification.

This legislation (Measure of a General Nature) will be notified in accordance with Directive (EU) 2015/1535 of the European Parliament and of the Council of 9 September 2015 laying down a procedure for the provision of information in the field of technical regulations and of rules on information society services.

III.

INSTRUCTIONS

In accordance with § 172(1) CAP, in conjunction with § 39(1) CAP, the CMI has stipulated a time limit for comments of 30 days from the date of posting the draft on the official notice board. Comments submitted after this deadline will not be considered.

The persons concerned are hereby invited to comment on this draft Measure of a General Nature. With regard to the provisions of § 172(4) CAP, the comments shall be submitted in writing.

In accordance with § 174(l) CAP in conjunction with § 37(l) CAP, it must be clear who is making the comments, which measure of a general nature they concern, how it contradicts legislation or how the measure of a general nature is inaccurate, and they must be signed by the person making them.

The supporting documents for this draft measure of a general nature may be consulted at the Czech Metrological Institute, Department of Legal Metrology, Okružní 31, 638 00 Brno, upon appointment by telephone.

This draft Measure of a General Nature will be posted for a period of 15 days.

IV.

REPEALING PROVISIONS

Measure of a General Nature number: 0111-OOP-C022-18, laying down the metrological and technical requirements for specified measuring instruments, including testing methods for verification of the following specified measuring instruments: ‘electricity meters’ is repealed.

Director General

Czech Metrology Institute