ARCHIVES HISTORIQUES DE LA COMMISSION

COLLECTION RELIEE DES DOCUMENTS "COM"

COM (73)276

Vol. 1973/0043

COMMISSION OF THE EUROPEAN COMMUNITIES

COM(73) 276 final
Brussels, 23 February 1973

Proposed directive of the Council

concerning the harmonization of legislation in the Member States relating to electrical energy meters

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(submitted to the Council by the Commission)

STATEMENT OF REASONS

I. GENERAL OBSERVATIONS

The present directive is an application of Article 100 of the Treaty in conjunction with the Council Directive of 26 July 1971 concerning the harmonization of legislation in the Member States relating to common provisions of, measuring instruments and methods of metrological testing (1).

Its object is to eliminate the technical barriers to intra-Community trade at present existing in the electrical energy meter sector as a result of the disparity between national legislations relating to these meters in the Member States.

A comparative examination of the regulations applicable to electrical energy meters has shown that the differences are not limited only to the technical provisions relating to construction, materials, indication devices and inscriptions, but also to the accuracy, the methods of metrological testing to which these meters are subjected before being marketed and their utilization.

A similar situation prevails as regards exchanges, owing to the obligation upon manufacturers to diversify their production in order to conform with the regulations in force in the Member State in which these meters are to be used, and to submit to repeated tests performed in differing ways.

As the existing national legislations are justified by the legitimate concern to protect consumer and user, their harmonization appears to be the only means of eliminating the drawbacks arising from their divergence and of creating the necessary conditions for the establishment of the Common Market.

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(1) Journal Officiel des Communautés Européennes n° L 202 of 6 September 1971.

Although the aim of this directive is mainly metrological, i.e., the harmonization of the relevant provisions, the problems of meter safety have nontheless not been disregarded. The directive imposes on meters provisions designed to ensure the correct functioning of the meter not only from the standpoint of its measuring qualities but also from that of safety of use. As regards the other safety aspects which are not regulated in the present directive, it must of course be borne in mind that these are dealt with in the directive already approved by the Council relating to electrical equipment destined to be used within certain voltage limits.

An important discussion on acceptance test conditions took place between the experts consulted, the issue being whether these tests should be carried out on each meter or statistically by a sampling method.

The countries which do not at present require the primary examination are reluctant to set up the ponderous and expensive control system which this would entail. However, some of the experts consulted said they could not accept statistical testing because at the present moment, despite the work in progress in international organizations such as the International Electrotechnical Commission or the European Committee for the Coordination of the Electrical Standards of Member Countries of the European Community (CENELCOM), no agreement has yet been reached on such a method.

The directive therefore presents a method of primary individual examination. But the Commission is aware of the limitations of this solution, and has undertaken to present a modification of the directive in this sense. This proposed modification will be submitted as soon as possible for examination to the Committee for Adaptation to Technical Progress for the measuring instruments sector.

As regards the legal provision, the first article defines the field of application of the directive, i.e., it lists the electrical energy meters defined in the annex to the directive.

Article 2 stipulates that the electrical energy meters which can receive the EEC marks and signs are described in the annex and that EEC approval of the model is required in all cases.

For the primary examination, on the other hand, this article provides that the test shall be imposed only where such a provision exists for national meters. This nuance is inserted in order to allow for the existing situation in certain Member States. It should be noted that this solution has already been adopted as regards approval of the model in the directive relating to length measurements.

Article 3 specifies that when electrical energy meters are provided with the EEC model approval mark, and where appropriate with the EEC primary examination mark, they may be imported, marketed and used as meters satisfying the national provisions.

The period of time for introduction, fixed at 18 months as in the other directives adopted in the measuring instruments sector, is specified in Article 4. In addition this article obliges Memeber States to communicate to the Commission the text of any internal laws which they may adopt in the field of the present directive.

Article 5 indicates that this directive is addressed to all the Member States.

II. SOLUTION BY HARMONIZATION

The solution by harmonization actually chosen is called optional, like that adopted for most of the special directives in the measuring instrument sector. The optional harmonization solution is proposed as an alternative to the solution of total harmonization in the Council directive relating to measuring instruments and methods of metrological testing.

This optional harmonization means that the electrical energy meters satisfying the present Directive can be marketed and used freely as between Member States in the same way as electrical energy meters which have satisfied the national tests can be marketed and used within each of the Member States.

III. CONSULTATION OF PARLIAMENT AND OF THE ECONOMIC AND SOCIAL COMMITTEE

The opinion of these two bodies appears necessary to conform with the provisions of Article 100, para. 2. Implementation of the directive's provisions will necessitate modification of the laws of certain Member States.

A N N E X

to the statement of reasons for the proposed directive on electrical energy meters

Legislation in force in the Member States relating to electrical energy meters.

1. Belgium

- Royal decree of 6 August 1962 relating to electrical energy meters.
- Ministerial decree of 10 August 1962 concerning model approval.

2. Germany

- Law on the metrology and calibration of weights and measures (calibration law - Eichgesetz) of 11 July 1969.
- Regulation on calibration (Eichordnung) in the version of regulation 14c concerning the modification of the regulation on calibration.

3. France

- Decree of 28 December 1935 relating to the examination of electrical energy meters (Journal officiel of 1 January 1936).
- Order of 29 December 1954 relating to the construction and approval of types of electrical energy meter (Journal officiel of 9 January 1955).
- Order of 30 December 1954 relating to the primary examination of new electrical energy meters (Journal officiel of 9 January 1955).

4. Italy

- Royal decree of 11 July 1941 - XIX - No. 1104
- Royal decree of 11 July 1941 - XIX - N° 1105
- Law of 1 July 1968 N° 186
- Standard 13-2 of section N° 178 Edition XII-61 (CNR/CEI)
- Standard 38-1 of section N° 236 Edition VII-68 (CNR/CEI)
- Standard 38-2 of section N° 237 Edition VII-68 (CNR/CEI)
- Publication N° 53-111 of 13 February 1961 (CNR/CEI)

5. Netherlands

- Law on measuring instruments of 22 April 1937, published in the Journal officiel N° 627.
- Regulation on measuring instruments of 29 April 1939.
- Royal decree of 5 February 1970 concerning electrical energy meters.
- Ministerial decree of 9 May 1939 relating to measuring instruments.

6. Luxembourg

Nil.

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concerning the harmonization of legislation in the Member States
relating to electrical energy meters

The Council of the European Communities,

in view of the Treaty establishing the European Economic Community, and in particular its Article 100,

in view of the Commission's proposal,

in view of the opinion of the European Parliament,

in view of the opinion of the Economic and Social Committee,

considering that, in the Member States, the construction and also the methods of testing of electrical energy meters are the subject of strict regulations which differ from one Member State to another and hence impede trade in these meters; that a harmonization of these regulations is therefore necessary;

considering that the directive of the Council of 26 July 1971, concerning the harmonization of legislation in the Member States relating to common provisions of, measuring instruments and methods of metrological testing has defined the procedures for EEC approval of the model and EEC primary examination; that in conformity with this directive it is necessary to specify the technical provisions for the construction and operation of electrical energy meters;

considering that the above directive also stipulates that particular directives may fix when conditions permit, the date at which each Member State is to abrogate the national provisions applicable to instruments similar to those which satisfy the Community provisions; that in the present case it is not yet permitted to fix this date :

HAS ADOPTED THE PRESENT DIRECTIVE :

Article 1

The present directive is applicable to induction meters, in current use, with direct connection, new, with single or multiple tariffs, designed to measure the active power single-phase or three-phase current at 50 Hz frequency.

Article 2

The electrical energy meters which may be given EEC marks and signs are described in an Annex to this Directive. They shall be the subject of the EEC type approval. They shall not be submitted to the EEC primary examination except where a corresponding check is prescribed for national electrical energy meters.

Article 3

Member States may not prevent, prohibit or restrict the marketing and putting into operation of electrical energy meters bearing the sign of EEC type approval and where appropriate of the EEC primary examination.

Article 4

1. The Member States shall put into force the laws, regulations and administrative action necessary for conformity to the present Directive within 18 months following notification of it and shall inform the Commission immediately.

2. The Member States shall take care to communicate to the Commission the test of any provisions of internal law which they may adopt in the field covered by the present Directive.

Article 5

This Directive is addressed to all Member States.

A N N E X

CHAPTER I - DEFINITIONS

1. Definition of certain terms used in the present Annex

1.1. Magnitude or factor of influence

Any magnitude, or any phenomenon other than the measured magnitude, the effects of which may modify the result of the measurement.

1.2. Variation of error as a function of a magnitude of influence

Difference between the errors of the meter when a single magnitude of influence assumes in succession two specified values.

1.3. Reference value of a magnitude of influence

Value of this magnitude as a function of which certain characteristics of the meter are fixed.

1.4. Basic current (I_b)

Value of the current as a function of which the values of certain characteristics of the meter are fixed.

1.5. Maximum current (I_{max})

Value of current up to which the meter should satisfy the provisions relating to accuracy.

1.6. Distortion factor

Ratio of the effective value of the remainder obtained by subtracting the fundamental factor from a non-sinusoidal alternating magnitude, to the effective value of the non-sinusoidal magnitude. The distortion factor is usually expressed as a percentage.

1.7. Nominal speed of rotation

The value of the speed of rotation of the rotor, under the reference conditions (section 5.2.), for the basic current and a power factor of 1.

1.8. Nominal torque

The value of the torque exerted on the rotor at rest, under the reference conditions (section 5.2.), for the basic current and a power factor of 1.

1.9 Nominal insulation voltage

The highest value of the voltage with respect to the earth to which the circuits of a meter can be raised in normal service.

1.10. Model

Designation used to define all the meters with a single tariff or multiple tariffs, made by one and the same manufacturer, to which correspond :

- the same metrological properties,
- uniformity of construction of the parts which determine these qualities,
- the same ratio between maximum current and basic current,
- various basic currents and various reference voltages.

Remarks

a) These meters are designated, by the manufacturer, by one or more groupes either of letters or of numbers, or of a combination of letters and numbers. Each model has one designation only.

b) The model is represented by the sample meter/meters intended for model approval tests, the characteristics of which (basic currents and reference voltage) are chosen from among those appearing in the tables proposed by the manufacturer (section 6.1.1.).

c) In the case of special productions, the product of the number of turns of the windings and the intensity of the basic current may differ from that of the sample meters representing the model. The number immediately above or below should be chosen, so as to have a whole number of turns.

As a result of this, the number of turns per volt of the voltage windings must not differ by more than 20 % from that of the sample meters representing the model.

d) The ratio of the highest to the lowest nominal speed of rotation of the rotor of each meter of the same model must not exceed 1.5.

CHAPTER II - TECHNICAL SPECIFICATIONS

2. Mechanical specifications

2.1. General

The insulating materials used in the meters must for practical purposes be non-hygroscopic and not easily inflammable.

All the parts exposed to corrosion under conditions of use must be effectively protected against corrosion due to atmospheric influences. The protective layers must not be susceptible to deterioration during normal handling, nor to damage by exposure to the air under the usual conditions of use.

2.2. Casing

The casing of the meter must for practical purposes be dust-proof. This casing must be able to be lead sealed or sealed in such a way that the internal components of the meter cannot be accessible until after the seals have been removed.

Meters for which the reference voltage is higher than 250 volts referred to earth, and of which the casing is completely or partly metallic, must be provided with a correctly rated protective terminal.

2.3. Windows

If the casing of the meter is not transparent, it must include one or more windows for reading the indicator and observing the movement of the rotor. These windows must be covered by plates of transparent material which it must be impossible to remove without breaking the seals.

2.4. Terminals - terminal plates

The terminals must be grouped in one or more terminal plates of sufficient mechanical strength. They must permit the fixing of rigid conductors or of cables.

It must be possible easily to disconnect the voltage terminals from the current input terminals.

Connection of the conductors to the terminals must be made in such a way as ensure sufficient and durable contact, so that there is no risk of loosening or excessive heating. The holes which are a prolongation of the terminal holes in the insulating material must be large enough to allow the easy insertion of the insulation of the conductors.

Note

The material of which the terminal plate is made must satisfy the test of ISO recommendation R 75 (1958), section 6, for a temperature of 135 °C.

2.5. Terminal cover

The terminals of the meter must be covered by a terminal cover which it must be possible to seal independently of the lid.

When the meter is mounted on its board, it must not be possible to reach the terminals without breaking the seals on the terminal cover. The terminal cover must therefore cover the upper part of the terminal plate, the screws which hold the conductors in the terminals and, if necessary, a sufficient length of the connecting conductors and their insulation.

2.6. Indicating device

The indicating device may consist of drums or pointers.

The unit of the indicating device must be the kilowatt hour.

In the case of indicating devices with drums, the unit must be stated near the drum assembly.

In the case of indicating devices with pointers, there should be marked near the unit dial : 1 kWh/div, and alongside the other dials, the number of kilowatt hours corresponding to one division, i.e. 10; 100; 1,000.

The dial of pointer-type indicating devices, or the drum of drum-type indicating devices, which indicates one-tenth of the reading unit must be framed or coloured.

The dial, or continuous rotation drum, indicating the lowest values must include a scale of 100 equal divisions, or any other arrangement giving similar accuracy of reading.

The indicating device must be able to record, from zero, for a minimum of 1,500 hours, the energy corresponding to the maximum current at the reference voltage and a power factor of one.

All the indications appearing on the indicating device must be indelible and easily legible.

2.7. Direction of rotation of the rotor

The front part of the rotor, for an observer placed in front of the meter and looking at it, must move from left to right. This direction must be indicated by a fixed arrow, easily visible and indelible.

The edge, or the edge and the top of the disc, must carry a main mark with a width of between one-twentieth and one-thirty-fifth of the circumference of the disc, allowing the number of revolutions to be counted.

The disc may also carry marks permitting stroboscopic or other tests to be made. These marks must not impair the use of the main mark when this is used for photo-electric counting of the number of revolutions of the disc.

3. Electrical specifications

3.1. Value of the maximum current

The maximum current must be a whole multiple of the basic current.

3.2. Consumption of the circuits

3.2.1. Voltage circuits

The power consumed by each voltage circuit of a meter must not exceed 2 W and 8 VA for the reference voltage and reference frequency.

3.2.2. Current circuits

The apparent power absorbed by each current circuit must not exceed 2.5 VA for the basic current, the reference frequency and temperature.

3.3. Heating

In the usual conditions of use, the windings and insulators should not reach a temperature liable to endanger the functioning of the meter. This aim will be achieved if the insulating materials preserve their dielectrical qualities during the following test :

This test must be carried out for two hours on a meter not exposed to draughts or to direct sunlight, under the following conditions :

- current circuits : maximum current
- voltage circuits and auxiliary circuits connected up in service for a period greater than their thermic time constant : 1.2 times the reference voltage.

After this text, the increase in temperature Δt of the meter windings and the external surface of the casing, whether metallic or insulating, must not exceed the values indicated in the table below. The meter must not show any damage and must satisfy the insulation tests in section 3.4.

Increase of temperature Δt of the windings and the casing

Parts of the meter	Δt °C
Windings Class A	65
Windings Class E	80
External surface of the casing	25

The temperatures of the windings are determined by adding to the ambient temperature the heating determined by the resistance variation method (see Publication 28 of the International Electrotechnical Commission's "International Specifications for a Copper-type Annealing").

The maximum values of the heatings mentioned in the table correspond, for an ambient temperature of 40 °C, to the maximum temperature fixed by Publication 85 of the I.E.C.

3.4. Insulation tests

The insulation of all the circuits of a meter must be arranged so as not only to allow it to function correctly, but also to ensure suitable protection against the danger of electric shock when the meter is in normal service, or in conditions of accidental overload.

The insulators must have a suitable dielectrical rigidity and offer sufficient resistance to mechanical stresses to preserve their qualities permanently.

The insulation quality of the meter circuits will be verified by:

- tests at impulse voltage,
- the dielectrical rigidity test.

3.4.1. General conditions for the insulation tests

The tests are carried out on new meters in normal conditions of use, i.e., the meter fully mounted, the casing closed and the terminal cover in place.

During the test, the insulation quality must not be altered by the presence of dust or abnormal humidity.

In the absence of contrary specifications, the normal conditions for insulation tests are :

- ambient temperature	15 - 25 °C
- relative humidity	45 - 75 %
- atmospherical pressure	86.10^3 - 106.10^3 N/m^2 (860 - 1060 mbar)

3.4.2. Tests at impulse voltage

The tests at impulse voltage are provided in order to determine the ability of the meter to withstand without damage excess voltages of short duration but very high value.

3.4.2.1. Characteristics of the generator

The impulse voltage is produced by an apparatus in which a certain number of condensers are charged in parallel by a continuous voltage source, then discharged in series in a circuit including the meter. The impendances of the parts of the circuit must be such that the impulse to be applied in a given test remains invariable at all voltages.

3.4.2.2. Form of the impulse voltage

The wave form is that of the normal impulse voltage. It is a full impulse voltage with a conventional duration of the front of 1.2 /us and a conventional duration of up to the half-value of 50 /us.

It is designated in writing in the form of : impulse voltage 1.2/50.

The tolerances are :

- on the time of rise ± 30 %
- on the time of descent ± 20 %

3.4.2.3. Peak voltage

The peak value of the impulse voltage is : 6 kV ± 5 %.

3.4.2.4. Points of application of the impulse voltage

The impulse voltage must be applied :

- between the terminals of each voltage circuit;
- between the frame on the one hand and on the other hand the terminals of all the voltage and current circuits connected together, including - if any - those auxiliary circuits whose reference voltage is higher than 40 V (when the casing is insulating or has an insulating base, this test should be made with the casing open);
- in addition, for the meters whose casing is insulating or has an insulating base, between, on the one hand, all the terminals connected together as above and, on the other, a conducting foil surrounding the meter, in contact with a flat metallic surface on which rests the base of the meter; this conducting foil must be connected to the accessible conducting parts of the base and leave a space of at the most 20 mm around the terminals.

3.4.2.5. Test procedure and conclusions

The test voltage must be applied ten times, as indicated above, without inversion of polarity.

During the test, no disruptive discharge must take place.

After the test, the meter must, on the one hand, satisfy all the specified characteristics and, on the other hand, have a variation of error not greater than 0.5 % (uncertainty of measurement).

3.4.3. Test of dielectrical rigidity

3.4.3.1. Characteristics of the source of supply

- Frequency : 50 Hz ± 5 %
- Wave form : practically sinusoidal
- Voltage : variable 0 - 2 kV
- Power : greater than 500 VA.

3.4.3.2. Values and points of application of the test voltage

The dielectrical rigidity test voltage, at the effective value, and the points of application of the test voltage are indicated in the table below :

Test voltage	Points of application of the test voltage
2 kV	- between, on the one hand, the frame and, on the other hand : a) each independent current circuit; b) each independent voltage circuit; c) each auxiliary circuit whose reference voltage is higher than 40 V; d) each assembly of voltage and current circuits normally connected together inside the meter; (when the casing is insulating or has an insulating base, these tests should be made with the casing open); - in addition, for the meters whose casing is insulating or has an insulating base, between, on the one hand, all the circuits (mentioned above in a), b) and c)) connected together, and, on the other hand, a conducting foil placed in the same conditions as that described in paragraph 3.4.2.4.
500 V	between, on the one hand, the frame and, on the other hand, each auxiliary circuit whose reference voltage is equal at the most to 40 V (when the casing is insulating or has an insulating base, this test should be made with the casing open).
The highest of the two following values : - 600 V - twice the reference voltage when this is higher than 300 V.	between the voltage circuit and the current circuit of each driving part normally connected together, after having temporarily suppressed this connection for the duration of the test.

3.4.3.3. Procedure for the dielectrical rigidity test and conclusions

The dielectrical rigidity test voltage is increased progressively for about 30 s up to the prescribed value, and maintained at this value for 60 s. It is then reduced progressively, and as quickly as possible, to zero.

The results of the dielectrical rigidity test are considered satisfactory when :

- during the test, no abnormality occurs such as : abnormal variation of the applied voltage, noise, smell, distortion etc,
- after the test, the meter complies with all the specifications, and the variation in the error is not greater than 0.5 % (uncertainty of measurement).

4. Indications to be shown on the meters

4.1. Marking plate

Each meter must carry a marking plate which may be either the dial of the indicating device or a plate fixed inside the meter.

The following indications must be shown there, in an indelible manner, easily legible and visible from outside :

a) the manufacture's identification mark or trade name;
b) the description of the model;
c) the sign of EEC type approval of the meter;
d) the description of the number and arrangement of the motor components, either in the form single-phase two-wire, three-phase four-wire, etc., or using symbols conforming with a standard harmonized at Community level;
e) the reference voltage;
f) the basic current and the maximum current, in the form : 10 - 40 A or 10 (40) A;
g) the reference frequency 50 Hz;
h) the constant of the meter in either of these forms :

x Wh/tr or X tr/kWh

i) the serial number of the meter and its year of manufacture.

The meter may also carry information as to its place of manufacture, a commercial description, a special serial number, the name of the supplier of electricity, a sign of conformity to a European standard and an indication relating to repairs carried out. Except by special authorization, any other indication or inscription is prohibited.

4.2. Connection diagram

Each meter must carry an easily identifiable connection diagram showing the correspondence between the connecting terminals and the various phases of the conductors to be connected.

CHAPTER III - METROLOGICAL SPECIFICATIONS

5. Metrological specifications

5.1. Maximum errors

Under the reference conditions described in paragraph 5.2., single-phase meters and three-phase meters with balanced loads must not exceed the errors indicated in Table I, and three-phase meters with single-phase loads (under balanced voltages) must not exceed the errors indicated in Table II.

Table I

Value of current	Power factor	Max. tolerated errors
$0.05\ I_b$	1	$\pm$ 2.5 %
from $0.1\ I_b$ to I_{max}	1	$\pm$ 2 %
$0.1\ I_b$	0.5 inductive	$\pm$ 2.5 %
from $0.2\ I_b$ to I_{max}	0.5 inductive	$\pm$ 2 %

Table II

Value of current	Power factor	Max. tolerated errors
$0.2\ I_b \leqslant I \leqslant I_b$	1	$\pm$ 3 %
$I_b \leqslant I \leqslant I_{max}$	1	$\pm$ 4 %
I_b	0.5 inductive	$\pm$ 3 %

Note

The single-phase loading of a three-phase meter must be understood as only affecting one star voltage in a system with four

conductors (one of which is neutral) or a single composed voltage in a system with three conductors (without a neutral). In every case, the complete system of voltages must remain connected to the meter.

5.2. Reference conditions

The tests for the determination of the errors and of the variations of error as a function of the magnitudes of influence must be carried out under the following reference conditions :

a) the meter must be closed, that is fitted with its lid;
b) in the case of indicating devices with drums, only the drum which turns the fastest should be engaged, even if it is not visible;
c) before any measurement, the voltage must have been connected for at least one hour and the testing currents must each be adjusted by progressively increasing or decreasing values and connected for a sufficient time for the speed of rotation of the rotor to become stabilised;

In addition, for three-phase meters :

d) the order of the phases must correspond to the direct sequence (O - 4 - 8 or R - S - T);
e) the voltages and currents must for practical purposes be balanced, i.e. :
   - each of the simple and composite voltages should not differ by more than 1 % from the mean of the corresponding voltages;
   - each of the currents in the conductors should not differ by more the 1 % from the mean of these currents;
   - the phase displacements presented by each of these currents with the corresponding star voltage should not differ between themselves by more than 2°.

The reference values (with specified tolerances) of the magnitudes of influence are indicated in Table III as follows :

Table III

Magnitude of influence	Reference value	Tolerance
Ambient temperature	Reference temperature indicated by the manufacturer or, in default : 23 °C	± 2 °C
Position	Vertical position (note 1)	± 0.5 %
Voltage	Reference voltage	± 1 %
Frequency	50 Hz	± 0.5 %
Wave form	Voltages and currents of sinusoidal form for practical purposes	Distortion factor not exceeding 3%
Magnetic field	Field, the influence of which is not appreciable, i.e. such that the residual induction of this field does not cause any variation of the error, as a percentage, greater than ± 0.3 % (note 2) for : single-phase meter : on the one hand for a curr of 0.1 I_b and a power factor of 1 and, on the other hand, for a current of 0.2 I_b and a power factor of 0.5. three-phase meter : for a current equal to 0.1 I_b and a power facter of 1.	

Note 1. Adjusting verticality

a) When the meter has three mounting points, its position is determined by the height of the isosceles triangle formed by the three centres of these mounting holes; this height must be vertical.

b) When the meter allows of another method of mounting, its position is determined, for example, by the rear plane of the frame, which should be vertical, and by the lower part of the terminal plate, which should be horizontal.

Note 2. Residual magnetic induction of external origin

The test method to carry out this check consists :

a) for a single-phase meter, in determining the difference between the errors of the meter before and after reversing the connections of the current and voltage circuits. Half this difference is the value variation sought;

b) for a three-phase meter, in determining the errors of the meter by supplying the current and voltage circuits while permuting the phases three times by 120° in the direct order of sequence.

The difference between each of these errors and their arithmetical mean is the value of the variation sought.

5.3. Effects of the magnitude of influence

The variations in the error are determined for each of the magnitudes of influence under the conditions indicated in Table IV, all the other conditions as in section 5.2. being observed.

Table IV

Magnitude of influence	Nature of the tests and conditions	Power factor	
Temperature (note 1)			Maximum value of the mean temperature coefficient
	From C.1 I_b to I_{max}	1	± C.1 % / °C
	From 0.2 I_b to I_{max}	0.5 induct.	± 0.15% / °C
			Maximum permissible variation of errors
Position	For an inclination of 3° to the vertical in any direction :		
	- at C.C5 I_b	1	± 3 %
	- at I_b	1	± 1 %
Voltage	For a variation of ± 10 % in relation to the reference voltage :		
	- at C.1 I_b	1	± 1.5 %
	- from I_b to I_{max}	1	± 1 %
Frequency	For a variation of ± 5 % as against 50 Hz :		
	- at 0.1 I_b and at I_b	1	± 1.5 %
	- at I_b	0.5 induct.	± 1.5 %
Wave form (note 2)	For an increase of 10 % in harmonics of the third order in the current wave :		
	- at I_b	1	± 0.8 %
Magnetic induction of external origin (note 3)	For a magnetic induction of C.5 mT, at the reference frequency, under the most unfavourable conditions of phase and direction :		
	- to I_b	1	± 3 %
Order of phases for polyphase circuits	For a reversal of the direct phase order :		
	- from 0.5 I_b to I_{max}	symmetr. 1	± 1.5 %
		0.5	± 2 %
	- to 0.5 I_b on one terminal	1	± 2 %

Note 1. For a given temperature, the value of the mean temperature coefficient is determined for an area of 20 °C chosen within the range 0 - 40 °C and centred on this temperature.

Note 2. When determining the variation of error as a function of the wave form the harmonics content of the voltage curve must remain less than 1 %, and the phase of the harmonic of the third order inserted into the current curve must vary between zero and 360°.

Note 3. The induction required is obtained at the centre of a circular coil of a mean diameter of 1 m, of square section, of small radial thickness in relation to its diameter and providing a magnetomotive force of 400 A/tr.

5.4. Effect of strong voltage surges of short duration

The meter should be able to undergo for 0.5 seconds a current equal to 30 times the basic current when this does not exceed 10 amps, 20 times the basic current when this is greater than 10 amps.

The circuit in which the meter is placed should for practical purposes be non-inductive, the voltage at the terminals of the voltage circuit being the reference voltage and the frequency being 50 Hz.

The voltage being maintained at the terminals of the meter, the latter should be allowed to rest for sufficient time for it to return to the ambient temperature (about 1 hour).

A test should then be made at the reference voltage, at the reference frequency, with a current equal to the basic current and a power factor of 1. The variation in error should not exceed 1.5 %.

5.5. Variation in the error due to the intrinsic heating

The meter having been previously maintained under reference voltage for at least one hour without the circuits being supplied with current is put into service under the maximum current.

The error of the meter is measured under a power factor of 1

immediately after putting into service and then at intervals sufficiently short to permit correct plotting of the curve of variation of error as a function of time.

The test must be continued for at least an hour, and at all events until the variation noted over a period of 20 min is not greater than 0.2 %.

The variation in the error due to the intrinsic heating measured as indicated above must not be greater than 1 %.

5.6. Running without load

Under the conditions indicated in paragraph 5.2., the current circuits of the meter being switched off, the rotor should not run free for any voltage value between 80 % and 110 % of the reference voltage : the rotor may turn slightly, but should make less than one complete turn. In the case of an indicating device with drums, this specification is valid when only one roll is engaged.

5.7. Starting

Under the conditions indicated in paragraph 5.2., the meter passing a current equal to 0.5 % of the basic current with a power factor of one, should start cleanly and continue to revolve. It should be verified that the rotor definitely makes a complete turn. In the case of an indicating device with drums, this specification is valid for one or two drums engaged.

5.8. Agreement of the indicating device with the reading constant of the meter

The energy recorded by the indicating device is compared with that obtained by multiplying the corresponding number of revolutions of the disc by the constant of the meter.

The difference thus measured must not be greater than the uncertainty of measurement.

5.9. Margins of adjustment

A meter adjusted to conform to the present specifications

should allow at least the following margins of adjustment :

a) Adjustment at full load :
4 % in the direction of increasing the speed of the rotor and 6 % in the direction of reducing it for a current equal to half the maximum current, with the reference voltage, a frequency of 50 Hz and a power factor of 1.

b) Adjustment at slight load :
± 4 % of the variation of the rotor speed at 5 % of the basic current 50 Hz frequency, the reference voltage and a power factor of 1.

c) Adjustment when out of phase : (if the meter is capable of such adjustment)
± 1 % of the variation of the rotor speed for a power factor of 0.5 (inductive) with a current equal to half the maximum current, 50 Hz frequency and the reference voltage.

CHAPTER IV - TYPE APPROVAL

The EEC type approval of electrical energy meters will be issued in accordance with the provisions of the Council directive of 26 July 1971 concerning the harmonization of legislation in the Member States relating to common provisions of measuring instruments and methods of metrological control.

Some of these regulations are specified in the present chapter.

6. Type approval

6.1. Procedure for type approval

6.1.1. Technical documents

A request for type approval should include the following documents :

a) A detailed description of the model, in particular with regard to :
- the construction of the motor components;

- the dimensions of the motor disc, the weight of the rotor, and the manner of its suspension;
- the construction of the braking device;
- the functioning of the adjusting devices;
- the type of temperature compensation;
- the construction of the indicating device;
- the construction of supplementary devices such as for changing the tariff etc.;
- the construction of the casing.

b) A table giving the different combinations of basic current and reference voltage of meters of the given type and showing for each combination :

- the number of windings in the current and voltage circuits as well as the diameter of the wires (or their dimensions in section);
- the constants, the number of teeth of the wheels connected with the indicating device, and the decimal divisions of the indicating device;
- the reference voltage and the basic current of the meter which has served as a reference for the dimensioning of the windings of the other meters (reference meter).

c) A diagram to show the internal and external electrical connections.

d) A diagrammatic drawing of the whole meter, showing all the principal components.

6.1.2. Presentation of meters submitted for type approval

A request for type approval should be accompanied by the presentation of three meters identical to the model.

The competent authority may request the submission of additional meters having different combinations of basic current and reference voltage, in order to ascertain in particular that certain of these combinations may be considered as belonging to the same model and complying with the regulations given in this chapter.

If the request is for the extension of the approval of a model already approved, the metrological authority may demand the submission of an additional meter.

6.2. Examination for type approval

The meters submitted must conform to the technical specifications given in paragraphs 2, 3 and 4 and to the metrological specifications given in paragraph 5.

However, in order to take into account the possible errors in the means of calibration, it is permissible, when drawing the graphs of error corresponding to Tables I and II, to move the axis of abscissae parallel to itself by a value not exceeding 0.5 %, the same for all graphs.

On condition that the whole of the load curve is plotted not only in the reference conditions but also in constant test conditions, the meters submitted must also satisfy the following conditions when they are symmetrically charged :

- the difference between the maximum and minimum values of the error expressed algebraically, between 0.1 I_b and I_{max} with a power factor of 1, must be less than or equal to 3%.
- the difference between the maximum and minimum values of the error expressed algebraically, between 0.2 I_b and I_{max} with a power factor of 0.5 inductive, must be less than or equal to 3 %.

6.3. Measuring points for type approval tests

When carrying out tests concerned with the metrological specifications given in paragraph 5, measurements should be made at least for the following points :

- for all the meters, multi-phase meters with balanced loads, with a power factor of 1 :
  5 %, 10 %, 20 %, 50 % and 100 % of I_b and every whole multiple of I_b up to I_{max};
- for all meters, multi-phase meters with balanced loads, with a power factor of 0.5 (inductive) :
  10 %, 20 %, 50 %, 100 % of I_b and every whole multiple of I_b up to I_{max};

- for multi-phase meters with only 1 phase loaded : 20 %, 50 % and 100 % of I_b, 50 % I_{max} and I_{max} with a factor of 1, and I_b with a power factor of 0.5 (inductive). These tests are carried out successively in all the phases.

The effects of the magnitudes of influence are examined at least for the following points :

- the influence of the ambient temperature for 0.1 I_b, I_b and I_{max} (power factor of 1), and I_b (power factor of 0.5 inductive);
- the influence of the position for 0.05 I_b and I_b (power factor of 1);
- the influence of the voltage for 0.1 I_b, I_b and I_{max} (power factor of 1);
- the influence of the frequency, of the wave form and of external magnetic fields for the points and under the conditions indicated in Table IV;
- the influence of inversion of the phases (multi-phase meters) for 0.5 I_b, I_b and I_{max}, with a power factor of 1 and 0.5 (inductive), for balanced loads, and for 0.5 I_b with a power factor of 1 (inductive), with a single-phased load (this last test to be repeated for each of the phases).

The effect of strong voltage surges of short duration and the influence of the intrinsic heating are determined as indicated in paragraphs 5.4 and 5.5.

The test of running without load is carried out with 80 %, 100 % and 110 % of the reference voltage.

The starting test is carried out under the conditions given in paragraph 5.7.

The test of the indicating device is carried out under the conditions given in paragraph 5.8.

The duration of the test must be sufficient for the uncertainty of reading not to exceed $\pm$ 0.2 %.

The reference torque, with the rotor stopped, of the meters submitted and their intrinsic consumption (voltage circuits for the reference voltage and current circuits for the basic current) should also be measured.

6.4. EEC type approval certificate

The descriptions, plans and diagrams which accompany the EEC type approval certificate include :

- a note describing the functioning of the meter;
- a comprehensive plan (if possible from several angles, showing the arrangement and the connections of the components);
- a plan of the motor component(s) and its/their regulating devices;
- a plan of the braking device and its regulation;
- a plan of the mobile parts (diameter and thickness of the disc, weight and torque of the rotor) and of the manner of its suspension (upper and lower bearings);
- a plan of the temperature compensating device;
- a plan of the indicating device;
- a side view of the casing, the base plate and the terminal housing;
- a connection diagram;
- a table of the characteristics of the voltage and current windings (number of turns, cross-section of the wires, intrinsic consumption) for the various combinations of basic currents and reference voltage;
- a table showing the transmission wheels and the constants for these combinations;
- the variations in construction (casing material, any devices for multiple tariff, remote indication device, anti-reversing device etc.).

CHAPTER V - PRIMARY EXAMINATION

The EEC primary examination of electrical energy meters will be carried out in accordance with the regulations in the Council directive of 26 July 1971 concerning the harmonization of legislation in the Member States relating to common provisions, measuring instruments and methods of metrological testing.

These regulations are supplemented by the following particular provisions :

7. Primary Examination

The primary examination of electrical energy meters consists of acceptance (or reception) tests and examinations of conformity to the model.

7.1. Acceptance tests

The acceptance tests of the meters guarantee their quality with regard to the points listed in section 7.1.1.

7.1.1. Nature of the acceptance tests

(1) - Dielectric quality
(2) - Mechanical quality, without opening the casing
(3) - Running without load
(4) - Starting
(5 to 10) - Accuracy tests
(11) - Examination of the constant
(12) - Mechanical quality, with the casing open.

The tests should preferably be carried out in the above order, as detailed in sections 7.1.2. and 7.1.3.

7.1.2. Conditions of the acceptance tests

The tests must be carried out on each meter, with the casing closed, except for certain mechanical qualities and if necessary for checking the indicating device.

Note

However, when the primary examination takes place in the manufacturer's workshops, it may be permissible to carry out the tests with the casing open, as long as the influence of the lid has first been seen to be negligible. Nevertheless, when checking dielectric qualities, the casings should be closed.

Before any test, the meters must be supplied with electricity for at least half an hour at the reference voltage and with a current of about 0.1 I_b, with a power factor of 1. This allows the heating of the voltage circuit in advance, and also a check that the rotor turns freely.

Tests Nos 3 to 11 should be carried out under the conditions given in Table III or Table V.

Table V

Magnitude of influence	Reference value	Tolerance
Ambient temperature	23 °C	± 2 °C (1)
Position	Vertical	± 1°
Voltage	Reference voltage	± 1.5 %
Frequency	50 Hz	± 0.5 %
Voltage and current wave form	Sinusoidal	Distortion factor up to 5 %
Magnetic induction of exterior origin at a frequency of 50 Hz	None	Induction not causing any variation in the error greater than ± 0.3 % at 0.1 I_b, for a power factor of 1 (2)
In addition, for three-phase meters		
Phase Order	Direct sequence	
Imbalance of the voltages and currents (3)	None	As in paragraph 5.2. e), replacing 1 % by 1.5 %

(1) The tests may be carried out at a temperature outside the range 21-25 °C, but within the range 15-30 °C, as long as a correction is made in relation to the reference temperature of 23 °C by using the mean temperature coefficient indicated by the manufacturer.

(2) See note 2 to Table III.

(3) Except for tests with a single-phase load.

7.1.3. Results of (or assent to) acceptance

7.1.3.1. Test of dielectric rigidity (test n° 1)

The test of dielectric rigidity consists in applying an AC voltage of frequency 50 Hz and effective value 2 kV between all the terminals connected together and the flat metal surface on which the meter is placed.

7.1.3.2. Mechanical qualities (tests nos. 2 and 12)

The tests to be carried out regularly, with the casing closed, are as follows :

- apparent good condition of the casing and terminal plate;
- correct positioning of the dial;
- presence of all the prescribed indications.

The checks necessitating the opening of the casing are as follows, and should be carried out after the other tests on five meters chosen at random, whatever the size of the batch of meters to be checked :

- quality of the surface protection, e.g. of paint;
- gear ratios;
- nature of the gearing of the indicating device;
- quality of the soldering;
- tightness of the screws;
- absence of filings and metallic dust;
- margins of adjustment.

7.1.3.3. Running without load (test n° 3)

The meter being supplied with electricity at the reference voltage, with a power factor of 1, by a current equal to 0.001 I_b, the rotor must not complete a whole revolution.

7.1.3.4. Starting (test n° 4)

The meter being supplied with electricity at the reference voltage, with a power factor of 1, by a current equal to 0.006 I_b, the rotor should start up and make more than 1 revolution.

7.1.3.5. Accuracy tests (tests nos. 5 to 10)

The accuracy tests should be carried out for the current values and power factors indicated in Table VI, without the need to wait for the thermal balance of the windings to be reached. If these tests are carried out under the conditions given in Table V, the maximum permissible errors, given in Tables I and II, are increased to the values indicated in Table VI.

Table VI

Test No.	Current Value	Power Factor	Meters	Load of three-phase Meters	Maximum Permissible Errors
5	0.05 I_b	1	Single-phase and three-phase	Balanced	± 3.5 %
6	I_b	1	"	"	± 2.5 %
7	I_b	0.5 induct.	"	"	± 3 %
8 and 9	I_b	1	three-phase	1 phase loaded (1 test in 2 of the phases)	± 3.5 %
10	I_{max}	1	Single-phase and three-phase	Balanced	± 2.5 %

The permissible limits of error must not be systematically exploited in the same direction.

7.1.3.6. Check on the agreement of the indicating device with the reading constant of the meter (test n° 11)

The check on the indicating device of a batch is effected either on the whole batch or on a sample of 40 meters chosen at random from a batch comprising up to 1000 units. When the check is made at the manufacturer's it may be carried out with the casing open.

The duration of the test and the method used must be chosen in such a way that the uncertainty of measurement does not exceed 2 %. When a meter in the sample exceeds the tolerances, the check must be made on each unit in the whole batch. In addition, a test will be carried out on five meters with casing open with an uncertainty of measurement not exceeding 0.5 %.

7.1.3.7. Uncertainty of measurement

The quality of the measuring instruments and of the other apparatus used to carry out tests nos. 2 to 9 must be such that the errors of measurement which can be attributed to them do not exceed in relative value :

± 0.4 % with a power factor of 1
± 0.6 % with a power factor of 0.5 (inductive).

7.2. Examination for conformity to the model

7.2.1. Nature of the examination for conformity to the model

In order to determine whether the metrological qualitites of the meters manufactured and presented for primary examination conform to the regulations given in this Directive, an examination for conformity to the model should be carried out at intervals determined by the competent authority, on a meter chosen at random after the acceptance tests.

This examination consists, at least, in the drawing up of two graphs of error, one between 0.05 I_b and I_{max} with a power factor of 1, and the other between 0.1 I_b and I_{max} with a power factor of 0.5 (inductive) and, possibly, in any other test described in this Directive which may appear necessary to the competent authority.

Note

When the manufacture of meters of a given model is regular, it is desirable that the frequency of the examination for conformity to the model should be geared to the volume of production.

In addition, this procedure should be carried out each time any faults which seem systematic are discoverd during the acceptance tests or during other tests.

7.2.2. Authority of the examination for conformity to the model

The results of the examination for conformity to the model must be consistent with the specifications given in Articles 2, 3 and 5 of this Directive. However, in order to take into account the possible errors arising from the means of calibration and from the dispersal of output from the factory, it is permissible when drawing the graphs of error corresponding to Table I (and possibly to Table II), to move the axis of abscissae parallel to itself by a value not exceeding 0.5 %, the same for all the graphs. In addition, if a starting test is carried out, it should be under the conditions of paragraph 7.1.3.4. (current equal to 0.006 I_b).

If the meter examined does not comply with these conditions, the competent authority must carry out more frequent and possibly more complete examinations for conformity to the model, until it appears that the meters manufactured again comply with the requirements of this Directive.

If successive examinations for conformity to the model show that the quality of manufacture cannot be improved in order to comply with the requirements of this Directive, the competent authority should revoke the type approval.

7.3. Ratification marks and sealing

Meters which have successfully undergone the tests of the primary examination shall be sealed.

The seals shall include the marks of the EEC primary examination and shall be affixed in such a way that it shall be impossible to remove the lid of the meter, to gain access to the meter and braking components, the controls, the moveable parts and the indicating device, without damaging the primary ratification marks.