

COMMISSION OF THE EUROPEAN COMMUNITIES

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PROPOSAL FOR A COUNCIL DIRECTIVE AMENDING 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

(Submitted by the Commission to the Council)

COM (78) 766 final

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EXPLANATORY MEMORANDUM

I. Introduction

The measuring instruments industry is in full evolution because of the development of electronics.

At present within the Community, the market in these instruments is expanding about 10 % per year. In 1976 this market represented more than 400 million Units of Account. With reference to the field of weighing machines, whose turnover is to the order of 250 million Units of Account in the EEC, electronic machines represent each year a growing percentage of the turnover, percentage which is at present between 30 % and 40 %. When one thinks of the introduction of electronics into the field of meters for liquids (petrol pumps !) one can imagine the enormous market which is open to electronics in the field of measuring instruments. And yet the situation is still blocked from the point of view of intra Community trade because of diverging national laws, in particular in France and in Germany. For some time now the Community has turned its attention to the elimination of technical barriers in the metrological field. Since 1971 more than 25 directives adopted for the elimination of technical barriers, relate to this sector. However the instruments which have been affected to this date have always been mechanical or electromechanical instruments which represented the major part of the market. This will no longer be the case in the future. In order to facilitate the Community industry in its natural evolution towards electronics, in the face of its third country competitors, it was necessary to allow it also to benefit from the advantages of a unified internal market in this field.

II. Contents of the proposal

This Directive amending Council Directive 71/316/EEC is adopted pursuant to Article 100 of the Treaty establishing the European Economic Community.

The 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 control¹ was adopted with a view to harmonizing the laws, regulations and administrative provisions which were in force at the time of each of the Member States and which were intended to lay down the procedures and methods of metrological control on their respective territories.

The advantage of that Directive was therefore to establish appropriate EEC pattern approval and initial verification procedures and EEC methods of metrological control recognized by all the Member States which, combined with the requirements of the separate directives, allow free movement of the instruments in question. The instruments covered by the Community studies were mechanical or electromechanical.

Since the adoption of this Council Directive 71/316/EEC, considerable changes have occurred in the technology of these measuring instruments.

When Directive 71/316/EEC was drawn up, measuring instruments were mostly of the mechanical and electromechanical types. Nowadays the situation is completely different: the development, standardization and increasingly widespread use of electronic devices have completely revolutionized measuring techniques.

Not all measuring instruments are affected by this innovation, but many are fitted with or associated with electronic devices. By way of example, mention may be made of weighing instruments in general, taximeters and certain meters whose readout systems make use of these devices. Others, such as devices for measuring liquids other than water (e.g. petrol pumps used in service stations) also rely on this modern technique.

Because of the use of electronic devices in measuring instruments, certain Member States have laid down technical requirements concerning these devices and these requirements have created barriers to trade in these measuring instruments.

Conscious of this technical development and of the problems thus created, the Commission began a few years ago to study the various aspects of this question in collaboration with the competent national departments in each of the Member States and with the manufacturers and users of these instruments, associated in organizations belonging to the Liaison Group for the European Industries (ORGALIME). These include the Committee of Electrical and Electronic Measuring Instrument Industries of the EEC (CIMEC), the European Committee of Weighing Instrument Manufacturers (CECIP) and the European Committee of Manufacturers of Equipment for the Metering and Distribution of Hydrocarbons (CECOD); the European Committee for Electro-technical Standardization (CENELEC) and the International Electrotechnical Commission (IEC) have also been kept informed and, especially CENELEC, associated with the studies.

A number of difficulties were encountered in preparing the proposal for a directive amending Council Directive 71/316/EEC. These were due principally to the conflicting interests of the industrial sectors concerned, but also to differences in the principles adopted by the Member States to allow these measuring instruments equipped with electronic devices on their national territories.

The preparatory discussions showed that two equally prevalent schools of thought in the Member States were acceptable as regards the design of these devices. One advocated the incorporation of a number of checks along the electronic chain in order to detect and indicate significant defects, the other that the aim should be to produce electronic devices with a satisfactory standard of quality and reliability.

After numerous studies and talks with the protagonists of these two schools of thought, the Commission has finalized the general requirements for both systems which should thus provide reciprocally accepted metrological security. With a few exceptions, the manufacturer remains free to choose between these two methods according to circumstances. The new proposal for amending the Directive adds an Annex III to the original text and makes certain amendments to Annexes I and II to the old Directive.

This has two advantages: for mechanical and electrical appliances, the Directive retains its intrinsic value with regard to EEC control (EEC pattern approval and EEC initial verification) while at the same time it is brought up to date by the addition of requirements specific to these instruments fitted with electronic devices.

All of these new requirements, with which the national experts have expressed a large degree of agreement, thus allow provision to be made in the vertical directives for requirements peculiar to EEC pattern approval and to the tests to be carried out on them.

This proposal for a directive, supplemented by separate directives, will make possible the free movement of these new measuring instruments within the Community.

CONSULTATION OF THE EUROPEAN PARLIAMENT AND THE ECONOMIC AND SOCIAL COMMITTEE

Pursuant to Article 100, paragraph 2, the opinion of these two bodies is necessary, since implementation of the requirements laid down in the proposal for a directive involves the amendment of legislation in some of the Member States.

As far as the procedure is concerned, the proposed amendments are necessary to adapt Directive 71/316EEC to technical innovations as explained above. It would therefore seem appropriate to use the special procedure laid down in Articles 17 to 19 of the Directive.

However, since it considers the innovations to be of fundamental importance, the Commission has decided to submit to the Council a proposal for an amendment under Article 100. This will enable the Council to discuss the problems in depth to lay down the principles for the adaptation of particular directives according to what is known as the procedure for adapting to technical progress.

PROPOSAL FOR A COUNCIL DIRECTIVE AMENDING 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

(submitted by the Commission to the Council)

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,

Having regard to the Opinion of the Economic and Social Committee,

Whereas Council Directive 71/316/EEC of 26 July 1971¹ is intended to
achieve the free movement of these instruments within the Community by
harmonizing the differing national laws relating to metrological controls
and by establishing for this purpose appropriate EEC pattern approval and
initial verification procedures as well as EEC methods of metrological
control;

Whereas, since the adoption of that Directive, progress in technology and
engineering has led to the development of methods of construction based
on electronics which are today regularly used in the design, elaboration
and manufacture of measuring instruments;

¹ OJ No L202 6.9.1971 p.1

Whereas this technical progress could not be taken into account at the time Directive 71/316/EEC was adopted; whereas since then Member States have embodied in their national laws requirements allowing national approval to be granted to measuring instruments fitted with electronic devices;

Whereas it is consequently advisable, in order to extend the scope of the above-mentioned Council Directive to measuring instruments equipped with electronic devices and to harmonize the national laws adopted to this end, to amend and supplement the text of the European requirements at present in force,

HAS ADOPTED THIS DIRECTIVE:

Article I

Articles 2(2) and (5), 5(3) and (4), 7(1) and (4), 8(1) and (2), 9 first paragraph, 15(2) and (17) of Directive 71/316/EEC are replaced by the following texts respectively:
Article 2(2)

In so far as their control equipment permits, Member States shall, at the request of the manufacturer or of his authorized representative, grant EEC pattern approval for every pattern of instrument and all ancillary equipment which satisfies the measurement characteristics and the technical design and functioning requirements laid down by this Directive, where appropriate, and by the separate directive relating to the category of instrument in question.

Article 2(5)

Member States shall grant EEC pattern approval in accordance with the provisions of this Directive and of the separate directives.

Article 5(3)

When new techniques which are not provided for in this Directive or in a separate directive are employed, limited EEC pattern approval may also be granted after prior consultation with the other Member States. This limited approval may be subject to the restrictions mentioned in paragraph 2 and to special conditions connected with the technique used.

This limited approval can, however, be granted only:

- if the separate directive for the relevant category of instruments has already entered into force;
- if the maximum permissible errors specified in the separate directives are not exceeded.

Such limited approval shall be valid for not more than two years. It may be extended for a further period of three years.

Article 5(4)

If the Member State which granted limited EEC pattern approval as referred to in paragraph 3 considers that a new technique has proved satisfactory, it shall apply for the adjustment to technical progress of the Annexes to this Directive, where appropriate, and of the Annexes to the relevant separate directive, in accordance with the provisions of Articles 18 and 19.

Article 7(1)

The Member State which has granted EEC pattern approval may withdraw it:

- (a) if instruments for which this approval was granted do not conform to the approved pattern and/or to the provisions of this Directive, where appropriate, and of the relevant separate directive;
- (b) if the metrological requirements specified in the certificate of approval or the provisions of Article 5(2) and (3) are not met.

Article 7(4)

A Member State which discovers a case coming within the terms of paragraph 2 may suspend the placing on the market and putting into service of the instruments concerned.

It shall immediately inform the other Member States and the Commission, stating the reasons on which its decision is based.

The same procedure shall apply in the cases mentioned in paragraph 1, with respect to instruments which have been exempted from EEC initial verification, if the manufacturer, after due warning, does not bring the instruments into line with the approved pattern and/or with the provisions of this Directive, where appropriate, and of the relevant separate directive.

Article 8(1)

The EEC initial verification constitutes the inspection of a new or reconditioned instrument to confirm that it conforms to the approved pattern and/or to the provisions of this Directive, where appropriate, and of the relevant separate directive; it is certified by the EEC initial verification mark.

Article 8(2)

If they have the requisite equipment, Member States shall carry out EEC initial verification of instruments submitted as having the measurement characteristics and satisfying the technical construction and functioning requirements laid down by this Directive, where appropriate, and by the separate directive on this category of instruments.

Article 9, first paragraph

When an instrument is submitted for EEC initial verification, the Member State carrying out the examination shall determine:

- (a) whether the instrument belongs to a category exempt from EEC pattern approval, and, if so, whether it satisfies the technical construction and functioning requirements laid down by this Directive, where appropriate, and by the separate directive on this category of instruments;
- (b) whether the instrument has received an EEC pattern approval and, if so, whether it conforms to the approved pattern and to the provisions of this Directive, where appropriate, as well as to those of the relevant separate directive.

Article 15(2)

Notwithstanding the provisions of Article 1(1), an instrument in service which bears EEC signs or marks but does not satisfy the requirements of this Directive and/or of the relevant separate directive, in particular with regard to maximum permissible errors, may be banned from service in the same way as an instrument bearing national marks.

Article 17

The amendments necessary to keep:

- the Annexes to this Directive
 - the Annexes to the separate directives dealing with the different categories of instruments, the legal units of measurement and EEC methods of metrological control,
- in line with technical progress shall be made in accordance with the procedure laid down in Article 19.

Article II

The following texts are added to items 1.3 and 2.1 of Annex 1 to Directive 71/316/EEC:

1.3.4.

In addition, in the case of an instrument equipped with electronic devices:

- a list of its electronic components with their essential characteristics,
- a description of the electronic devices with drawings and diagrams explaining their construction and operation.

2.1.3.

Where appropriate, a detailed study of the electronic devices consisting principally of an examination of their design, proving tests of design and/or operation and an endurance test as provided for in item 8 of Annex III.

Article III

Item 1 of Annex II to Directive 71/316/EEC is replaced by the following text:

1. General points

- 1.1. The EEC initial verification may be carried out in one or more stages (usually two).

1.2. Subject to the provisions of the separate directives:

1.2.1. The EEC initial verification shall be carried out in one stage on instruments which constitute a whole on leaving the factory, that is to say instruments which, theoretically, can be transferred to their place of installation without first having to be dismantled.

1.2.2. The EEC initial verification shall be carried out in two or more stages for instruments whose correct functioning depends on the conditions in which they are installed or used.

1.2.3. The first stage of the verification procedure must ensure, in particular, that the instrument conforms to the approved pattern and/or to the provisions of this Directive, where appropriate, and of the relevant separate directive, or, in the case of instruments exempt from pattern approval, that they conform to the relevant provisions.

1a Examination for EEC initial verification

For EEC initial verification, instruments equipped with electronic devices shall, in addition to meeting the requirements stipulated in Article 9, undergo the examinations set out in item 9 of Annex III in order to ensure that the electronic devices conform to those incorporated in the approved pattern.

Article IV

The Annex to this Directive, is added to Directive 71/316/EEC.

Article V

(a) Member States shall adopt and publish by 31 December 1981 the laws, regulations and administrative provisions which are needed in order to comply with this Directive and which shall enter into force on 1 April 1982, and shall inform the Commission thereof.

(b) Once this Directive has been notified, the Member States shall also ensure that the Commission is informed, in sufficient time for it to submit its comments, of any draft law, regulation or administrative provision which they propose to adopt in the field covered by this Directive.

Article VI

This Directive is addressed to the Member States.

Done at Brussels

A N N E X

ANNEX III

REQUIREMENTS RELATING TO ELECTRONIC DEVICES INCORPORATED IN OR ASSOCIATED WITH MEASURING INSTRUMENTS

Chapter I

1. General points

This Annex specifies the general metrological and technical characteristics which must be exhibited by electronic devices incorporated in or associated with measuring instruments or their ancillary equipment, together with the relevant examinations and tests.

The separate directives relating to the different categories of measuring instruments supplement and clarify the general requirements.

2. Aim

The object to be attained is to ensure that the electronic devices will function continuously and will in no case introduce significant errors into the measurement results.

3. Definitions and terminology

The following terms which are defined in this Annex may be used in the separate directives in which they shall have the same meaning.

3.1. Electronic devices

3.1.1. Electronic device

For the purposes of this Annex an electronic device is a part of a measuring instrument or ancillary equipment containing at least one electronic component and performing a specific function in the instrument.

3.1.2. Electronic device with full checking capability

An electronic device shall be considered to have full checking capability if every sub-assembly of the electronic device having an essential function in the measuring is checked.

3.1.3. Electronic device with no or only partial checking capability

Electronic devices without the full checking capability as specified in item 3.1.2.

3.2. Primary and auxiliary indications

3.2.1. Primary indications

Any output data considered as authentic for the purpose of legal metrology.

The primary indication may include not only the indication of the measured quantity, in display, printed or recorded form, but also a function of that quantity.

The separate directive may specify which of the indications of a measuring instrument are to be regarded as primary indication.

3.2.2. Auxiliary indications

Any output data not regarded as primary indications.

3.3. Repeatable and non-repeatable measurement

3.3.1. Repeatable measurement

Measurement in which the determination of the measured quantity can normally be repeated.

3.3.2. Non-repeatable measurement

Measurement in which only one determination of the measured quantity is possible.

3.4. Types of electronic devices

3.4.1. Analogue device

Device in which all the signals are continuous functions of the quantity being processed.

3.4.2. Digital device

Device in which all the signals are discontinuous functions of the quantity being processed.

3.4.3. Mixed device

Indivisible device making use of both the preceding types of signals.

3.5. Types of function

3.5.1. Static function (parallel)

Function in which the output data depend only on the instantaneous value of the input data.

3.5.2. Kinetic function (serial)

Function in which the output data depend not only on the current instantaneous values of the input data but also on the previous instantaneous values of the input data.

3.6. Faults

3.6.1. Faults

For the purpose of this Annex, a fault is a malfunction of the electronic device due to a failure of components or their connections, or to external disturbances.

3.6.2. Faults according to duration

3.6.2.1. Transient faults

Faults the duration of which may be less than that of the shortest measuring operation involved.

3.6.2.2. Permanent faults

Faults which are not transient.

3.6.3. Faults according to their seriousness

3.6.3.1. Insignificant faults

Faults causing no errors or causing errors in the measurement results which are smaller than the value laid down in the separate directive relating to the instrument concerned.

3.6.3.2. Significant faults

Faults not covered by item 3.6.3.1.

3.7. Types of checking

3.7.1. Permanent automatic checking (P)

Checking permitting the correct operation of electronic devices to be verified during a measurement either continuously or discontinuously and preventing the inclusion of erroneous information, without the intervention of an operator.

3.7.2. Intermittent automatic checking (I)

Checking permitting cyclic verification of the correct operation of electronic devices without the intervention of an operator.

3.7.3. Non-automatic checking (N)

Checking to permit verification of the correct operation of electronic devices and requiring the intervention of an operator.

3.8. Metrological security

The metrological security of a measuring instrument equipped with electronic devices is the ability of these devices to comply with the metrological and technical requirements to which they are subject.

Chapter II

Requirements concerning electronic devices

4. General requirements

4.1. Metrological security

Measuring instruments and ancillary equipment fitted with electronic devices shall have the metrological security required for the use to which they are to be put.

This security may be achieved by one of the following methods:

- by means of a suitable design and type of construction which will result in electronic devices which correspond to the requisite standard of quality and for which an adequate working life can be predicted by means of tests,
- by providing, for each sub-assembly of an electronic device with an essential function in the measurement, checking facilities which detect and indicate significant defects,
- by a combination of these methods.

The choice of one of these methods is left to the manufacturer, unless a separate directive specifies otherwise.

4.2. Emergency power supply

If an emergency power supply is required by a separate directive, switching over to the emergency power supply shall not cause faults in the electronic devices.

5. Requirements concerning electronic devices with full checking capability

The design of devices with full checking capability shall be such that the functioning of the device is verified and that functional faults are detected automatically or by an operator and indicated.

5.1. Fault detection

Faults are detected by means of checking facilities as specified in item 3.7. The type of checking (P, I, N) depends on the types of electronic devices in which these checking facilities are incorporated.

Automatic checking facilities are required in the following instances, unless a separate directive specifies otherwise:

- digital kinetic function (digital/serial) devices shall be equipped with a permanent automatic checking system (P).

However, if the aforementioned checking system is fitted to only one part of the digital kinetic function device, but enables transient faults in the whole of this device to be detected, the other parts need only be fitted with an intermittent automatic checking system (I).

- digital static function (digital/parallel) devices shall be equipped with a permanent automatic checking system (P) or an intermittent automatic checking system (I).

The frequency of the intermittent automatic checks shall be laid down by the separate directive.

Non-automatic checks (N) shall be used only where provided for by the separate directives.

However, certain faults need not be detected:

- faults arising from two or more simultaneous failures resulting from independent causes,
- faults which make it impossible to perform any measurement,
- faults involving measuring errors so serious that they are bound to be noticed by all those interested in the result of the measurement,
- faults which are specified in the separate directives.

5.2. Indication of a fault

When a fault has been detected, action specified in the separate directive (setting off an audible or visible alarm, stopping the measuring operation, switching off the indicating device, etc.) shall be taken automatically.

This action shall be taken when:

- any fault is detected in digital devices,
- any fault resulting in a measurement error exceeding the value laid down by the separate directive is detected in analogue or mixed devices.

5.3. Manual test devices

If a measuring instrument is fitted with electronic devices equipped with checking facilities, one or more manual test devices incorporated in the instrument shall allow the existence and operating condition of the checking facility to be verified.

6. Requirements concerning electronic devices without checking capability or with partial checking capability

The design and construction of electronic devices without checking capability or with partial checking capability shall be such as to give them a quality standard enabling them to function sufficiently continuously and accurately under the nominal operating conditions of the measuring instruments in which they are incorporated or with which they are associated.

Furthermore, these electronic devices shall be protected against external disturbances to which they may be exposed and which are likely to cause significant faults.

Tests shall be carried out to assess the quality of these electronic devices.

Chapter III

Examinations and tests of electronic devices for EEC pattern approval and EEC initial verification

7. For EEC pattern approval and EEC initial verification of measuring instruments equipped with electronic devices, these devices shall undergo the examinations and/or the tests specified in this chapter.

8. Examination for EEC pattern approval

8.1. Examination and testing of electronic devices with full checking capability

8.1.1. Examination of the design

The examination of the design drawings is intended to verify that electronic devices and their checking systems meet the requirements of items 4 and 5 of this Annex.

This examination shall include:

- (a) an assessment of the constructional features and components used to ensure that the minimum required quality is attained,
- (b) consideration of any functional faults caused by external influences or by failures due to the components or their connections to ensure that in all instances the devices meet the requirements of item 5,
- (c) verification of the existence and the correct functioning of one or more manual test devices.

8.1.2. Examination of correct functioning and operational tests

Electronic devices incorporated in the measuring instrument shall be examined to ensure that they have been constructed with care and that the connections and joints have been correctly made.

If an emergency power supply is required, a check shall be made that the requirements of item 4.2. have been met.

Operational tests shall then be carried out on the electronic devices incorporated in the fully operational measuring instrument.

(a) Response to influence factors

When the instrument is subjected to the influence factors specified in item 11.1. of this Annex, the electronic devices shall continue to function correctly without giving rise to errors in the instrument in excess of those permitted under the conditions specified by the relevant separate directive.

(b) Response to disturbances

The instrument shall be subjected to the external disturbances specified in item 11.2. of this Annex and supplemented, where appropriate, by the separate directive, and also to simulated component and connection failures.

Throughout these tests the electronic device shall continue to operate normally or else shall detect and indicate any significant faults in accordance with the requirements of item 5.

8.1.3. Description of the pattern

Operation of the built-in manual test device or devices shall show the existence and the correct functioning of the checking system.

An endurance test shall then be carried out. It shall consist in submitting one or more instruments to a test programme for a specified length of time or for a specified number of operating cycles.

The length of the tests and the procedure for carrying them out shall be specified in the relevant separate directive.

On completion of these tests, the condition or the correct functioning of the checking system shall be verified using the test device or devices and an assessment shall be made of whether the behaviour of the electronic devices during these tests can be considered satisfactory for the use to which these devices are to be put.

8.2. Examination and testing of electronic devices without checking capability or with partial checking capability

8.2.1. Examination of the design and design testing

This study of the design of electronic devices is intended to verify that the devices meet the requirements of items 4, 6 and 10 of this Annex.

8.2.1.1. Examination of the design

The examination includes:

- (a) An appraisal of the characteristics of the components, design and construction of the electronic device to determine its reliability and suitability for use in the measuring instrument,
- (b) consideration of any functional faults caused by failures due to components or connections to ensure that these faults are not significant, or, if they are significant, that their frequency is low enough to ensure compliance with the required level of reliability,
- (c) study of the measures taken by the manufacturer to protect the electronic device from the external influences specified in item 11.2.

8.2.1.2. Design proving tests

The design proving tests provided for in item 10 of this Annex shall be carried out on each non-operational electronic device.

The correct functioning of the electronic devices shall be verified before and after these tests.

8.2.2. Examination of correct functioning and operational tests

Electronic devices incorporated in the measuring instrument shall be examined to ensure that they have been constructed with care and that the connections and joints have been correctly made.

If an emergency power supply is required a check shall be made that the requirements of item 4.2. have been met. The operational tests provided for in items 11.1. and 11.2. of this Annex shall then be carried out on the electronic devices incorporated in the fully operational measuring instrument. When the instrument is subjected to this test programme the electronic devices shall continue to function correctly so that the instrument retains the required metrological qualities.

8.2.3. Description of the pattern

The pattern is characterized by the list of components used, the manufacturing methods and an objective quality criterion. The quality is assessed by carrying out an endurance test which consists in submitting one or more instruments to a test programme for a specified length of time or for a specified number of operating cycles.

The length of and procedure for each test shall be specified in the relevant separate directive.

Electronic devices shall continue to function correctly throughout the endurance test.

8.3. Performance of the tests

The operational tests provided for in items 8.1.2. and 8.2.2. may, depending on circumstances and in any case in compliance with the relevant separate directives, be combined with the endurance tests specified in items 8.1.3. and 8.2.3.

All these tests shall result in a homogeneous programme, suited to the instrument concerned and applied uniformly by the competent services of the Member States.

Furthermore, when provided for by the separate directives, these tests shall be carried out on sub-assemblies, fitted with electronic devices, which can be made operational.

9. Examination for EEC initial verification

9.1. Electronic devices with full checking capability

The built-in manual test device or devices shall be operated on all the instruments submitted for initial verification in order to show that the checking systems are present and are functioning properly.

For every n instrument submitted to the metrological service for EEC initial verification, one instrument shall be taken for performance of the tests provided for in item 8.1.3. or, depending on circumstances, the test programme drawn up pursuant to item 8.3.

The number n and the consequences of unsatisfactory results in these tests shall be specified in the separate directive.

9.2. Electronic devices with no or with partial checking capability

For every m instrument submitted for EEC initial verification, one shall be taken for the purpose of:

- verifying that the main components used in the manufacture of the electronic devices are in an equivalent condition and are at least equal in quality to those contained in the list of components included in the EEC pattern approval file,

- submitting the instrument to the tests provided for in item 8.2.3. or to the test programme drawn up pursuant to item 8.3.

The number m and the consequences of unsatisfactory results in the abovementioned operations shall be specified in the separate directive.

Chapter IV

Tests to be carried out on electronic devices

10. Design proving tests

The design proving tests are intended to ensure the quality and durability of electronic devices with no or with partial checking capability.

These tests, to which each of these electronic devices must be subjected, shall be carried out when the examination for EEC pattern approval is made.

The operations carried out during this examination shall consist of:

- verifying the correct functioning of the instrument,
- carrying out the tests listed in the following items,
- refitting the electronic devices in the instrument and,
- rechecking the correct functioning of the instrument by verifying in particular that the maximum permissible errors are still adhered to.

10.1. Damp heat cycling test

The electronic device shall be placed in a chamber whose temperature shall be stabilized at $25 \pm 3^\circ\text{C}$ and relative humidity at not less than 95%.

Start the cycle by increasing the temperature to 40°C in $3\text{h} \pm 30\text{ min.}$; the relative humidity (R.H.) shall not be less than 95% except during the last 15 minutes when it shall not be less than 90%.

Keep temperature at $40 \pm 2^\circ\text{C}$ until $12\text{h} \pm 30\text{ min.}$ from start of cycle; R.H. $93 \pm 3\%$.

Reduce temperature to $25 \pm 3^\circ\text{C}$ in $3\text{h} \pm 30\text{ min.}$; R.H. not less than 95% except during the first 15 minutes when it shall not be less than 90%. Keep temperature at $25 \pm 3^\circ\text{C}$ with R.H. not less than 95% until the 24-hour cycle is completed.

Six 24-hour cycles shall be completed.

10.2. Thermal shock test

The electronic device shall be placed in a chamber at $5 \pm 3^\circ\text{C}$ for 3h; it shall be removed from the cold chamber and subjected to the ambient temperature for not less than 2 minutes or more than 3 minutes.

The electronic device shall be placed in a hot chamber at $40 \pm 2^\circ\text{C}$ for 3h; it shall be removed from the hot chamber and subjected to the ambient temperature for not less than 2 minutes or more than 3 minutes.

Five cycles shall be completed.

10.3. Mechanical shock test

Equipment of a mass of less than 50 kg shall be allowed to fall freely from a height of 25 mm on to a steel plate not less than 8 mm thick, fixed to a concrete base not less than 50 cm thick.

The height of the drop shall be measured from the point of the equipment nearest to the steel plate prior to dropping.

The unit, supported in a rigid frame by its normal support points, shall be dropped six times on each of three mutually perpendicular faces.

Equipment of over 50 kg shall be dropped on to a steel plate not less than 8 mm thick, fixed to a concrete base not less than 50 cm thick. When the test is performed, one edge of the equipment shall remain in contact with this plate and its centre of gravity shall fall through 12 mm. Each base edge shall be taken in turn, and the test shall be carried out six times.

10.4. Vibration test

The vibrations shall be applied successively along three axes perpendicular to each other and selected so that the weaknesses have every chance of being revealed.

The test shall cover the frequency range from 10 to 150 Hz with slight sinusoidal excitation and a sweep rate not greater than 1 octave/min. up and down.

One of the following peak levels of acceleration shall be selected, depending on the environmental conditions of use, unless otherwise specified in the separate directives:

5 m/s^2 for a normal environment

10 m/s^2 for an industrial environment

This test shall last for two hours.

10.5. Additional tests

The additional tests required for a measuring instrument designed for a special purpose shall be specified in the separate directives.

11. Operational test

All the electronic devices incorporated in a measuring instrument shall be subjected to operational tests under one or more of the test conditions specified in this section, unless otherwise specified in the separate directive. The tests shall be carried out, at the time of the examination for EEC pattern approval, on fully operational instruments.

11.1. Influence factors

When the instrument is subjected to the effect of the influence factors, the electronic devices must continue to function correctly without giving rise to errors in the instrument in excess of the maximum errors provided for under these conditions by the relevant separate directive.

11.1.1. Temperature

These tests shall be performed at a sufficient number of stable temperatures to cover the temperature ranges specified by the separate directive.

The ambient temperature is considered stable if the following two conditions are satisfied:

- the difference between the extreme temperatures recorded during a test does not exceed 5°C;
- the temperature variation does not exceed 1°C in five minutes.

11.1.2. Relative humidity

These tests shall be performed at least at the two ends of the range specified below:

- from 20% to 80% if the electronic device is incorporated in a part of the instrument intended for indoor use, or,
- from 5% to 95% if the electronic device is incorporated in a part of the instrument intended for outdoor use.

11.1.3. Variation in the power supply

These tests shall be performed at the nominal voltage and frequency and at the limits of variation specified by the separate directive.

11.1.4. Other influence factors

Other tests bringing into play influence factors such as vibration, harmonic distortions in the power supply, etc., shall be laid down in the separate directives relating to measuring instruments for which the factors shall be specified.

11.2. External disturbances

Unless otherwise specified in a separate directive, the following tests shall be carried out:

11.2.1. Power supply

11.2.1.1. Interruptions or reductions

100% voltage reduction for approximately 10 milliseconds.

50% voltage reduction for approximately 20 milliseconds.

20% voltage reduction for approximately 50 milliseconds.

The time interval between two consecutive tests must be at least 10 seconds.

11.2.1.2. Mains - Borne interference

Randomly phased transient overvoltages of either polarity shall be applied to the system. These transients shall be supplied in common-mode and series-mode from an impedance of 50Ω .

The amplitude, risetime, duration and repetition rate shall be as specified in the following table:

| Amplitude | Risetime | Half-amplitude duration | Repetition rate |
|-------------------------|---|-------------------------|-------------------|
| 500 V | 2 ns | 100 ns | 10 Hz |
| 1 500 V | 25 ns | 1 μ s | ≤ 12 Hz |
| 300 V | Burst of pulses lasting for about 1 ms of about 1 MHz | | ≤ 12 Hz |
| 5% of the nominal value | sine wave superimposed on the mains | | 30 kHz - 150 kHz |
| 1-1 V | sine wave superimposed on the mains | | 150 kHz - 400 MHz |

11.2.2. External interferences

11.2.2.1. Mains-borne interference

Mains-borne interference over power lines is specified in item 11.2.1.2.

11.2.2.2. Radiated interference

- Induction field

Induction field of 60 A/m and 50 Hz obtained for example by a cable carrying 10 Amps at a distance of about 2.5 cm.

- Electromagnetic radiation

Field strength of 10V/m at frequencies of
100 kHz - 500 MHz

Field strength of 1 V/m at frequencies of
500 MHz - 1 000 MHz.

11.2.2.3. Electrostatic discharge

Electrostatic discharge of 6 kV with energy of
2 mJ on earthed chassis with a minimum of
10 s between individual discharges.

11.2.3. Other external disturbances

Other tests involving disturbances such as power supply failure, interference by the low voltage network, etc., shall be specified in the separate directives relating to measuring instruments likely to be affected by these disturbances.