

Official Journal

of the European Communities

Volume 19 No L 336

4 December 1976

English Edition

Legislation

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II

(Acts whose publication is not obligatory)

COUNCIL

COUNCIL DIRECTIVE

of 4 November 1976

on the approximation of the laws of the Member States relating to radio interference caused by electrical household appliances, portable tools and similar equipment

(76/889/EEC)

THE COUNCIL OF THE EUROPEAN COMMUNITIES,

Having regard to the Treaty establishing the European Economic Community, and in particular Article 100 thereof,

Having regard to the proposal from the Commission,

Having regard to the opinion of the European Parliament ⁽¹⁾,

Having regard to the opinion of the Economic and Social Committee ⁽²⁾,

Whereas in most Member States electrical household appliances, portable tools and similar equipment which cause radio interference are subject to mandatory provisions relating to such possible interference; whereas such provisions differ from one Member State to another;

Whereas the differences between such national provisions are a barrier to trade in electrical household appliances, portable tools and similar equipment likely to cause radio interference; whereas for that reason they directly affect the establishment and functioning of the common market;

Whereas it is therefore necessary to lay down at Community level the rules to be observed with regard to the permissible upper limits of the radio interference caused by the appliances covered by this Directive, together with the methods for measuring such interference;

Whereas, as a general rule, when applying interference limits it is necessary to distinguish between interference heard as a continuous sound or a 'buzz' as distinct from interference heard as a 'click';

Whereas in order to measure the interference produced by the appliances covered by this Directive, it is necessary to operate the appliance under specified conditions, to interpret in a uniform manner the values given by the measuring apparatus and to carry out the measurement in accordance with a defined statistical procedure based on uniform rules of evaluation, to ensure that the results conform with the limits laid down;

Whereas technical progress necessitates frequent adaptation of the technical requirements contained in this Directive and in subsequent Directives in the field of radio interference; whereas in order to facilitate implementation of the necessary measures, a procedure should be set up for establishing close cooperation between Member States and the Commission in the Committee responsible for adapting to technical progress Directives for eliminating technical barriers to trade in equipment likely to cause radio interference,

⁽¹⁾ OJ No C 37, 4. 6. 1973, p. 8.

⁽²⁾ OJ No C 52, 5. 7. 1973, p. 23.

HAS ADOPTED THIS DIRECTIVE:

Article 1

1. The purpose of this Directive is the approximation of the laws, regulations and administrative provisions of the Member States relating to radio interference caused by electrical household appliances, portable tools and similar equipment which cause a similar type of continuous or discontinuous radio interference, by fixing the permissible upper limits for the interference caused by such equipment and the methods for measuring such interference.

2. The scope of this Directive is specified in section 1 of the Annex.

3. 'Continuous' radio interference means the interference defined in section 2.1 and 'discontinuous' radio interference the interference defined in section 2.2 of the Annex.

Article 2

The equipment referred to in Article 1 may not be placed on the market unless it meets the requirements of this Directive with regard to the radio interference which it is likely to cause.

Article 3

1. The conformity of the equipment with the requirements of this Directive shall be certified by the manufacturer, assembler or importer, on his own responsibility, in a statement to be included in the instructions for use, the guarantee certificate or on the equipment itself.

2. The statement provided for in paragraph 1 shall be unnecessary where use is made of marks or certificates issued by the bodies notified by each Member State to the other Member States and to the Commission.

3. For a period of five and a half years from the time this Directive is notified, Member States may require that compliance by equipment with the requirements of this Directive shall be attested by marks or certificates issued on behalf of the competent authorities on the basis of prior type testing.

In the light of experience gained and the results obtained within the Community, all appropriate measures shall be taken in accordance with the procedure laid down in Article 8, within this period of five and a half years.

Article 4

Member States may not prohibit or prevent the placing on the market or use of equipment on grounds relating to radio interference, if such equipment meets the requirements of this Directive.

Article 5

Member States shall take the necessary steps to ensure that the methods of measurement used in official tests for verifying compliance with the permissible limits specified for each type of appliance, are in accordance with those specified in the Annex.

Article 6

1. The requirements of this Directive shall not prevent, with regard to the use of the equipment referred to in Article 1, the application in any Member State of the following measures to protect reception:

- (a) special measures, in the case of receiving stations used for public utility or safety purposes;
- (b) additional suppression measures, in isolated cases, where individual appliances, even though complying with the requirements of this Directive, have caused interference.

2. Member States shall inform the Commission of the special measures taken pursuant to paragraph 1 (a) and each year forward a brief summary of action taken in individual cases.

Article 7

1. A committee, hereinafter called 'the Committee', is hereby set up to adjust to technical progress the Directives on the elimination of technical barriers to trade in appliances causing radio interference. It shall consist of representatives of the Member States and be chaired by a Commission representative.

2. The Committee shall adopt its own rules of procedure.

3. Any amendments required to adapt the requirements of the Annex (excluding section 1) to technical progress shall be adopted in accordance with the procedure laid down in Article 8. However, such amendments must not result in a decrease in the

quality of radioelectric communications, including sound radio and TV reception, in the frequency range covered by this Directive.

Article 8

1. In the event of the procedure laid down in this Article being invoked, the matter shall be referred to the Committee by its chairman, either on his own initiative, or at the request of the representative of a Member State.

2. The Commission representative shall submit to the Committee a draft of the measures to be adopted. The Committee shall give its view on this draft within a period to be fixed by the chairman having regard to the urgency of the matter.

The Committee shall take its decisions by a majority of 41 votes, the votes of the Member States being weighted as provided for in Article 148 (2) of the Treaty. The chairman shall not vote.

3. (a) The Commission shall adopt the proposed measures where they are in accordance with the opinion of the Committee.

(b) Where the proposed measures are not in accordance with the opinion of the Committee, or if no view is given, the Commission shall without delay propose to the Council the measures to be adopted. The Council shall decide by a qualified majority.

(c) If, within three months of the matter being submitted to it, the Council has not taken a decision, the proposed measures shall be adopted by the Commission.

Article 9

1. Member States shall bring into force the provisions necessary in order to comply with this Directive within 18 months of its notification and shall forthwith inform the Commission thereof. Within the United Kingdom the 18-month period shall be extended to 30 months for the class of semi-conductor devices rated up to 1 000 W and intended for use as lighting dimmers.

2. Member States shall ensure that the texts of the provisions of national law which they adopt in the field covered by this Directive are communicated to the Commission.

Article 10

This Directive is addressed to the Member States.

Done at Brussels, 4 November 1976.

For the Council

The President

Th. E. WESTERTERP

ANNEX

1. SCOPE

- 1.1. These provisions shall apply to electrical household appliances, portable tools and other electrical equipment causing similar types of interference, continuous or discontinuous, such as office machines, cine or slide projectors, record players, milking machines, motor operated electromedical apparatus, regulating controls incorporating semi-conductors, electric fences, vending machines and slot-machines, etc., excluding appliances using in-built batteries.
- 1.2. Procedures are given for the measurement of interference and limits are laid down within the frequency range 0.15 to 300 MHz. There must be 80 % confidence that at least 80 % of the series-produced appliances comply with these limits.
- 1.3. Portable tools with a rated power exceeding 2 kW and regulating controls incorporating semi-conductors with a rated input current exceeding 16 A are excluded from the scope of this Directive.
- 1.4. Unattached motors, sold as such, are also excluded from the provisions of section 3 *et seq.* They shall carry a label drawing the attention of the user to the fact that he is responsible for any action necessary to ensure that his equipment complies with the requirements laid down.

2. DEFINITIONS

For the purpose of this Directive the following definitions shall apply.

2.1. Continuous interference

Continuous interference may arise from either impulsive or random noise or maybe a superposition of these, the disturbance lasting for more than 200 ms.

2.2. Discontinuous interference

Interference which is not continuous. In the calculation of limits and the measurement of discontinuous interference the following definitions are used.

2.2.1. Click

A disturbance which lasts not more than 200 ms, and which is separated from a subsequent disturbance by at least 200 ms. A click may contain a number of impulses. Examples of discontinuous interference which are classified as clicks are shown in figures 1a, 1b and 1c.

2.2.2. Counted clicks

Clicks which exceed the limit of continuous interference.

2.2.3. Switching operation

One opening or one closing of a switch or contact.

2.2.4. The minimum observation time T

In general, the time taken to register 40 counted clicks and to count 40 switching operations (see 6.1.1.5 for details).

2.2.5. Click rate N

The number of counted clicks per minute determined from the formula $N = n_1/T$; n_1 being the number of counted clicks during the observation time T minutes.

For certain appliances (see 3.2.6.4) the click rate N is determined from the formula $N = fn_2/T$, where n_2 is the number of switching operations during the observation time T and f is a factor given in Annex 1, Table D.

2.2.6. *Permitted limit L_q (for counted clicks)*

The relevant limit for continuous interference increased by a specified amount (given in 3.2.3 and 3.2.6).

2.2.7. *Typical value (of counted clicks)*

The value allocated to the equipment or appliance according to the upper-quartile method. That is, the equipment or appliance under test shall be deemed to comply with the limits if not more than a quarter of the counted clicks are higher than the permitted limit. Examples of application of the upper-quartile method are shown in Annex 2.

2.3. **Duty cycle**

Over a number of cycles of openings and closings the duty cycle is the sum of the times during which the contacts are closed expressed as a ratio of the total time.

3. **INTERFERENCE LIMITS**3.1. **Continuous interference**3.1.1. *Frequency range 0.15 to 30 MHz (terminal voltage)*

Limits of interference voltage produced in the frequency range 0.15 to 30 MHz are given in Table I.

TABLE I

Frequency range	Limits for the frequency range 0.15 to 30 MHz					
	Electrical household appliances and similar equipment	Portable tools			Regulating controls not incorporated	
		Rated power of motor				
		Up to and including 700 W	Above 700 W up to and including 1 000 W	Above 1 000 W up to and including 2 000 W	At mains terminals	At load terminals
(MHz)	dB (μV) mV	dB (μV) mV	dB (μV) mV	dB (μV) mV	dB (μV) mV	dB (μV) mV
0.15 to 0.50	66 2	66 2	70 3	76 6	66 2	80 10
0.50 to 5	60 1	60 1	64 1.5	70 3	60 1	74 5
5 to 30	66 2	66 2	70 3	76 6	66 2	80 10

Note: The limits apply across the whole frequency range but, for practical reasons, measurements may be made at the following preferred frequencies: 0.16; 0.24; 0.55; 1.0; 1.4; 2.0; 3.5; 6.0; 10 and 22 MHz; all of which have the permitted tolerance of $\pm 10\%$.

3.1.2. *Frequency range from 30 to 300 MHz (interference power)*

Tables II and III show the limits of interference power.

TABLE II

Frequency range	Limits for the frequency range 30 to 300 MHz			
	Electrical household appliances and similar equipment	Portable tools		
		Rated power of motor		
		Up to and including 700 W	Above 700 W up to and including 1 000 W	Above 1 000 W up to and including 2 000 W
(MHz)	dB (pW)	dB (pW)	dB (pW)	dB (pW)
30 to 300	45 to 55	45 to 55	49 to 59	55 to 65
increasing linearly with frequency				

Note: The limits indicated apply across the whole frequency range but, for practical reasons, measurements may be made at the six preferred frequencies, the limits for which are indicated in Table III. Each test frequency may be selected within a tolerance of ± 5 MHz.

TABLE III

Limits at preferred frequencies

Frequencies MHz	Limits dB (pW)			
	Electrical household appliances and similar equipment	Rated power of motors of portable tools		
		Up to and including 700 W	Above 700 W up to and including 1 000 W	Above 1 000 W up to and including 2 000 W
45	46	46	50	56
65	46	46	50	56
90	47	47	51	57
150	49	49	53	59
180	51	51	55	61
220	52	52	56	62

3.2. Discontinuous interference

For household appliances, portable tools, electric fence supply units and similar equipment, which produce discontinuous interference as defined in 2.2, limits shall be determined in accordance with 3.2.1 to 3.2.6. Annex 1 summarizes the limits for certain appliances for specified operating conditions. Limits for appliances not shown in Annex 1 shall be calculated in accordance with the principles laid down in 3.2.1 to 3.2.6 using as a guide the examples shown in Annex 1.

- 3.2.1. When switching operations produce more than two clicks in any two-second period, or interference other than clicks, the resulting interference shall, with the exception of that caused by appliances as detailed in 3.2.6.3, be subject to the limits for continuous interference laid down in 3.1.

Examples of discontinuous interference for which the limits for continuous interference apply are given in Figures 2a, 2b and 2c.

- 3.2.2. In the case of counted clicks not occurring more frequently than twice in any two-second period for all classes of equipment and appliances except those detailed in 3.2.6, the permitted limit L_q is as defined in 2.2.6 and set out in 3.2.3. Specific examples of formulae are shown in Annex 1, Tables A 1, B and C.

- 3.2.3. The permitted limit L_q applying to counted clicks in relation to the limit L for continuous interference, is obtained from the formulae:

$$L_q = (L + 44) (*) \quad [N < 0.2]$$

$$L_q = \left(L + 20 \log_{10} \frac{30}{N} \right) (*) \quad [0.2 \leq N \leq 30]$$

$$L_q = L (*) \quad [N > 30]$$

(*) dB (μ V) for the frequency range 0.15 to 30 MHz.

dB (pW) for the frequency range 30 to 300 MHz.

The value of N shall be determined at 160 kHz, 550 kHz and 45 MHz for the frequency ranges 150 to 500 kHz, 0.5 to 30 MHz and 30 to 300 MHz respectively.

- 3.2.4. Measurements of radio noise generated by switching operations shall be made at the following restricted number of frequencies: 160 kHz, 550 kHz, 1.4 MHz, 10 MHz, 45 MHz, 90 MHz and 220 MHz. A tolerance of $\pm 10\%$ is permitted for the first four frequencies, and $\pm 5\%$ for the other three. Further restriction to the following three frequencies is permitted for prolonged tests: 160 kHz, 550 kHz and 45 MHz.

- 3.2.5. The click rate N shall be determined under the operating conditions specified in section 6. The appliances shall therefore be operated under these conditions for the measurement of discontinuous interference.

- 3.2.6. For certain appliances, listed in the subsidiary points below, limits and conditions laid down in 3.2.1 to 3.2.5 shall apply with the exceptions specified.

- 3.2.6.1. Manually operated switches which are included in an appliance for the purpose only of mains isolation or programme selection (e.g. the switch for a lamp or an electric typewriter, but not stop-start switches of sewing machines and calculating machines) are exempted from the provisions of this Directive.

- 3.2.6.2. For appliances listed in Annex 1, Table B and the like, the limit in the frequency range 0.15 to 0.2 MHz shall be:

$$L_q = 70 + 20 \log_{10} \frac{30}{N} \text{ dB } (\mu\text{V}).$$

In addition, appliances listed in Annex 1, Table B and marked with a double asterisk, which have instantaneous switching (i.e. the duration of each click is less than 10 ms), and a click rate of not more than five shall be deemed to comply with the limit independently of the amplitude of the clicks.

- 3.2.6.3. For appliances which have a click rate N of less than five, any two disturbances caused by the sequential operation of two or more contacts, each disturbance having a maximum duration of 200 ms and neither preceded nor followed within two seconds by any other disturbance, shall be evaluated as two clicks even when the separation between the disturbances is less than 200 ms.

For this class of equipment, e.g. refrigerators, the example shown in Figure 2c would be evaluated as two clicks and not as continuous interference.

- 3.2.6.4. For appliances listed in Annex 1, Table D the click rate $N = f n_2 / T$, where n_2 is the sum of the switching operations during the observation time T minutes, and f is a factor given in Annex 1, Table D.

- 3.2.6.5. Limits for electric fence supply units are applicable only up to 30 MHz.

4. APPLICATION OF LIMITS IN TESTS FOR CONFORMITY OF APPLIANCES IN SERIES PRODUCTION

4.1. Tests shall be made:

4.1.1. either on a sample of appliances of the type using the statistical method of evaluation set out in 4.3,

4.1.2. or for simplicity's sake on one item only. The value measured must in this case be at least 2 dB less than the limit value.

4.2. Subsequent tests are necessary from time to time on items taken at random from the production especially in the case of 4.1.2. In the case of any dispute which could lead to a ban on sales, such a ban shall be considered only after tests have been carried out in accordance with 4.1.1.

4.3. Statistical assessment of compliance shall be made as follows:

This test shall be performed on a sample of not less than five and not more than 12 items of the type, but if in exceptional circumstances five items are not available, then a sample of three or four shall be used. Compliance is achieved when the following relationship is met:

$$\bar{x} + kS_n \leq L,$$

where

$\bar{x}$ = the arithmetic mean value of the interference levels of n items in the sample;

S_n^2 = the standard deviation of the sample, where

$$S_n^2 = \frac{1}{n-1} \sum (x - \bar{x})^2;$$

x = the interference level of an individual item;

k = the factor derived from tables of the non-central t -distribution which ensures with 80 % confidence that 80 % or more of the production is below the limit. Values of k as a function of n are given in the table below;

L = the limit;

x , $\bar{x}$, S_n and L are expressed logarithmically [dB (μ V) or dB (pW)].

n	3	4	5	6	7	8	9	10	11	12
k	2.04	1.69	1.52	1.42	1.35	1.30	1.27	1.24	1.21	1.20

5. MEASURING APPARATUS AND METHODS

5.1. Frequency range 0.15 to 30 MHz

— The measuring apparatus shall comply with the CISPR Publication 1 'Specification of CISPR radio interference measuring apparatus for the frequency range 0.15 MHz to 30 MHz' (1972), second edition.

— Measurements are made of the interference voltages produced by the apparatus at the terminals of an artificial mains V-network of 150 ohms impedance in accordance with that publication.

5.1.1. *Specific measures for regulating controls incorporating semi-conductor devices*

In the case of regulating controls incorporated within appliances, measurement shall be made in accordance with 5.1.

For such regulating controls as are not incorporated within an appliance the apparatus shall be arranged as shown in Figure 3, or in the case of two-terminal apparatus in accordance with the outline in Figure 3a. The load shall be of the correct rated value and unless otherwise stated by the manufacturer shall consist of incandescent lamps. Measurement of interference voltages at the mains terminals shall be made in accordance with the provisions of 5.1 above. Measurement of interference voltages at the load terminals shall be made using a probe consisting of a

capacitor and a resistor having a resistance of a minimum value of 1 500 ohms in series with the input of the measuring receiver. Due allowance shall be made for the voltage division between the probe and the measuring set.

During all such measurement, the regulating control shall be adjusted to give maximum indication on the measuring apparatus at each frequency.

5.1.2. *Electric fence supply units*

The unit under test shall be set up in accordance with Figure 4, the fence being replaced by a circuit having a 300 ohms resistance in series with a 10 nF capacitance (rated voltage 10 kV dc.).

The earth terminal of the fence circuit shall be connected to the earth terminal of the artificial mains V-network. If the terminals of the fence circuit are not clearly marked they shall each be earthed in turn.

Electric fence supply units designed to operate on ac or dc shall be tested with both kinds of current.

If the connecting device of the current source does not provide a fixed polarity, tests shall be made with both polarities.

The interference voltage shall be measured at terminals a, b and c of the circuit shown in figure 4, the appliance being in its normal position, with a maximum inclination of 15° from the vertical, and the controls accessible without tools set to the positions of maximum interference.

5.2. **Frequency range 30 to 300 MHz**

The measuring apparatus shall comply with CISPR Publication 2 'Specification for CISPR radio interference measuring apparatus for the frequency range 25 MHz to 300 MHz' (1961) and Amendment No 1 (1969).

5.3. Discontinuous interference measuring apparatus shall comply with CISPR Recommendation 41 (1970) 'Automatic Assessment of Interference produced by Switching Operations'.

Other methods shall be allowed if they yield the same results with the same degree of accuracy.

5.4. **Measurement of the duration of disturbances shorter than 10 ms**

It is necessary to determine the duration of the disturbances caused by the thermostats of appliances referred to in 3.2.6.2 having instantaneous switching. This duration may be determined in the following manner: the appliance to be tested is connected to a CISPR artificial mains V-network. If a CISPR meter is available, it is connected to the V-network and a cathode-ray oscilloscope is connected to the i.f. output of the CISPR meter. If a CISPR meter is not available, the oscilloscope is connected directly to the V-network. The time base of the oscilloscope can be started by the disturbances to be tested; the velocity of the time base is set to a value of 1-10 ms/cm. The phenomena can either be recorded on the screen of a storage oscilloscope or a photograph can be made, thus enabling the time duration to be measured.

6. **OPERATING CONDITIONS FOR APPLIANCES DURING TESTS**

6.1. **Conditions and duration of operations and interpretation of results**

6.1.1. The appliance is to be operated under the following conditions:

6.1.1.1. the load shall be as defined in 6.2, and 6.3 or, for appliances not covered by these paragraphs, under normal operating conditions as indicated in the manufacturer's instructions;

6.1.1.2. where an appliance is marked with an indication of the normal period of operation, the operating period shall be of that length; in all other cases no limit is set as to the operating period; it is recommended that the appliance be kept in operation while measurements are effected at various frequencies;

- 6.1.1.3. no running-in period is laid down, but prior to testing the appliance must have been used sufficiently for its operating condition to be representative of the operating condition during the normal life of the appliance; running-in shall be carried out by the manufacturer;
- 6.1.1.4. operation shall be from a supply having the rated voltage of the appliance. If the level of interference varies considerably with supply voltage, a test shall be conducted at frequencies for which the results are closest to the limits and at supply voltages between 0.9 and 1.1 times the rated voltage of the appliance. Appliances with more than one rated voltage must be tested at the rated voltage which causes maximum interference;
- 6.1.1.5. the minimum observation time *T* mentioned in 2.2.4 shall be, for equipment with automatic stop, a complete programme if this produces 40 or more counted clicks. If the programme does not produce 40 counted clicks, it shall be repeated in full as often as necessary to produce a minimum of 40 clicks, but with a two hour limit in the case of equipment without automatic stop if 40 clicks are not produced within such a period. The interval between the end of one programme and the start of the next programme shall be excluded from the observation time.
- 6.1.1.6. When determining *N* (but not when determining the typical value of counted clicks) the time *T* may be restricted to two hours for appliances which are not programme-controlled.
- 6.1.1.7. For programmed appliances and appliances with automatic stop, the programme which produces the greatest number of clicks shall be chosen for determining the click rate *N*.
- 6.1.2. For interpretation of the readings on the measuring set the following procedure shall be adopted:
 - 6.1.2.1. the readings on the measuring receiver shall be observed for at least 15 seconds at each measuring frequency, the highest reading being recorded;
 - 6.1.2.2. within the range 30 to 300 MHz, the tests must be carried out as follows.
 - 6.1.2.2.1. The entire spectrum shall be measured;
Note: For this purpose it is sufficient to measure at the following preferred frequencies: 45, 65, 90, 150, 180, 220 MHz, with a tolerance of ± 5 MHz.
 - 6.1.2.2.2. The measurements shall be repeated on at least one frequency close to each the following: 45, 90, 220 MHz.
 - 6.1.2.2.3. If differences of not more than 2 dB are observed between the levels of interference as measured in 6.1.2.2.1 and 6.1.2.2.2, for the frequencies concerned, the curve obtained under 6.1.2.2.1 shall be adopted. If the differences are greater than 2 dB, the measurement shall be repeated for the entire spectrum and the highest level of all measurements at each frequency shall be adopted.
- 6.2. **Standardized loads for electric motor-operated appliances**
 - 6.2.1. *Electric motor-operated appliances for household and similar purposes*
 - 6.2.1.1. Vacuum cleaners: to be operated continuously without accessories and with maximum air flow, but with dust bag in place.
 - 6.2.1.2. Floor polishers: to be operated continuously without mechanical load on the polishing brushes.
 - 6.2.1.3. Sewing machines:
 - (a) continuous interference from the motor: the motor to be operated continuously with sewing mechanism *in situ* but not sewing a fabric. The regulator must be set in the position for maximum speed.
 - (b) interference during starting and stopping: the speed of the motor to be increased to maximum speed over a five-second period. For stopping, the regulator is to be reset quickly. To determine the click rate *N*, the period between two starts shall be 15 seconds.

- 6.2.1.4. Juice extractors: as in 6.2.1.7.
- 6.2.1.5. Clocks: continuous operation.
- 6.2.1.6. Fans: continuous operation with maximum air flow: if heating is incorporated, the fan should be tested both with and without heating.
- 6.2.1.7. Food mixers (kitchen type): to be operated without load and set first at half speed, then at maximum speed.
- 6.2.1.8. Liquid mixers: as in 6.2.1.7.
- 6.2.1.9. Refrigerators: to be operated continuously with door closed. The thermostat to be set to the middle of the range. The cabinet shall be empty and not heated. Measurement is made when the steady state has been reached.
The click rate N is calculated on the basis of half the number of switching operations per hour.
- 6.2.1.10. Washing machines: to be operated with water but without washing. When a thermostat is fitted it must be adjusted to the maximum setting or to 90 °C whichever is lower. The programme should be set to produce the highest value for N.
- 6.2.1.11. Spin dryers: to be tested in continuous operation without load.
- 6.2.1.12. Dish-washing machines: as in 6.2.1.10.
- 6.2.1.13. Hair dryers: as in 6.2.1.6.
- 6.2.1.14. Shavers and hair clippers: to be tested in continuous operation without load for not more than 10 minutes.
- 6.2.1.15. Massage appliances: to be tested in continuous operation without load.
- 6.2.1.16. Office machines, vending machines and amusement machines
 - 6.2.1.16.1. Typewriters: continuous operation.
 - 6.2.1.16.2. Adding and calculating machines and cash registers:
 - (a) Interference from motors: if possible, the motor should operate for a sufficient period of time to give steady readings unaffected by switching disturbances.
 - (b) Interference from switches: intermittent operation with at least 30 starts per minute. If 30 starts per minute cannot be attained, then intermittent operation with as many starts per minute as possible in practice must be used.
 - 6.2.1.16.3. Vending machines and amusement machines: as in 6.1.1.7.
- 6.2.1.17. Projectors
 - 6.2.1.17.1. Cinema projectors: to be tested in continuous operation with film and with the lamp switched on.
 - 6.2.1.17.2. Slide projectors: to be tested in continuous operation without slides but with lamp switched on. The click rate N is determined on a basis of four picture-changes per minute, but without slides.
- 6.2.1.18. Coffee grinders: to be operated without grinding charge.
- 6.2.1.19. Lawn mowers: to be operated continuously without load.

- 6.2.1.20. Milking machines: to be operated continuously without vacuum.
- 6.2.2. *Portable tools with electric motors*
Hand-held tools which incorporate vibrating or swinging masses shall where possible be measured with these masses removed or disconnected unless otherwise stated.
- 6.2.2.1. Drills: to be operated continuously without load.
- 6.2.2.2. Screwdrivers and impact wrenches: as in 6.2.2.1.
- 6.2.2.3. Grinders, disc type sanders and polishers: as in 6.2.2.1.
- 6.2.2.4. Sanders, other than disc sanders: as in 6.2.2.1.
- 6.2.2.5. Saws and cutters: as in 6.2.2.1.
- 6.2.2.6. Hammers: as in 6.2.2.1.
- 6.2.2.7. Spray guns: to be operated continuously without accessories and with empty reservoir.
- 6.2.2.8. Shears: as in 6.2.2.1.
- 6.2.2.9. Thread cutting machines: as in 6.2.2.1.
- 6.2.2.10. Compass saws for wood and similar material: as in 6.2.2.1.
- 6.2.2.11. Liquid agitators (internal vibrators) with agitators fitted: to be operated continuously in the centre of a round steel-plate container filled with water, the volume of water being equal to 50 times that of the agitator (vibrator).
- 6.2.2.12. Impact drills: as in 6.2.2.1.
- 6.2.2.13. Planing machines: as in 6.2.2.1.
- 6.2.3. *Sound recording and reproduction equipment*
- 6.2.3.1. Record players: to be operated continuously without record.
- 6.2.3.2. Magnetic recorders: to be operated continuously using a magnetic recording medium.
- 6.2.3.3. Sound-film projectors: to be operated continuously with film, the lamp being switched on.
- 6.2.4. *Electro-medical equipment with motor*
Paragraph 6.2.4 is under revision to take account of current techniques.
- 6.2.4.1. Dental drills:
(a) continuous interference from the motor: the motor to be operated continuously with the drilling gear but not drilling a material. The speed control shall be set to the position for maximum speed.
(b) interference during starting and stopping: as in 6.2.1.3.
- 6.2.4.2. Saws and scalpels: to be operated continuously without a load.
- 6.2.4.3. Electro-cardiographs and similar recorders: to be operated continuously with a recording tape.

6.2.4.4. **P u m p s** : to be operated continuously with liquid.

6.3. **Supplementary conditions for household electrical and similar appliances without a motor**

Before measurement, the appliances should reach a state of thermal equilibrium.

If the specified duty cycle (see 2.3) cannot be achieved the switching rate applied should be the highest possible.

6.3.1. *Cookers, appliances with one or more hot plates controlled by thermostats or energy regulators*

To be tested under conditions of adequate heat discharge; an aluminium saucepan filled with water is placed on the hot plate and brought to the boil. The click rate N is equal to half the number per minute of the switching operations for a 50 % duty cycle.

6.3.2. *Cooking ovens*

To be operated without utilization of the heat developed, the door being closed. N is determined with the control set for a 50 % duty cycle.

6.3.3. *Plate warmers, heated tables, heated drawers, hot-presses*

To be operated without utilization of the heat developed. N is determined with the control set for a 50 % duty cycle.

6.3.4. *Steam generators for indirect heating of appliances in the hotel industry, open water-baths*

To be operated under conditions of adequate heat discharge and using the normal quantity of water. N is determined with the control set for a 50 % duty cycle.

6.3.5. *Frying pans, table-type spit-roasters, deep-fryers*

To be operated under conditions of adequate heat discharge. The quantity of oil above the hottest point of the heated surface should be:

30 mm for frying pans (sauté pans)

10 mm for table-type spit-roasters

10 mm for deep fryers (unless a minimum oil level is specified).

N is determined with the control set for a 50 % duty cycle.

6.3.6. *Waffle irons, grills*

To be operated without utilization of the heat developed, the lid being closed. N is determined with the control set for a 50 % duty cycle.

6.3.7. *Cauldrons, cooking pots, fixed water boilers, casseroles, kettles, percolators, milk-warmers, feeding-bottle warmers, glue boilers, sterilizers, wash-boilers*

To be operated under conditions of adequate heat discharge, half-filled with water and with the lid off. If it is possible to regulate the temperature, the click rate N shall be determined with a medium setting.

6.3.8. *Absorption refrigerators*

As in 6.2.1.9.

6.3.9. *Ironing machines (table, roller, pressing machines)*

The repetition rate N for the clicks caused by the thermostat shall be determined without utilization of the heat developed, the heated surface being in the open position and the thermostat set to a high temperature. The repetition rate N for any motor control contacts shall be determined under such conditions that the heat discharged permits the ironing of two damp hand-towels (of approximately 1 m × 0.5 m) per minute. To establish the permitted limit of interference, the two values of N should be added.

6.3.10. *Smoothing irons*

To be tested with suitable heat discharge, using air, oil, or water cooling. N is taken as 0.66 times the number of switching operations for a duty cycle of 50 % and a high temperature setting.

6.3.11. *Room heaters* (convection radiators, oil-filled heaters etc.)

To be operated under conditions of adequate heat discharge. N is determined with the control set for a duty cycle of 50 %.

6.3.12. *Hair dryers*

As in 6.3.11.

6.3.13. *Toasters*

To be tested under conditions of adequate heat discharge with slices of bread about 24 hours old (dimensions approximately 10 cm x 9 cm x 1 cm), each cycle comprising a period of operation and a period of rest. The rest period should last 30 seconds. N should be determined for a setting giving golden-brown toast.

6.3.14. *Instantaneous water heaters, storage heaters, non-storage heaters*

To be tested under conditions of adequate heat discharge, the temperature of the water entering not exceeding 35 °C. N shall be determined with the control mechanism set for a duty cycle of 50 %.

6.3.15. *Flexible electrical heating appliances* (pillows, blankets, bed-warmers, heating mattresses)

Should be stretched out between two soft coverings (for example, insulating mats) extending beyond the heating surface by at least 10 cm. The thickness and the thermal conductivity must be chosen so that N can be determined with the control set for a duty cycle of 50 %.

6.3.16. *Thermostats for controlling electric room heaters or water heaters, oil or gas burners and the like* (as in 6.3.11)

Where the thermostat can in practice be connected to a relay or contactor, all measurements should be taken using as a load such a device, having the highest coil inductance used in practice. In order to effect satisfactory measurement, the contacts must be operated a sufficient number of times at a suitable load in order to ensure that interference levels are representative of those registered in normal operation.

Figure 1: Examples of discontinuous interference classified as clicks (see 2.2.1)

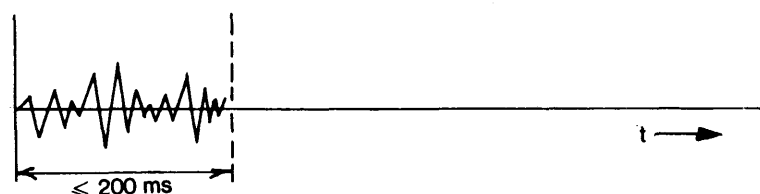


Figure 1a

One click

Disturbance not longer than 200 ms consisting of a continuous series of impulses



Figure 1b

One click

Individual impulses shorter than 200 ms, spaced closer than 200 ms, and not continuing for more than 200 ms

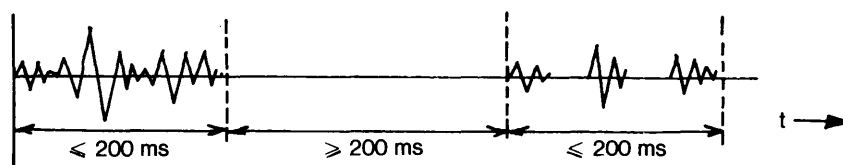


Figure 1c

Two clicks

Two disturbances, neither exceeding 200 ms, and spaced by minimum of 200 ms

Figure 2: Examples of discontinuous interference for which the limits of continuous interference apply (see 3.2.1)

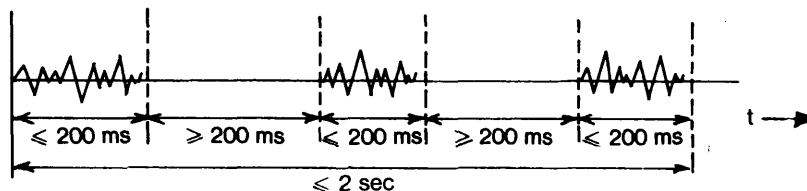


Figure 2a

More than two disturbances of duration less than 200 ms spaced by 200 ms or more, in a period of two seconds

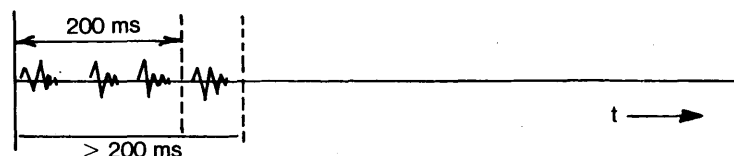


Figure 2b

Individual impulses shorter than 200 ms spaced closer than 200 ms and continuing for more than 200 ms

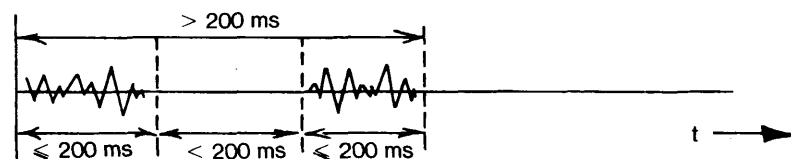
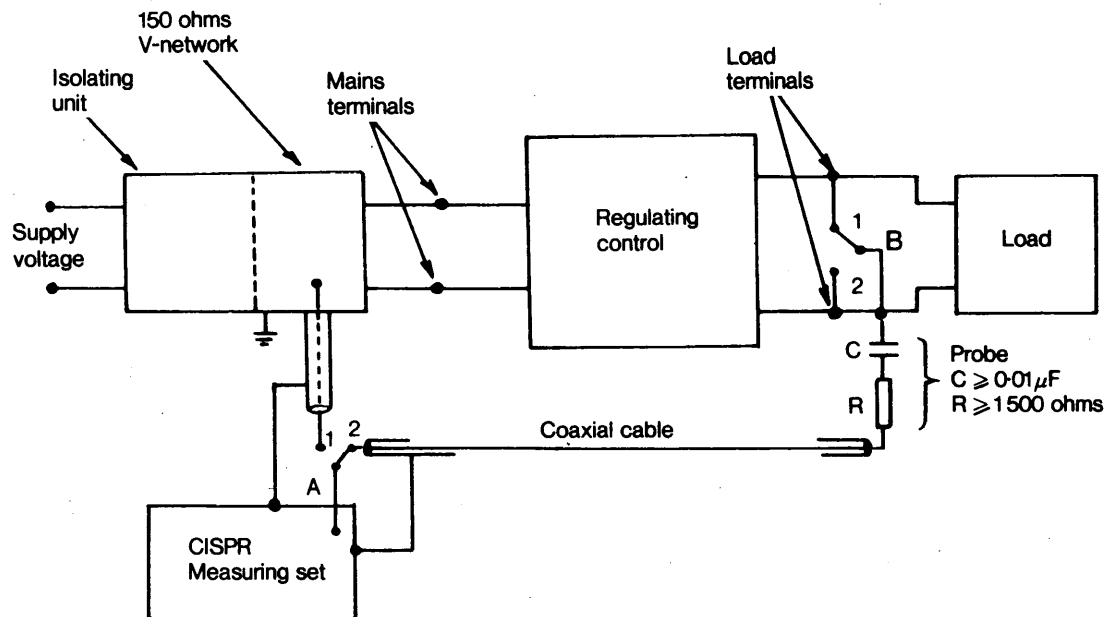


Figure 2c

Two disturbances spaced by less than 200 ms and continuing for more than 200 ms.

Figure 3: Measuring arrangement for regulating controls (see 5.1.1)



Switch positions

- A 1 — For mains measurements
A 2 — For load measurements
B 1 } Successive connections during load measurement
B 2 }

Notes: 1. The earth of the measuring set shall be permanently connected to the V-network.

2. The length of the coaxial cable from the probe shall not exceed 2 m.
3. When the switch A is in position 2 the output of the V-network at terminal 1 shall be closed by an impedance equivalent to the input impedance of the CISPR measuring set.
4. The leads connecting the load to the output terminal shall be from 0.5 to 1 m in length.
5. Where a two-terminal regulating control is inserted in one leg only of the supply, measurements shall be made in associating the second leg of the supply as follows:

Figure 3a: Layout for measurement of two-terminal regulating controls (see 5.1.1)

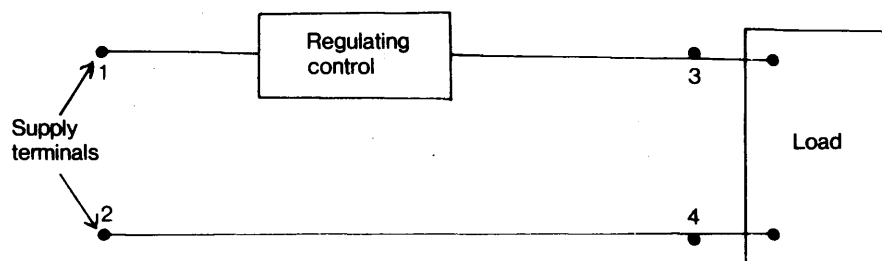
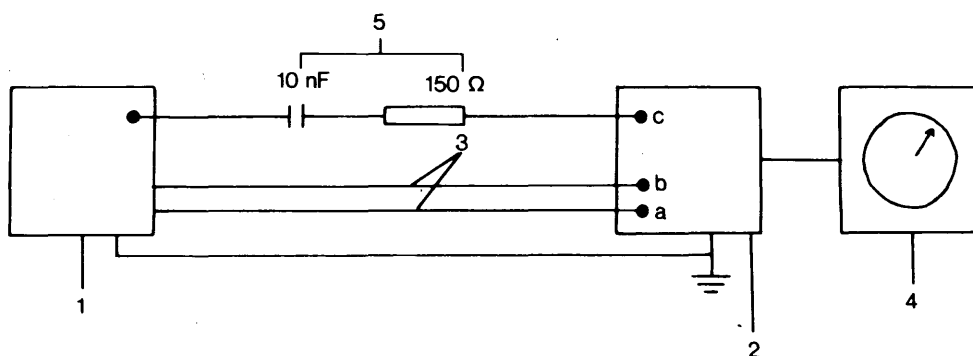


Figure 4: Arrangement for measurement of interference voltage produced by an electric fence supply unit (see 5.1.2)



1. Supply unit of electric fence.
2. V-network conforming to Figure 9, Appendix D of CISPR Publication 1 (the network presents an impedance of 150 ohms between each of the terminals a, b and c and earth).
3. Mains lead to supply unit for the electric fence.
4. CISPR receiver, in accordance with CISPR Publication 1.
5. Elements of the equivalent circuit to replace the fence (the specified resistance of 300 ohms is provided by the 150 ohm resistance in series with the resistances of the V-network).

Annex 1

Limits of radio noise produced by the switching operations of specific appliances when the formula $20 \log_{10} 30/N$ is applicable

TABLE A 1

Type of appliance	Special conditions	Frequency range (MHz)	Limit
Steam generators	None	0.15 — 0.5	$66 + 20 \log_{10} \frac{30}{N}$ dB (μ V)
Sauté pans			
Table spit-roasters			
Waffle grills			
Feeding bottle heaters		0.5 — 5.0	$60 + 20 \log_{10} \frac{30}{N}$ dB (μ V)
Glue pots			
Rotating ironing machines		5.0 — 30	$66 + 20 \log_{10} \frac{30}{N}$ dB (μ V)
Fan heaters			
Oil-filled heaters and the like		30 — 300	$(45-55) + 20 \log_{10} \frac{30}{N}$ dB (pW) (increasing linearly)
Hair dryers			
Thermal and non-thermal storage water-heaters			
Heating mattresses			
Electric fences			3.2.1 to 3.2.5 apply
Washing machines			
Dishwashing machines			

TABLE A 2

Type of appliance	Special conditions	Frequency range (MHz)	Limit
Sewing machine starter switches			As for Table A 1, but values of N are derived according to 6.2 (see also Table D)
Dental drill starter switches			
Table and free standing ironing machines			
Ironing presses			
Sewing machine speed controls			
Dental drill speed controls			
Adding machine starter switches			
Calculating machine starter switches			
Cash register starter switches			
Slide projector picture change devices			

TABLE B

Type of appliance	Special conditions	Frequency range (MHz)	Limit
Warming plates	None	{ 0.15 — 0.2 0.2 — 0.5 0.5 — 5 5 — 30 30 — 300	
Cooking ovens			
Deep fat fryers			
Space heaters			
Fan heaters			
Convectors			$70 + 20 \log_{10} \frac{30}{N}$ dB (μ V)
Refrigerators (*)			$66 + 20 \log_{10} \frac{30}{N}$ dB (μ V)
Immersion heaters			$60 + 20 \log_{10} \frac{30}{N}$ dB (μ V)
Water baths			$66 + 20 \log_{10} \frac{30}{N}$ dB (μ V)
Instantaneous water heaters			$(45-55) + 20 \log_{10} \frac{30}{N}$ dB(pW)
Waffle irons			(increasing linearly)
Kettles			
Coffee percolators			
Milk warmers			
Sterilizers			
Warming pads			
Blankets			
Bedwarmers			
Separate thermostats for control of room or water heaters and oil burners			3.2.6.2 applies
Irons (**)			
Frying pans (**)			
Automatic toasters (**)			
Cooking ranges with automatic plates (**)			
Stewing pans (**)			

(*) See also 3.2.6.3.

(**) When the conditions < 10 ms click, $N \leq 5$ are fulfilled, there is no amplitude limit.

TABLE C

Type of appliance	Special conditions	Frequency range (MHz)	Limit
All appliances except those appearing in Table B for which the limit is 114 dB (μ V) in the frequency range 0.15—0.2 MHz	For values of $N < 0.2$	0.15 — 0.5	110 dB (μ V)
		0.5 — 5	104 dB (μ V)
		5 — 30	110 dB (μ V)
		30 — 300	89—99 dB (pW)
			3.2.3 applies

TABLE D

Click rate $N = \frac{fn_2}{T}$ where n_2 is the sum of the openings and closings (switching operations) during the observation time T minutes

Type of appliance	Factor f	Special conditions see points below	Limit
Cooking ranges	0.5	6.3.1	See Tables A 1, A 2, B and C
Appliances with one or more boiling flames controlled by thermostats or energy regulators	0.5	6.3.1	
Refrigerators	0.5	6.2.1.9	
Irons	0.66	6.3.10	
Speed controls and starting switches for sewing machines	1.0	6.2.1.3	
Dental drills	1.0	6.2.4.1	
Starting switches for adding machines	1.0	6.2.1.16.2	
Calculating machines	1.0	6.2.1.16.2	
Cash registers	1.0	6.2.1.16.2	
Slide projectors	1.0	6.2.1.17.2	

Annex 2

Examples of use of the upper quartile method to determine compliance with reference limits

(see 2.2.7)

Click No Level db (μ V)	Test record No									
	1	2	3	4	5	6	7	8	9	10
	94	100	98	102	97	90	98	99	96	94
	11	12	13	14	15	16	17	18	19	20
	94	90	97	94	100	94	99	80	96	91
	21	22	23	24	25	26	27	28	29	30
	87	88	98	88	86	80	94	90	92	83
	31	32	33	34	35	36	37	38	39	40
	96	86	96	86	98	92	97	90	97	90
	41	42	43	44	45					
	98	93	97	99	100					

Example I: Deep fat fryer (appliance rejected)

Total time of the record (T) = 35 min.

Total number of clicks (n_1) = 45.

$$N = \frac{45}{35} = 1.3$$

$$20 \log_{10} \frac{30}{N} = 20 \log_{10} \frac{30}{1.3} = 27.5 \text{ dB}$$

Admissible level for 160 kHz = 70 + 27.5 = 97.5 dB (μ V).In this example 12 clicks (Nos 2, 3, 4, 7, 8, 15, 17, 23, 35, 41, 44 and 45) are above the limit of 97.5 dB (μ V).As only $\frac{45}{4} = 11$ such clicks are allowed, the appliance has to be rejected.*Example II:* Oil heater (appliance accepted)

Total time of record (T) = 135 min.

Total number of clicks (n_1) = 45.

$$N = \frac{45}{135} = \frac{1}{3}$$

$$20 \log_{10} \frac{30}{N} = 20 \log_{10} 90 = 39.2 \text{ dB}$$

Admissible level for 160 kHz = 66 + 39.2 = 105.2 dB (μ V).In this example no clicks are above the limit of 105.2 dB (μ V) and the appliance is accepted.

COUNCIL DIRECTIVE

of 4 November 1976

on the approximation of the laws of the Member States relating to the suppression of radio interference with regard to fluorescent lighting luminaires fitted with starters

(76/890/EEC)

THE COUNCIL OF THE EUROPEAN COMMUNITIES,

Having regard to the Treaty establishing the European Economic Community, and in particular Article 100 thereof,

Having regard to the proposal from the Commission,

Having regard to the opinion of the European Parliament ⁽¹⁾,

Having regard to the opinion of the Economic and Social Committee ⁽²⁾,

Whereas, in most Member States, fluorescent lighting luminaires fitted with starters are subject to mandatory provisions relating to the suppression of radio interference; whereas such provisions differ from one Member State to another;

Whereas the differences between such national provisions relating to the suppression of radio interference are a barrier to trade in fluorescent lighting luminaires fitted with starters and make it necessary for undertakings in the Community which manufacture them to differentiate their products according to their Member State of destination; whereas for that reason they directly affect the establishment and functioning of the common market;

Whereas it is therefore necessary to lay down at Community level the rules to be observed with regard to the permissible minimum values for insertion loss of fluorescent lighting luminaires fitted with starters covered by this Directive, together with the methods for measuring such insertion loss;

Whereas the insertion loss may vary from one luminaire to another depending on the position of the fluorescent tube,

HAS ADOPTED THIS DIRECTIVE:

Article 1

1. The purpose of this Directive is the approximation of the laws, regulations and

administrative provisions of the Member States relating to the suppression of radio interference with regard to fluorescent lighting luminaires fitted with starters, by fixing the permissible minimum values for insertion loss of such luminaires and the methods for measuring such insertion loss.

2. The scope of this Directive is specified in section 1 of the Annex.

Article 2

The equipment referred to in Article 1 may not be placed on the market unless it meets the requirements of this Directive.

Article 3

1. The conformity of fluorescent lighting luminaires fitted with starters with the requirements of this Directive shall be certified by the manufacturer, assembler or importer, on his own responsibility, in a statement to be included in the instructions for use, the guarantee certificate or on the equipment itself.

2. The statement provided for in paragraph 1 shall be unnecessary where use is made of marks or certificates issued by the bodies notified by each Member State to the other Member States and to the Commission.

3. For a period of five and a half years from the time this Directive is notified, Member States may require that compliance by equipment with the requirements of this Directive shall be attested by marks or certificates issued on behalf of the competent authorities on the basis of prior type testing.

In the light of experience gained and the results obtained within the Community, all appropriate measures shall be taken, within this period of five and a half years, in accordance with the procedure laid down in Article 8 of Council Directive 76/889/EEC of 4 November 1976 on the approximation of the laws of the Member States relating to radio interference caused by electrical household appliances, portable tools and similar equipment ⁽³⁾.

⁽¹⁾ OJ No C 37, 4. 6. 1973, p. 8.

⁽²⁾ OJ No C 52, 5. 7. 1973, p. 33.

⁽³⁾ See page 1 of this Official Journal.

Article 4

Member States may not prohibit or prevent the placing on the market or use of luminaires on grounds relating to the suppression of radio interference if such luminaires meet the requirements of this Directive.

Article 5

Member States shall take the necessary steps to ensure that the methods of measurement used in official tests for verifying compliance with the requirements relating to the suppression of interference are in accordance with those specified in the Annex.

Article 6

1. The requirements of this Directive shall not prevent, with regard to the use of the equipment referred to in Article 1, the application in any Member State of the following measures to protect reception:

- (a) special measures, in the case of receiving stations used for public utility or safety purposes;
- (b) additional suppression measures in isolated cases, where individual appliances, even though complying with the requirements of this Directive, have caused interference.

2. Member States shall inform the Commission of the special measures taken pursuant to paragraph 1 (a) and each year forward a brief summary of action taken in individual cases.

Article 7

Any amendments needed to adapt the requirements of the Annex (excluding section 1) to technical progress shall be adopted in accordance with the procedure laid down in Article 8 of Directive 76/889/EEC. However, such amendments must not result in a decrease in the quality of radioelectric communications, including sound radio and TV reception.

Article 8

1. Member States shall bring into force the measures necessary in order to comply with this Directive within 18 months of its notification and shall forthwith inform the Commission thereof.

2. Member States shall communicate to the Commission the texts of the provisions of national law which they adopt in the field covered by this Directive.

Article 9

This Directive is addressed to the Member States.

Done at Brussels, 4 November 1976.

For the Council

The President

Th. E. WESTERTERP

ANNEX

1. SCOPE

These provisions relate to fluorescent lighting luminaires fitted with starters.

The provisions of 2.2 *et seq.* shall apply to luminaires for residential areas. Unsuppressed luminaires shall be subject only to the labelling requirements of 2.1.

2. GENERAL REQUIREMENTS

2.1. Labelling of unsuppressed luminaires

The words 'unsuppressed luminaire for use in non-residential areas' must be printed on the luminaire. These words shall be used until the Committee on adjustment to technical progress has settled on an alternative.

Note: The definition of non-residential areas is a matter for the competent national authority.

2.2. Minimum values of insertion loss

The minimum values of insertion loss shall be met by at least 80 % of series-produced luminaires with 80 % confidence.

Methods of application of the minimum values of insertion loss are shown in section 4.

3. MINIMUM VALUES OF INSERTION LOSS

The minimum values of insertion loss at preferred measuring frequencies are given in Table I.

TABLE I

Minimum values of insertion loss

Frequency kHz	160	240	550	1 000	1 400
Minimum values of insertion loss (dB)	28	26	24	22	20

4. APPLICATION OF MINIMUM VALUES OF INSERTION LOSS IN TESTS FOR CONFORMITY OF LUMINAIRES IN SERIES PRODUCTION

4.1. Tests shall be made

4.1.1. either on a sample of luminaires of the type using the statistical method of evaluation set out in 4.3.

4.1.2. or, for simplicity's sake, on one luminaire only.

4.2. Subsequent tests are necessary from time to time on luminaires taken at random from the production especially in the case of 4.1.2. In the case of any dispute which could lead to a ban on sales, such a ban shall be considered only after tests have been carried out in accordance with 4.1.1.

4.3. Statistical assessment of compliance shall be made as follows:

This test should be performed on a sample of not less than five, and not more than 12 items of the type, but if in exceptional circumstances five items are not available, then a sample of three or four shall be used. Compliance is achieved when the following relationship is met:

$$\bar{x} - k S_n \geq L, \text{ where}$$

$\bar{x}$ is the arithmetic mean value of the insertion losses of n items, in the sample;

S_n^2 is the standard deviation of the sample, where:

$$S_n^2 = \frac{1}{n - 1} \sum (x - \bar{x})^2$$

x is the insertion loss of an individual luminaire;

k is the factor derived from tables of the non-central t-distribution which ensures with 80 % confidence that 80 % or more of the production exceeds the minimum value of insertion loss. Values of k as a function of n are given in the table below;

L is the minimum value of insertion loss;

x , $\bar{x}$, S_n and L are expressed logarithmically (dB).

n	3	4	5	6	7	8	9	10	11	12
k	2.04	1.69	1.52	1.42	1.35	1.30	1.27	1.24	1.21	1.20

5. MEASURING APPARATUS AND METHODS

5.1. Measuring apparatus

5.1.1. The measuring receiver

Any good quality radio-frequency selective voltmeter shall be used.

5.1.2. Balance/unbalance transformer

The essential requirements of the balance/unbalance transformer are:

- (a) the capacitance between the secondary and primary of the transformer must be no greater than 5 pF. The primary is connected to the metal box which encloses the device;
- (b) the output impedance must be 150 ± 4.5 ohms and substantially resistive in the frequency range 150 kHz to 1 605 kHz.

Figure 1 shows an example of the circuit and construction of a suitable transformer.

5.1.3. Artificial mains V-network

The V-network shall conform with CISPR Publication 1 (1972) paragraph 2.1 and Figure 9A.

5.1.4. Dummy lamp (dummy tube)

(For use in conjunction with 5.2.1 and Figure 3).

The configuration and component values of a dummy lamp are given in Figure 2.

Figure 1: Example of a balance/unbalance transformer

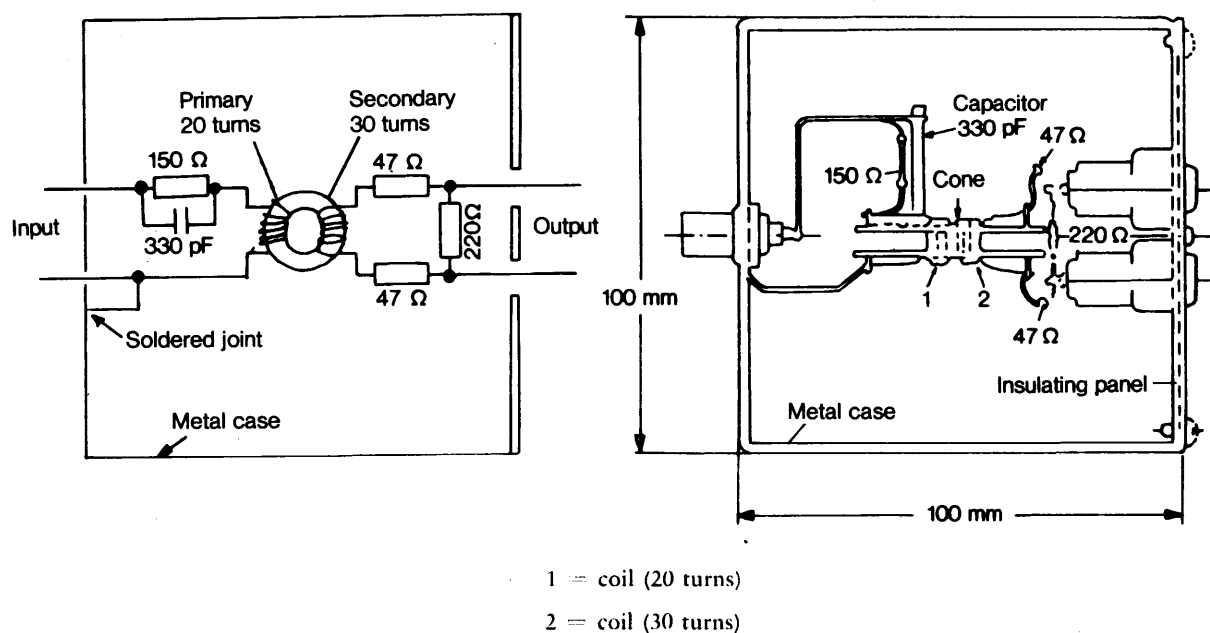
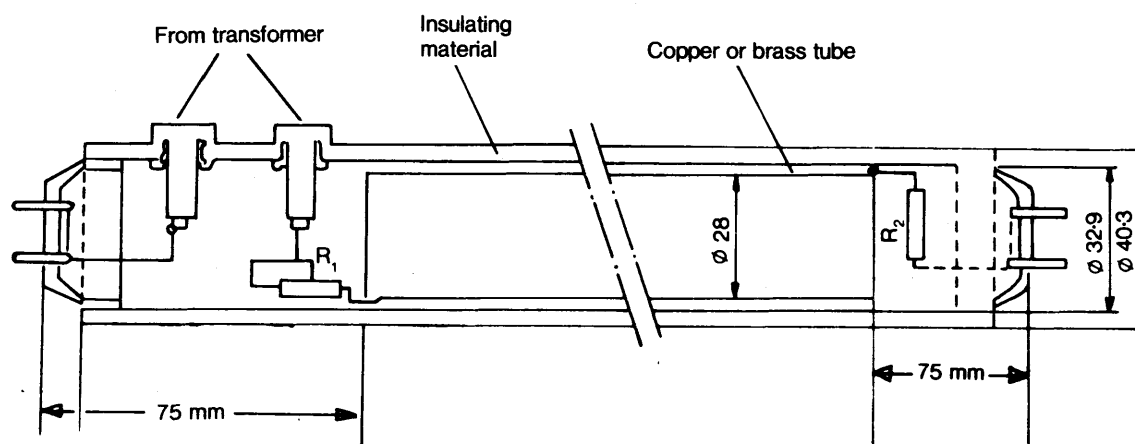


Figure 2: Configuration of a dummy lamp



5.2. Measurement of insertion loss of fluorescent luminaires

The insertion loss of luminaires shall be measured in accordance with the methods described in 5.2.1 and 5.2.3 or 5.2.2 and 5.2.3.

5.2.1. Luminaires intended for use with lamps of 20 W, 40 W, 65 W, 80 W and 65/80 W of a nominal diameter of 38 mm as specified in IEC Publication 81 (1961)

The apparatus shall be set up as shown in Figure 3 with the dummy lamp L_0 conforming to the details given in Figure 2.

5.2.2. *Luminaires intended for use with lamps specified in IEC Publication 81 (1961) but having ratings other than those given in 5.2.1*

The apparatus shall be set up as shown in Figure 4, with the dummy lamp L conforming to the details given therein.

5.2.3. *Measuring method*

The insertion loss is the ratio of the voltage U_1 , indicated on the measuring receiver M when the generator G is connected to the dummy mains network VN via the transformer T, to the voltage U_2 indicated on M when the generator G is connected to the network VN via the transformer T and the equipment under test.

The insertion loss shall be expressed in the form: Insertion loss = $20 \text{ Log}_{10} \frac{U_1}{U_2}$ dB.

Details of the procedures are as follows:

5.2.3.1. When a luminaire incorporates more than one lamp, each lamp shall be replaced in turn by the tube L_0 or L (see 5.2.1 and 5.2.2).

5.2.3.2. If, as normal, starters having integral capacitors are used, the starter shall be removed and replaced by a capacitor of $5\,000 \text{ pF} \pm 10\%$. However, where the manufacturer fits a capacitor external to the starter and gives a warning against the use of an additional starter capacitor, the original capacitor shall be retained and no test capacitor added.

Precautions shall be taken to ensure that the test capacitor maintains its characteristics over the whole frequency range covered by the measurements.

With the exception of the possible replacement of the capacitor by the starter and the replacement of the lamps, luminaires shall be measured as manufactured.

5.2.3.3. If a luminaire has a frame of insulating material, it should be placed with its back on a metal sheet connected to the earth terminal of VN.

5.2.3.4. The connections c-c' and d-d' between the tubes L_0 or L and the transformer T shall be made with unscreened leads not exceeding 10 cm in length.

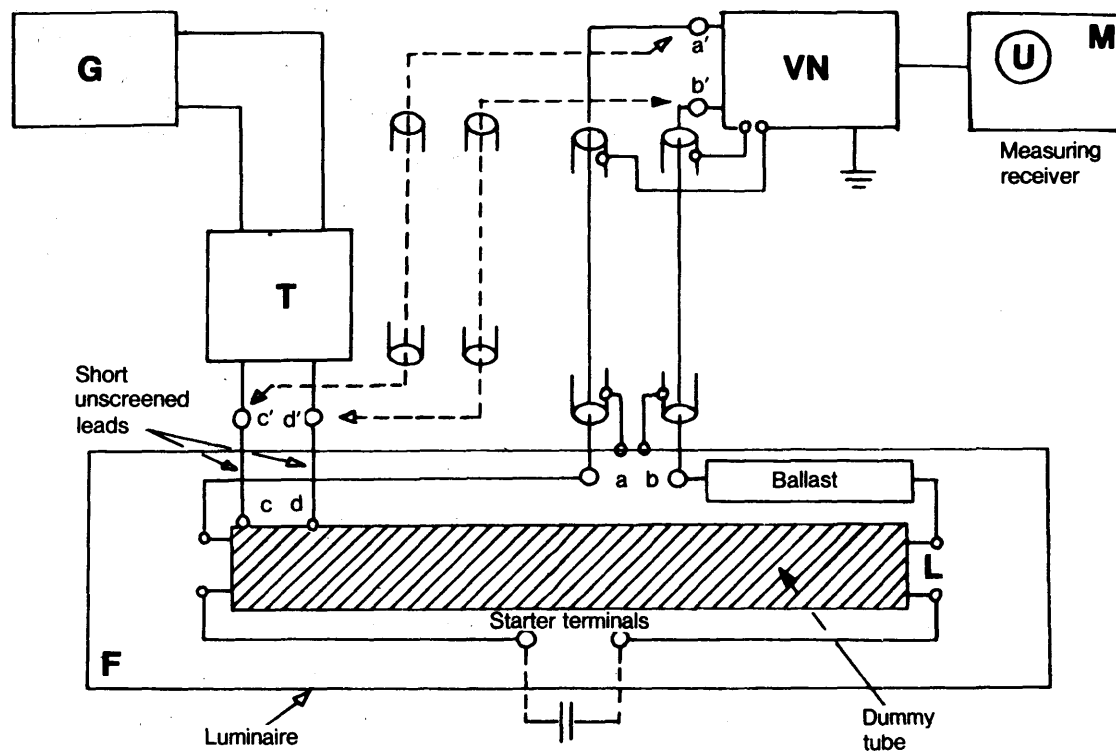
5.2.3.5. The generator output voltage shall be measured by means of the measuring receiver; for this purpose, a direct connection is made between c' and a' and between d' and b' by coaxial cables ($Z_0 = 75 \Omega$) of 1 m length with the screens connected to the earth terminal of VN; cables c-c', d-d', a-a', b-b' are removed.

5.2.3.6. U_1 is the voltage between a' and the earth terminal of VN or between b' and the earth terminal of VN. (The two voltages must be nominally the same — about 2mV.)

5.2.3.7. U_2 is the higher of the two voltages between a' and the earth terminal of VN and b' and the earth terminal of VN.

5.2.3.8. Where it is known that the insertion loss is a minimum for a given orientation of the dummy tube, measurement may be made for this orientation only. In cases where there is any doubt on this point, measurements shall be made for both orientations of the dummy tube.

Figure 3: Method of measurement for tubes of 20 W, 40 W, 65 W, 80 W and 65/80 W rating



G = h.f. generator

T = unbalance/balance transformer
(see 5.1.2 and Figure 1)

VN = CISPR V-network

M = measuring receiver

L = dummy tube (see 5.1.4 and Figure 2)

F = luminaire

a-b = mains terminals

a'-b' = input terminals VN

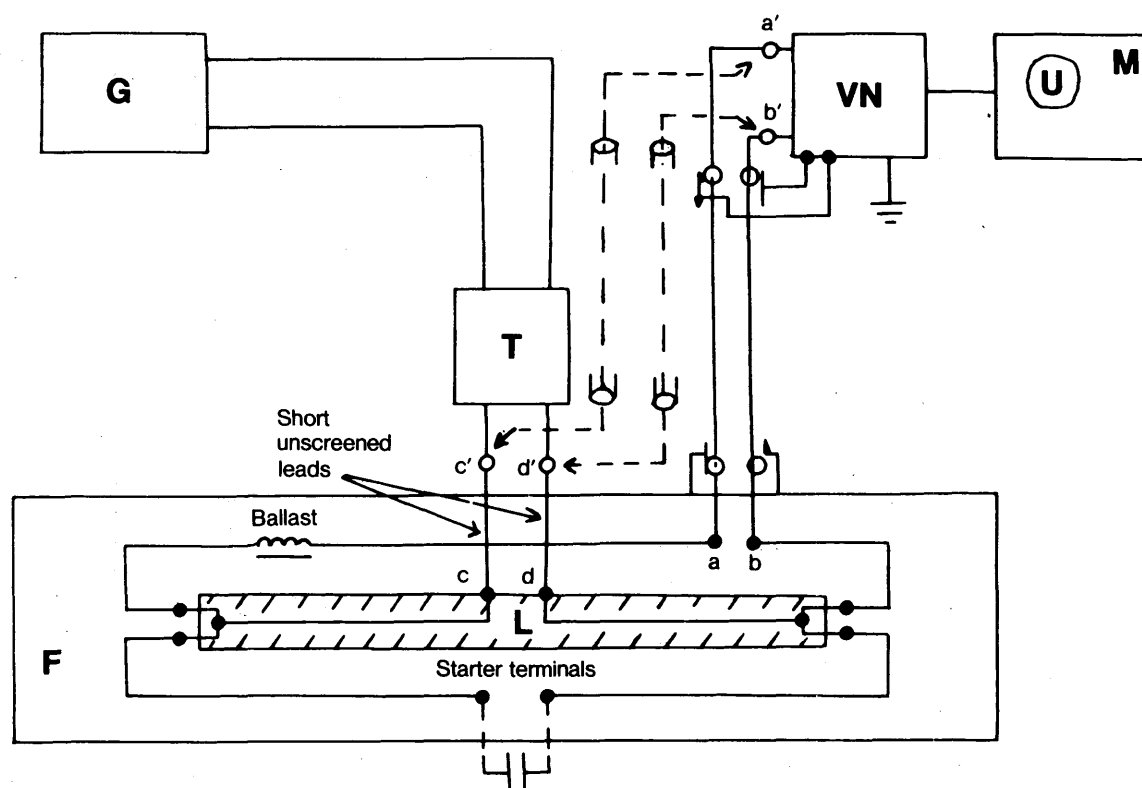
c-d = terminals at dummy tube

c'-d' = output terminals of T

a-a' and b-b' = connections by coaxial cables ($Z_0 = 75 \Omega$) with the respective ends of the screens connected to the metal-work of VN and F

c-c' and d-d' = connections by short unscreened leads

Figure 4: Method of measurement for tubes other than 20 W, 40 W, 65 W, 80 W and 65/80 W rating



G = h.f. generator

T = unbalance/balance transformer
(see 5.1.2 and Figure 1)

VN = CISPR V-network

M = measuring receiver

L = tube of insulating material with internal connections as shown replacing the lamp

F = luminaire

a-b = mains terminals

a'-b' = input terminals VN

c-d = terminals at centre of tube L

c'-d' = output terminals of T

a-a' and b-b' = connections by coaxial cables ($Z_0 = 75 \Omega$) with the respective ends of the screens connected to the metal-work of VN and F

c-c' and d-d' = connection of the transformer to the dummy tube must be made with unscreened leads not exceeding 10 cm in length

COUNCIL DIRECTIVE

of 4 November 1976

on the approximation of the laws of the Member States relating to electrical energy meters

(76/891/EEC)

THE COUNCIL OF THE EUROPEAN COMMUNITIES,

Having regard to the Treaty establishing the European Economic Community, and in particular Article 100 thereof,

Having regard to the proposal from the Commission,

Having regard to the opinion of the European Parliament ⁽¹⁾,

Having regard to the opinion of the Economic and Social Committee ⁽²⁾,

Whereas, in the Member States, both the construction of and the methods of testing electrical energy meters are the subject of strict regulations which differ from one Member State to another and consequently hinder trade in these meters; whereas it is, therefore, necessary to approximate these regulations;

Whereas Council Directive 71/316/EEC of 26 July 1971 on the approximation of the laws of the Member States relating to common provisions for both measuring instruments and methods of metrological control ⁽³⁾, as last amended by Directive 72/427/EEC ⁽⁴⁾, laid down the procedures for EEC type approval and EEC initial verification; whereas, in accordance with that Directive, it is necessary to specify the technical requirements for the design and functioning of electrical energy meters,

HAS ADOPTED THIS DIRECTIVE:

Article 1

This Directive shall apply to new direct connected induction meters, with single or multiple tariffs, designed to measure active energy single-phase or polyphase current at 50 Hz frequency.

Article 2

The electrical energy meters which may be given EEC marks and signs are described in the Annex to this Directive.

They shall be the subject of EEC type approval and shall be submitted for EEC initial verification.

Article 3

Member States may not prevent, prohibit or restrict the placing on the market or entry into service of electrical energy meters if such meters bear the EEC type-approval sign and the EEC initial verification mark.

Member States which use maximum permissible errors smaller than those set out in the Directive for initial verification may continue to use such maximum permissible errors during a period of five and a half years from the notification of this Directive.

In the light of experience gained in this period of derogation and of the results obtained in international bodies, the appropriate measures shall be taken before the end of this five and a half year period, according to the procedure set out in Article 19 of Directive 71/316/EEC.

Article 4

1. Member States shall put into force the laws, regulations and administrative provisions needed in order to comply with this Directive within eighteen months of its notification and shall forthwith inform the Commission thereof.

2. Member States shall ensure that the text of the provisions of national law which they adopt in the field covered by this Directive is communicated to the Commission.

Article 5

This Directive is addressed to the Member States.

Done at Brussels, 4 November 1976.

For the Council
The President

Th. E. WESTERTERP

⁽¹⁾ OJ No C 23, 8. 3. 1974, p. 51.

⁽²⁾ OJ No C 101, 23. 11. 1973, p. 6.

⁽³⁾ OJ No L 202, 6. 9. 1971, p. 1.

⁽⁴⁾ OJ No L 291, 28. 12. 1972, p. 156.

ANNEX

CHAPTER I — DEFINITIONS

1. DEFINITION OF CERTAIN TERMS USED IN THIS ANNEX

1.1. Influence quantity or factor

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

1.2. Variation of error as a result on an influence quantity

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

1.3. Reference value of an influence quantity

Value of this quantity on the basis of which certain characteristics of the meter are fixed.

1.4. Basic current (I_b)

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

1.5. Maximum current (I_{max})

Maximum value of the current at which the meter shall satisfy the requirements of this Directive.

1.6. Distortion factor

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

1.7. Basic speed

The nominal speed of rotation of the rotor expressed in revolutions per minute when the meter is under reference conditions and carries basic current at unity power factor.

1.8. Basic torque

The nominal value of the torque on the rotor to maintain it stationary with the meter under reference conditions and carrying basic current at unity power factor.

1.9. Type

Expression used to define all meters with single or multiple tariff, manufactured by the same manufacturer, to which correspond:

- similar metrological properties,
- uniformity of construction of the parts which determine these qualities,
- the same number of ampere-turns of the current windings for the basic current and the same number of turns per volt of the voltage windings for the reference voltage,
- the same ratio between maximum current and basic current.

The type may include different basic current and reference voltage values.

Remarks

- (a) These meters shall be designated, by the manufacturer, by one or more groups either of letters or numbers, or of a combination of letters and numbers. Each type shall have one designation only.
- (b) The type shall be represented by three sample meters intended for type approval tests, the characteristics of which (basic current and reference voltage) shall be chosen by the metrological service concerned from among those appearing in the tables proposed by the manufacturer (clause 6.1.1).
- (c) In the case of special productions of the same type, the product of the number of turns of the windings and the value of the basic current may differ from that of the meters representing the type. The nearest value of the product immediately above or below should be chosen in order to have a whole number of turns.

For this reason only, the number of turns per volt of the voltage windings may differ by not more than 20 % from that of the sample meters representing the type.
- (d) The ratio of the highest to the lowest basic speed of rotation of the rotor of each meter of the same type must not exceed 1:5.

CHAPTER II — TECHNICAL SPECIFICATIONS**2. MECHANICAL SPECIFICATIONS****2.1. General**

Meters shall be designed and constructed in such a way as to avoid introducing any danger in normal use and under normal conditions, so as to ensure especially:

- personal safety against electric shock;
- personal safety against effects of excessive temperature;
- safety against spread of fire.

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

The meter shall have adequate mechanical strength and shall be able to withstand the elevated temperature which is likely to occur in normal operating conditions.

The components shall be reliably fastened and secured against loosening during transport or in normal use.

The electrical connections shall be such as to prevent any opening of the circuit, including any overload conditions specified in this Directive.

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

2.2. Case

The meter case shall be virtually dustproof and shall be capable of being sealed in such a way that the internal parts of the meter are accessible only after the seals are broken.

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

The case shall be so constructed and arranged that any non-permanent deformation cannot prevent the meter from operating satisfactorily.

Meters intended for connection to the mains the voltage of which is more than 250 V in relation to earth and the case of which contains accessible metal parts shall be provided with a protective earth terminal.

For meters intended for connection to the mains with a reference voltage of 250 V or less in relation to earth and having a case wholly or partly made of metal, suitable provision shall be made for connecting the case to earth.

2.3. Windows

If the meter cover is not transparent, it shall include one or more windows to permit reading of the register and observation of the rotor movement. These windows shall be covered by plates of transparent material which it shall be impossible to remove without breaking the seals.

2.4. Terminals — terminal blocks

The terminals shall be grouped in one or more terminal blocks of sufficient mechanical strength to enable rigid conductors or cables to be fixed to them.

It shall be possible to disconnect the voltage terminals from the current input terminals without difficulty.

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

Note

The material of which the terminal plate is made shall satisfy the test laid down in 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 shall be possible to seal independently of the meter cover. When the meter is mounted on its board, it shall not be possible to reach the terminals without breaking the seals on the terminal cover. The terminal cover shall therefore cover 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. Register (counting mechanism)

Registers may be of the drum or pointer type.

The unit of the register shall be the kilowatt hour.

In drum-type registers, the units shall be marked adjacent to the set of drums.

In pointer type registers, the dials (except the dial indicating the lowest value) shall be marked off into 10 equal divisions and numbered from zero to nine. The units dial shall be marked in divisions of $1 \text{ d} \hat{=} 1 \text{ kWh}$ and near each of the other dials there shall be marked the number of kilowatt hours corresponding to one division of that dial, i.e. 10, 100, 1 000 and 10 000.

The dial of pointer-type registers, or the drum of drum-type registers, which indicates one-tenth of the reading unit, shall be edged in colour or coloured.

In addition, the dial or the continuous rotating drum indicating the lowest values shall include a scale of 100 equal divisions or any other arrangement giving similar accuracy of reading.

The register shall be able to record, from zero and for a minimum of 1 500 hours, the energy corresponding to the maximum current at the reference voltage and unity power factor.

All the indications appearing on the register shall be indelible and easily legible.

2.7. Direction of rotation of the rotor and marking of the rotor

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

The edge or the edge and the upper surface of the disc shall carry a main mark with a width of between 1/20th and 1/30th of the circumference of the disc to facilitate the counting of the number of revolutions.

The disc may also carry marks permitting stroboscopic or other tests to be made. These marks shall not impede the use of the main mark when it is employed for photo-electric counting of the number of revolutions of the disc.

3. ELECTRICAL SPECIFICATIONS

3.1. Power losses

3.1.1. Voltage circuits

The loss in each voltage circuit at reference voltage, at reference frequency and at reference temperature shall not exceed 2 W and 8 VA for single phase meters and 2 W and 10 VA for polyphase meters.

3.1.2. Current circuits

For meters having a basic current lower than 30 A, the apparent power taken by each circuit at basic current, at reference frequency and at reference temperature shall not exceed 2.5 VA. For higher basic current, it shall not exceed 5 VA.

3.2. Heating

In the usual conditions of use, the windings and insulation shall not reach a temperature liable adversely to affect the functioning of the meter.

When each circuit is supplied at its maximum current and each voltage circuit (and auxiliary circuits supplied for periods longer than their thermal time constant) is supplied at a voltage 1.2 times greater than reference voltage, the temperature rise (Δt) of the various parts of the meter shall not exceed that indicated in the table below, at an ambient temperature of not more than 40 °C.

The meter shall be tested for a period of two hours and shall not be exposed to draughts or direct sunlight.

Parts of the meter	Δt in °C
Windings	60
External surface of the case	25

In addition, after the test, the meter shall not show any damage and must satisfy the AC voltage test in clause 3.3.3.

The temperature of the windings shall be determined by the resistance variation method (see IEC Publication 28, 'International Specifications for Copper-type Annealing').

When measuring circuit resistance, the meter feed connections shall be at least 100 cm long and have a cross-section such that current density will be less than 4 A/mm². Measurement of resistance variation shall be made at the terminal box connections.

3.3. Dielectric properties

The meter and its incorporated auxiliary devices, if any, shall be such that they retain adequate dielectric qualities under normal conditions of use, taking account of atmospheric influences and the different voltages to which their circuits are subjected in normal conditions of use.

Consequently, the meter shall be able to withstand without damage the dielectric proving tests detailed in clauses 3.3.2 and 3.3.3.

The tests shall be carried out only on a complete new meter, with its cover (except where indicated below) and terminal cover in position, the screws of the conductors being screwed down to the maximum applicable conductor fitted in the terminals.

These tests shall be carried out once only on any one meter, and the procedure shall be in accordance with IEC Publication 60: 'High voltage tests (1962)'.

Note: When the terminal arrangements of a meter differ from those of the meter originally subjected to type approval, all the dielectric property tests shall be carried out for the different terminal arrangements.

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

- (a) when the meter case is made entirely of metal, the earth is the case itself placed on a flat conducting surface;
- (b) when the meter case or only part of it is made of insulating material, the earth is a conductive foil connected to the flat conducting surface on which the meter is placed.

Where the terminal cover allows this, a distance of approximately 2 cm shall be left between the foil and the holes for the conductors in the terminal casing.

During the impulse and the a.c. voltage tests, the circuits which are not under test shall be connected to either the frame or the earth as indicated below.

The impulse test shall be carried out first and the a.c. voltage test afterwards.

During these tests, no flashover, disruptive discharge or puncture shall occur.

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

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

3.3.1. *General conditions for dielectric quality tests*

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

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

- ambient temperature 15 °C to 25 °C
- relative humidity 45 % to 75 %
- atmospheric pressure $86 \cdot 10^3$ to $106 \cdot 10^3$ Pa
(860 mbar to 1 060 mbar).

3.3.2. *Impulse voltage test*

The impulse voltage test is intended to determine the capability of the meter to withstand without damage short-time overvoltage of high values.

Note: The aim of the tests in accordance with clause 3.3.2.1 is essentially to ensure, on the one hand, the quality of the insulation of the voltage winding between turns or between layers and, on the other hand, the insulation between different circuits of the meter which in normal service are connected to conductors of different phases of the mains between which overvoltage may occur.

The text provided for in clause 3.3.2.2 is intended to provide overall verification of the behaviour of the insulation of all the electrical circuits in the meter relative to earth. This insulation represents an essential safety factor for persons in the event of overvoltage on the mains.

The energy of the generator used for these tests shall be in accordance with the relevant requirements of IEC Publication 60. The wave form of the impulse is the standardized 1·2/50 and its peak value is 6 kV. For each test, the impulse voltage is applied ten times with the same polarity.

3.3.2.1. *Test of insulation of voltage circuits and of insulation between circuits*

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

Thus, when in normal use the voltage and the current circuits of a driving element are connected together, the test shall be made on the whole. The other end of the voltage circuit shall be connected to the earth and the impulse voltage shall be applied between the terminal of the current circuit and the earth.

When several voltage circuits of a meter have a common point, this point shall be connected to earth and the impulse voltage successively applied between each of the free ends (or the current circuit connected to it) and the earth.

The auxiliary circuits intended to be connected directly to the mains and having a reference voltage over 40 V shall be subjected to the impulse voltage test in the same conditions as those already given for voltage circuits. The other auxiliary circuits shall not be tested.

3.3.2.2. Test of insulation of electric circuits relative to earth

All the terminals of the meter circuits, except those of the auxiliary circuits with a reference voltage not greater than 40 V, shall be connected together.

The auxiliary circuits with a reference voltage not greater than 40 V shall be connected to the earth.

The impulse voltage shall be applied between all the meter circuits and the earth.

3.3.3. A.C. voltage test

The a.c. voltage tests shall be carried out in accordance with the table below.

The test voltage shall be substantially sinusoidal, having a frequency of 50 Hz applied for one minute. The power source shall be capable of supplying at least 500 VA.

During tests A and B in the table below, the circuits which are not submitted to the voltage test shall be connected to the frame.

During the tests relative to earth (C in the following table) the auxiliary circuits whose reference voltage is no more than 40 V shall be connected to the earth.

Test voltage r.m.s. value	Points at which test voltage is applied
2 kV	<i>A. Tests which may be carried out with the cover and terminal cover removed</i> — between the frame and: (a) each assembly of current-voltage windings of one and the same driving element which, in normal use, are connected together but are separated and suitably insulated from the other circuits; (b) each auxiliary circuit or set of auxiliary circuits having a common point, where the reference voltage is over 40 V; (c) each auxiliary circuit having a reference voltage not greater than 40 V.
2 kV	
500 V	
600 V or twice the voltage applied to the voltage windings under reference conditions, where the reference voltage is greater than 300 V (the higher figure shall apply)	<i>B. Tests which may be carried out with the terminal cover removed but with the cover in place when it is made of metal</i> — between the current circuit and the voltage circuit of each driving element, normally connected together, this connection being temporarily broken during the test (*)
2 kV	<i>C. Test to be carried out with the case closed, the cover and terminal cover in place</i> — between all the current and voltage circuits as well as the auxiliary circuits whose reference voltage is over 40 V connected together and the earth of the meter.

(*) This is not strictly speaking a dielectric strength test, but a means of verifying that the insulation distances are sufficient when the connecting device is open.

4. PARTICULARS TO BE SHOWN ON THE METERS

4.1. Rating plate

Each meter shall carry a rating plate which may be either the dial of the register or a plate fixed inside the meter.

The following particulars, indelible, easily legible and visible from the outside, shall be given there:

- (a) the manufacturer's identification mark or trade name;
- (b) the designation of the type;
- (c) the sign certifying EEC type approval of the meter;
- (d) the description of the number and arrangement of the driving elements, either in the form: single-phase two-wire, three-phase four-wire, etc., or using symbols conforming to 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/rev or x revs/kWh;
- (i) the serial number of the meter and its year of manufacture;
- (j) the reference temperature, if it differs from 23 °C.

The meter may also carry information as to its place of manufacture, a commercial description, a special serial number, the name of the electricity supplier, a sign of conformity to a European standard and the connection diagram identification number. Any other information or inscription shall be prohibited, unless specially authorized.

4.2. Connection diagram and terminal markings

Each meter must carry an easily identifiable connection diagram showing the correspondence between the connecting terminals, including the auxiliary device terminals and the conductors to be connected. For three-phase meters, the phase sequence for which the meter is intended shall be shown. The connection diagram may have a reference number stamped on the rating plate. If the meter terminals carry markings, these shall be indicated in the diagram. Connection diagrams may be replaced by a reference number specified in the national standard of the Member State in which the meter will be used.

CHAPTER III — METROLOGICAL REQUIREMENTS

5. METROLOGICAL REQUIREMENTS

5.1. Maximum permissible errors

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

TABLE I

Value of current	Power factor	Maximum permissible errors ($\pm$)
$0.05 I_b$	1	2.5 %
$0.1 I_b \leq I \leq I_{max}$	1	2.0 %
$0.1 I_b$	0.5 inductive	2.5 %
$0.2 I_b \leq I \leq I_{max}$	0.5 inductive	2.0 %

TABLE II

Value of current	Power factor	Maximum permissible errors ($\pm$)
$0.2 I_b \leq I \leq I_b$	1	3.0 %
$I_b \leq I \leq I_{max}$	1	4.0 %
I_b	0.5 inductive	3.0 %

With a basic current and unity power factor, the difference between the error on a meter with a single-phase load and the percentage error when the polyphase loads are balanced should not exceed 2.5 %.

Note: The single-phase load of a three-phase meter shall be understood as one being associated with one phase to neutral voltage of a four-wire system (one of which is neutral) or one phase to phase voltage of a three-wire system (without a neutral). In every case, the complete system of voltages shall remain connected to the meter.

5.2. Reference conditions

Save where an exception is expressly provided for in this Annex, tests to determine errors and error variations as a function of the influence quantities shall be carried out under the following reference conditions:

- (a) the meter shall be closed, i.e. the meter cover shall be in position;
- (b) in the case of drum-type registers, only the fastest-turning drum shall be engaged, even if it is not visible;
- (c) before any measurement, the voltage shall have been connected for at least one hour and the testing currents shall each be adjusted by progressively increasing or decreasing values and connected long enough for the speed of rotation of the rotor to become stabilized;

In addition, for polyphase meters:

- (d) the order of the phases shall correspond to the direct sequence (as shown in the connection diagram);

- (e) the voltages and currents shall for practical purposes be balanced, i.e.:
- each of the voltages between line and neutral or between any two lines shall not differ by more than 1 % from the mean of the corresponding voltages;
 - each of the currents in the conductors shall not differ by more than 2 % from the mean of these currents;
 - the phase displacements presented by each of these currents with the corresponding phase to neutral voltage shall not differ one from another by more than 2°, whatever the power factor.

The reference values of the influence quantities are indicated in Table III.

TABLE III

Influence quantities	Reference value	Tolerance
Ambient temperature	Reference temperature or, if not indicated, 23 °C	± 2 °C
Position in use	Vertical position in use ⁽¹⁾	± 0.5 °C
Voltage	Reference voltage	± 1 %
Frequency	Reference frequency 50 Hz	± 0.5 %
Wave form	Voltages and currents of sinusoidal form	Distortion factor of less than 3 %
Magnetic induction of external origin, 50 Hz	Magnetic induction nil	Induction value which does not produce a relative error variation of more than 0.3 % ⁽²⁾

⁽¹⁾ *Ascertaining the vertical position for use*

The meter shall be so constructed and assembled as to ensure that it remains in the correct vertical position (in both perpendicular planes, back-front and left-right) when:

- (a) the base of the meter is placed against a vertical surface, and
- (b) a guide mark (e.g. the lower edge of the terminal block), or a guide mark on the meter case, is horizontal.

⁽²⁾ *The test method for carrying out this check consists:*

- (a) for a single-phase meter, of determining the errors, first with the meter connected to the mains in the normal manner, then with the current and voltage circuit connections reversed. Half the difference between these two errors is the value of the error variation. As the external field phase is not known, the check shall be carried out 0.1 I_b with unity power factor, and at 0.2 I_b with 0.5 power factor;
- (b) for a polyphase meter, of making three measurements at 0.1 I_b with unity power factor; after each measurement the connections to the current and voltage circuits are permuted by 120°, without changing the phase sequence. The greatest difference between each of the errors thus measured and their arithmetical mean is the value of the error variation.

5.3. Effects of the influence quantities

The variations in the error shall be determined for each of the influence quantities under the conditions indicated in Table IV, all the other conditions set out in clause 5.2 being observed.

TABLE IV

Influence quantities	Nature of the tests and conditions	Power factor	Maximum value of the mean temperature coefficient ($\pm$)
Temperature ⁽¹⁾	From 0.1 I _b to I _{max} From 0.2 I _b to I _{max}	1 0.5 induct.	0.1 %/°K 0.15 %/°K

⁽¹⁾ For a given temperature between 10 and 30 °C, the value of the mean temperature coefficient shall be determined for an area of 20 °C centred on this temperature.

Influence quantities	Nature of the tests and conditions	Power factor	Maximum value of the mean temperature coefficient ($\pm$)
			Variation in the maximum permissible error ($\pm$)
Position	For an inclination of 3 ° to the vertical in any direction: 0.05 I_b I_b and I_{max}	1 1	3.0 % 0.5 %
Voltage	For a variation of 10 % in either direction in relation to the reference voltage 0.1 I_b 0.5 I_{max} 0.5 I_{max}	1 1 0.5 induct.	1.5 % 1.0 % 1.5 %
Frequency	For a variation of 5 % in either direction as against 50 Hz: 0.1 I_b 0.5 I_{max} 0.5 I_{max}	1 1 0.5 induct.	1.5 % 1.3 % 1.5 %
Wave form ⁽¹⁾	For an increase of 10 % in the harmonic of the third order in the current wave: at I_b	1	0.8 %
Magnetic induction of external origin ⁽²⁾	For a magnetic induction of 0.5 mT, at the reference frequency, under the most unfavourable conditions of phase and direction: at I_b	1	3.0 %
Reversed phase sequence	For a reversal of the direct phase sequence: 0.5 I_b to I_{max} (balanced load) 0.5 I_b a single phase load	1 1	1.5 % 2.0 %
Magnetic field of an accessory	0.05 I_b	1	1.0 %
Mechanical load of the register or of each register of a multi-rate meter ⁽³⁾	0.05 I_b	1	2.0 %

⁽¹⁾ When the variation of error as a function of the wave form is determined, the harmonics content of the voltage curve shall remain less than 1 % and the phase of the harmonic of the third order inserted into the current curve shall vary between zero and 360 °.

⁽²⁾ The required induction shall be 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 corresponding to 400 ampere-turns.

⁽³⁾ The influence of the mechanical load of the register shall be compensated when the meter is adjusted.

5.4. Effect of transient heavy overloads

The test circuit shall be virtually non-inductive. After applying the transient overcurrent, the voltage shall be maintained at the terminals and the meter allowed to rest long enough to recover its initial temperature (about 1 hour).

The meters shall be capable of carrying a current surge (obtained for example, from a capacitor discharge or from the mains via a thyristor control) with a peak value equal to 50 times the maximum current (up to 7 000 A) and a value at all times greater than 25 times the maximum current (or 3 500 A) for 1 ms.

At the end of this test, the error variation shall not be greater than 1.5 % at the basic current and unity power factor.

5.5. Variation in the error due to self-heating

After having first been maintained under reference voltage for at least one hour with no current supplied to the circuits, the rated maximum current shall be applied to the current windings. The error of the meter shall be measured immediately after it is put into operation and then at sufficiently short intervals to permit correct plotting of the curve of error variation as a function of time.

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

The variation in the error due to self-heating measured as indicated above shall not be greater than 1 % for unity power factor and 1.5 % for 0.5 power factor.

5.6. Running with no load

Under the conditions specified in clause 5.2, when the current circuits of the meter are open, the rotor shall not run free for any voltage value between 80 % and 110 % of the reference voltage: the rotor may turn slightly but shall under no circumstances make one complete revolution. In the case of a drum-type register, this requirement shall apply when only one drum is engaged.

5.7. Starting

Under the conditions specified in clause 5.2, if a current equal to 0.5 % of the basic current with unity power factor passes through the meter, it shall start and continue to revolve. It shall be verified that the rotor definitely makes a complete turn. In the case of a drum-type register, this requirement shall apply for one or two drums engaged.

5.8. Agreement of the register with the reading constant of the meter

The ratio between the number of revolutions of the meter rotor and the indication of the register must be correct.

5.9. Margins of adjustment

A meter adjusted to conform to the present requirements should have at least the following margins of adjustment:

(a) Adjustment at full load:

± 4 % of the variation of the rotor speed for a current equal to half the maximum current, with the reference voltage, a frequency of 50 Hz and unity power factor.

(b) Adjustment at light load:

± 4 % of the variation of the rotor speed at 5 % of the basic current, with 50 Hz frequency, the reference voltage and unity power factor.

(c) Adjustment when out of phase (if the meter is capable of such adjustment):

± 1 % of the variation of the rotor speed for 0.5 power factor (inductive) with a current equal to half the maximum current, 50 Hz frequency and the reference voltage.

CHAPTER IV — EEC TYPE APPROVAL

EEC type approval of electrical energy meters shall be granted in accordance with the requirements of Directive 71/316/EEC. Some of these requirements are specified in this Chapter.

6. EEC TYPE APPROVAL

6.1. Procedure for EEC type approval

6.1.1. *Technical documents*

A request for EEC type approval should be accompanied by the following documents:

- a drawing, and possibly a photograph, of the complete meter;
- a detailed description of the construction of the meter and of its main components (including any variations);
- drawings of the following main components (including any variations):
 - base, handle and fixing points,
 - cover,
 - terminal plate and cover,
 - driving element, windings and air gap,
 - braking element and method of adjustment,
 - register(s),
 - rotor,
 - upper and lower rotor bearings,
 - temperature compensating devices,
 - overload compensating devices,
 - inductive load adjustment,
 - light load adjustment,
 - auxiliary circuits,
 - rating plate;
- diagram of internal and external connections (including auxiliary circuits) showing the phase sequence;
- tables of all voltage and current windings, i.e. number of turns, size of conductors, insulation;
- table of meter constants and torques for all voltage and current values;
- a description of, and drawings showing, the positions intended for verification marks and seals.

6.1.2. *Presentation of meters submitted for EEC type approval*

A request for EEC type approval should be accompanied by the presentation of three meters representing the type (see clause 1.9 (b)).

The competent authority may request the submission of additional meters if:

- the application relates not only to the three meters referred to in the first paragraph above but also to one or more variants thereof (material of the case, any multiple tariff devices, remote indication and anti-reversing devices etc.) which may be considered as being of the same type, in particular where the arrangement of the terminals is different;
- the application is for the extension of a previous type approval.

6.2. **EEC type approval examination**

Meters submitted shall conform to the technical requirements set out in clauses 2, 3 and 4 and to the metrological requirements in clause 5.

However, in order to take into account possible errors in the methods of calibration, the axis of abscissae may, when the error curves corresponding to Tables I and II are being plotted, be moved for each of those curves by up to 1 % to a parallel position.

6.3. **Measuring points for EEC type approval tests**

When tests in respect of the metrological requirements given in clause 5 are being carried out, measurements shall be made for at least the following points:

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

These tests shall be carried out successively in all phases.

The effects of the influence quantities shall be examined for at least the following points:

- the influence of the ambient temperature
0.1 I_b , I_b and I_{max} (unity power factor),
0.2 I_b , I_b and I_{max} (0.5 power factor inductive);
- the influence of position, voltage, frequency, wave form, external magnetic inductions, magnetic field of an accessory and of the mechanical load of each register for the points and under the conditions set out in Table IV;
- the influence of inversion of the phases (polyphase meters)
for 0.5 I_b , I_b and I_{max} with a balanced load and unity power factor,
and for 0.5 I_b with a single-phased load and unity power factor (this last test to be repeated for each of the phases).

In addition, the following tests shall be carried out:

- the tests of transient overloads, self heating and starting and verification of the margins of adjustment shall be carried out as laid down in clauses 5.4, 5.5, 5.7 and 5.9;
- running-with-no-load tests shall be carried out with 80 %, 100 % and 110 % of the reference voltage;
- the test of the register shall be carried out under the conditions specified in clause 5.8. The duration of the test shall be sufficient for the reading inaccuracy not to exceed ± 0.2 %.

6.4. EEC type approval certificate

The EEC type approval certificate shall be accompanied by the descriptions, drawings and diagrams necessary to identify the type and to explain its functioning.

CHAPTER V — EEC INITIAL VERIFICATION

The EEC initial verification of electrical energy meters shall be carried out in accordance with the requirements of Directive 71/316/EEC. These requirements shall be supplemented by the following special provisions:

7. EEC INITIAL VERIFICATION

The initial verification of electrical energy meters shall consist of acceptance tests and examinations of conformity to the approved type.

7.1. Acceptance tests

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

7.1.1. *Nature of the acceptance tests*

- (1) — Dielectric strength test;
- (2) — Verification of mechanical properties with the meter cover fitted;
- (3) — Running-with-no-load-test;
- (4) — Starting test;
- (5 to 10) — Accuracy tests;
- (11) — Verification of the constant.

The tests shall preferably be carried out in the above order, as detailed in clauses 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 cover fitted, except for certain mechanical properties and, if necessary, for checking the register.

However, when the initial verification takes place in the manufacturer's workshops, the tests may be carried out with the cover removed as long as it has been previously accepted as having practically no effect on the performance of the meter. Nevertheless, when dielectric properties are checked, the meter cover shall be fitted. After the dielectric strength test has been satisfactorily carried out, but before any other test, the meters shall be supplied with electricity for at least half an hour at the reference voltage and with a current of about 0.1 I_b, at unity power factor. This allows the voltage circuit to be heated in advance and a check to be made that the rotor turns freely.

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

TABLE V

Influence quantity	Reference value	Tolerance ($\pm$)
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 of not more than 5 %
External magnetic induction 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 unity power factor ⁽²⁾
In addition, for polyphase meters		
Phase order	Direct sequence	
Imbalance of voltages and currents ⁽³⁾	None	As in clause 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. Carrying out of acceptance tests

7.1.3.1. Test of dielectric strength (test No 1)

The a.c. voltage test shall consist of applying an alternating voltage at a frequency of 50 Hz and an effective value of 2 kV for one minute between all the inter-connected terminals and the flat metal surface on which the meter is placed. For this test, those auxiliary circuits having a nominal voltage of 40 V or less shall be connected to the flat metal surface.

The test shall be carried out on each appliance by the manufacturer on his own responsibility. The appropriate metrological service shall carry out a check on it.

7.1.3.2. Verifications to be carried out with the cover fitted (test No 2)

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

7.1.3.3. Running with no load (test No 3)

The choice between the following two tests shall be left to the appropriate metrological service:

- when the meter is supplied with electricity at the reference voltage, with unity power factor, at a current equal to $0.001 I_b$, the rotor shall not complete a whole revolution.
- the test shall be conducted in accordance with clause 5.6.

7.1.3.4. Starting (test No 4)

Where the running with no load test has been carried out under the conditions set out in the first indent of clause 7.1.3.3, the starting test shall be carried out as follows:

when the meter is supplied with electricity at the reference voltage, with unity power factor, at a current equal to $0.006 I_b$, the rotor shall start up and revolve more than once.

Where the running with no load test has been carried out under the conditions set out in the second indent of clause 7.1.3.3, the starting test shall be carried out in accordance with clause 5.7.

Note: Tests 3 and 4 shall be carried out on polyphase meters with all phases under load.

7.1.3.5. Accuracy tests (test Nos 5 to 10)

The accuracy tests shall be carried out for the current values and power factors indicated in Table VI. There is no need to wait until the windings are in thermal balance. Since the conditions under which these tests are carried out are usually not the standard conditions for type approval, the values in Table VI below, which give more latitude, are used instead of the values set out in Tables I and II.

TABLE VI

Test No	Current value	Power factor	Meters	Load of polyphase meters	Maximum permissible error ($\pm$)
5	$0.05 I_b$	1	Single-phase and polyphase	Balanced	3.0 % ⁽¹⁾
6	I_b	1	Single-phase and polyphase	Balanced	2.5 %
7	I_b	0.5 inductive	Single-phase and polyphase	Balanced	2.5 %
8 and 9	I_b	1	Polyphase	1 phase loaded (1 test in 2 of the phases)	3.5 %
10	I_{max}	1	Single-phase and polyphase	Balanced	2.5 %

⁽¹⁾ For meters the maximum current of which is more than four times the basic current, the maximum permissible error in either direction in the case of test No 5 shall be increased by 0.5 % for the period of five and a half years referred to in Article 3 of this Directive.

Note: Test No 5 on meters with multiple tariffs shall be repeated for each reading corresponding to a different tariff. The tariff-adjusting electro-magnet(s) shall be supplied with electricity in accordance with the specifications in the connection diagram.

The permissible error limits may not be systematically utilized in the same direction.

7.1.3.6. Check on the agreement of the register with the meter constant (test No 11)

It shall be verified that the ratio between the number of revolutions of the meter rotor and the readings of the register(s) is correct.

7.1.3.7. Uncertainty of measurement

The properties of the measuring instruments and of the other apparatus used to carry out tests Nos 5 to 10 and where applicable, 11 shall be such that the errors of measurement which can be attributed to them do not exceed in relative value:

- ± 0.4 % with unity power factor,
- ± 0.6 % with 0.5 power factor (inductive).

7.2. Examination for conformity to the approved type

7.2.1. *Nature of the examination for conformity to the approved type*

In order to determine whether the metrological properties of the meters manufactured and presented for initial verification conform to the requirements of this Directive, an examination for conformity to the approved type may be carried out at intervals determined by the competent metrological authority, on three meters chosen at random after the acceptance tests.

This examination shall consist of one or more tests chosen from those described in this Directive (clauses 3 and 5), particularly from those which serve to determine the effects of influence quantities.

These tests shall be conducted under the reference conditions described in clause 5.2 and at those measuring points given in clause 6.3.

The following points may also be verified after the case has been opened:

- quality of surface protection, e.g. of paint,
- gear ratio,
- nature of the gearing of the register,
- quality of the soldering and/or welding,
- tightness of the screws,
- absence of filings and metallic dust,
- margins of adjustment (visual inspection).

Note

When meters of an approved type are manufactured in regular production, it is desirable that the frequency of the examination for conformity to the approved type be in proportion to the volume of production. In addition, this procedure shall be carried out each time any seemingly systematic faults are discovered during the acceptance or other tests.

7.3. EEC verification marks and sealing

Meters which have successfully undergone the initial verification tests shall be stamped with the EEC initial verification marks.

The seals shall include the EEC initial verification marks and shall be affixed in such a manner as to ensure that it will be impossible to gain access to the internal working parts of the meter without breaking the EEC initial verification seals.
