

ANNEX I

ESSENTIAL REQUIREMENTS

A measuring instrument shall provide a high level of metrological protection in order that any party affected can have confidence in the result of measurement, and shall be designed and manufactured to a high level of quality in respect of the measurement technology and security of the measurement data.

The essential requirements that shall be met by measuring instruments are set out below and are supplemented, where appropriate, by specific instrument requirements in Annexes III to XII that provide more detail on certain aspects of the general requirements.

The solutions adopted in the pursuit of the essential requirements shall take account of the intended use of the instrument and any foreseeable misuse thereof.

DEFINITIONS

Measurand	The measurand is the particular quantity subject to measurement.
Influence quantity	An influence quantity is a quantity that is not the measurand but that affects the result of measurement.
Rated Operating Conditions	The rated operating conditions are the values for the measurand and influence quantities making up the normal working conditions of an instrument.
Disturbance	An influence quantity having a value within the limits specified in the appropriate requirement but outside the specified rated operating conditions of the measuring instrument. An influence quantity is a disturbance if for that influence quantity the rated operating conditions are not specified.
Critical change value	The critical change value is the value at which the change in the measurement result is considered undesirable.
Material Measure	A material measure is a device intended to reproduce or supply in a permanent manner during its use one or more known values of a given quantity.
Direct sales	A trading transaction is direct sales if: <ul style="list-style-type: none"> — the measurement result serves as the basis for the price to pay; and — at least one of the parties involved in the transaction related to measurement is a consumer or any other party requiring a similar level of protection; and

	— all the parties in the transaction accept the measurement result at that time and place.
Climatic environments	Climatic environments are the conditions in which measuring instruments may be used. To cope with climatic differences between the Member States, a range of temperature limits has been defined.
Utility	A utility is regarded as a supplier of electricity, gas, thermal energy or water.

ESSENTIAL REQUIREMENTS

1. Allowable Errors

- 1.1. Under rated operating conditions and in the absence of a disturbance, the error of measurement shall not exceed the maximum permissible error (MPE) value as laid down in the appropriate instrument-specific requirements.

Unless stated otherwise in the instrument-specific annexes, MPE is expressed as a bilateral value of the deviation from the true measurement value.

- 1.2. Under rated operating conditions and in the presence of a disturbance, the performance requirement shall be as laid down in the appropriate instrument-specific requirements.

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

- 1.3. The manufacturer shall specify the climatic, mechanical and electromagnetic environments in which the instrument is intended to be used, power supply and other influence quantities likely to affect its accuracy, taking account of the requirements laid down in the appropriate instrument-specific annexes.

1.3.1. Climatic environments

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

TABLE 1

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

1.3.2.

- (a) Mechanical environments are classified into classes M1 to M3 as described below.

M1	This class applies to instruments used in locations with vibration and shocks of low significance, e.g. for instruments fastened to light supporting structures subject to negligible vibrations and shocks transmitted from local blasting or pile-driving activities, slamming doors, etc.
M2	This class applies to instruments used in locations with significant or high levels of vibration and shock, e.g. transmitted from machines and passing vehicles in the vicinity or adjacent to heavy machines, conveyor belts, etc.
M3	This class applies to instruments used in locations where the level of vibration and shock is high and very high, e.g. for instruments mounted directly on machines, conveyor belts, etc.

- (b) The following influence quantities shall be considered in relation with mechanical environments:
- vibration;
 - mechanical shock.

1.3.3.

- (a) Electromagnetic environments are classified into classes E1, E2 or E3 as described below, unless otherwise laid down in the appropriate instrument-specific annexes.

E1	This class applies to instruments used in locations with electromagnetic disturbances corresponding to those likely to be found in residential, commercial and light industrial buildings.
E2	This class applies to instruments used in locations with electromagnetic disturbances corresponding to those likely to be found in other industrial buildings.
E3	This class applies to instruments supplied by the battery of a vehicle. Such instruments shall comply with the requirements of E2 and the following additional requirements: <ul style="list-style-type: none"> — voltage reductions caused by energising the starter-motor

	circuits of internal combustion engines, — load dump transients occurring in the event of a discharged battery being disconnected while the engine is running.
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(b) The following influence quantities shall be considered in relation with electromagnetic environments:

- voltage interruptions;
- short voltage reductions;
- voltage transients on supply lines and/or signal lines;
- electrostatic discharges;
- radio frequency electromagnetic fields;
- conducted radio frequency electromagnetic fields on supply lines and/or signal lines;
- surges on supply lines and/or signal lines.

1.3.4. Other influence quantities to be considered, where appropriate, are:

- voltage variation;
- mains frequency variation;
- power frequency magnetic fields;
- any other quantity likely to influence in a significant way the accuracy of the instrument.

1.4. When carrying out the tests as envisaged in this Directive, the following points shall apply:

1.4.1. *Basic rules for testing and the determination of errors*

Essential requirements specified in points 1.1 and 1.2 shall be verified for each relevant influence quantity. Unless otherwise specified in the appropriate instrument-specific annex, these essential requirements apply when each influence quantity is applied and its effect evaluated separately, all other influence quantities being kept relatively constant at their reference value.

Metrological tests shall be carried out during or after the application of the influence quantity, whichever condition corresponds to the normal operational status of the instrument when that influence quantity is likely to occur.

1.4.2. *Ambient humidity*

- (a) According to the climatic operating environment in which the instrument is intended to be used either the damp heat-steady state (non-condensing) or damp heat cyclic (condensing) test may be appropriate.
- (b) The damp heat cyclic test is appropriate where condensation is important or when penetration of vapour will be accelerated by the effect of breathing. In conditions where non-condensing humidity is a factor the damp-heat steady state is appropriate.

2. **Reproducibility**

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

3. **Repeatability**

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

4. **Discrimination and Sensitivity**

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

5. **Durability**

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

6. **Reliability**

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

7. **Suitability**

- 7.1. A measuring instrument shall have no feature likely to facilitate fraudulent use, whereas possibilities for unintentional misuse shall be minimal.
- 7.2. A measuring instrument shall be suitable for its intended use taking account of the practical working conditions and shall not require unreasonable demands of the user in order to obtain a correct measurement result.
- 7.3. The errors of a utility measuring instrument at flows or currents outside the controlled range shall not be unduly biased.
- 7.4. Where a measuring instrument is designed for the measurement of values of the measurand that are constant over time, the measuring instrument shall be insensitive to small fluctuations of the value of the measurand, or shall take appropriate action.
- 7.5. A measuring instrument shall be robust and its materials of construction shall be suitable for the conditions in which it is intended to be used.
- 7.6. A measuring instrument shall be designed so as to allow the control of the measuring tasks after the instrument has been placed on the market and put into use. If necessary, special equipment or software for this control shall be part of the instrument. The test procedure shall be described in the operation manual.

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

8. **Protection against corruption**

- 8.1. The metrological characteristics of a measuring instrument shall not be influenced in any inadmissible way by the connection to it of another device, by any feature of the

connected device itself or by any remote device that communicates with the measuring instrument.

- 8.2. A hardware component that is critical for metrological characteristics shall be designed so that it can be secured. Security measures foreseen shall provide for evidence of an intervention.
- 8.3. Software that is critical for metrological characteristics shall be identified as such and shall be secured.

Software identification shall be easily provided by the measuring instrument.

Evidence of an intervention shall be available for a reasonable period of time.

- 8.4. Measurement data, software that is critical for measurement characteristics and metrologically important parameters stored or transmitted shall be adequately protected against accidental or intentional corruption.
- 8.5. For utility measuring instruments the display of the total quantity supplied or the displays from which the total quantity supplied can be derived, whole or partial reference to which is the basis for payment, shall not be able to be reset during use.

9. **Information to be borne by and to accompany the instrument**

- 9.1. A measuring instrument shall bear the following inscriptions:
- (a) manufacturer's name, registered trade name or registered trade mark;
 - (b) information in respect of its accuracy;
- and, where applicable:
- (c) information in respect of the conditions of use;
 - (d) measuring capacity;
 - (e) measuring range;
 - (f) identity marking;
 - (g) number of the EU-type examination certificate or the EU design examination certificate;
 - (h) information whether or not additional devices providing metrological results comply with the provisions of this Directive on legal metrological control.
- 9.2. An instrument of dimensions too small or of too sensitive a composition to allow it to bear the relevant information shall have its packaging, if any, and the accompanying documents required by the provisions of this Directive suitably marked.
- 9.3. The instrument shall be accompanied by information on its operation, unless the simplicity of the measuring instrument makes this unnecessary. Information shall be easily understandable and shall include where relevant:
- (a) rated operating conditions;
 - (b) mechanical and electromagnetic environment classes;
 - (c) the upper and lower temperature limit, whether condensation is possible or not, open or closed location;

- (d) instructions for installation, maintenance, repairs, permissible adjustments;
 - (e) instructions for correct operation and any special conditions of use;
 - (f) conditions for compatibility with interfaces, sub-assemblies or measuring instruments.
- 9.4. Groups of identical measuring instruments used in the same location or used for utility measurements do not necessarily require individual instruction manuals.
- 9.5. Unless specified otherwise in an instrument-specific annex, the scale interval for a measured value shall be in the form 1×10^n , 2×10^n , or 5×10^n , where n is any integer or zero. The unit of measurement or its symbol shall be shown close to the numerical value.
- 9.6. A material measure shall be marked with a nominal value or a scale, accompanied by the unit of measurement used.
- 9.7. The units of measurement used and their symbols shall be in accordance with the provisions of Union legislation on units of measurement and their symbols.
- 9.8. All marks and inscriptions required under any requirement shall be clear, non-erasable, unambiguous and non-transferable.
10. **Indication of result**
- 10.1. Indication of the result shall be by means of a display or hard copy.
- 10.2. The indication of any result shall be clear and unambiguous and accompanied by such marks and inscriptions necessary to inform the user of the significance of the result. Easy reading of the presented result shall be permitted under normal conditions of use. Additional indications may be shown provided they cannot be confused with the metrologically controlled indications.
- 10.3. In the case of hard copy the print or record shall also be easily legible and non-erasable.
- 10.4. A measuring instrument for direct sales trading transactions shall be designed to present the measurement result to both parties in the transaction when installed as intended. When critical in case of direct sales, any ticket provided to the consumer by an ancillary device not complying with the appropriate requirements of this Directive shall bear appropriate restrictive information.
- 10.5. Whether or not a measuring instrument intended for utility measurement purposes can be remotely read it shall in any case be fitted with a metrologically controlled display accessible without tools to the consumer. The reading of this display is the measurement result that serves as the basis for the price to pay.
11. **Further processing of data to conclude the trading transaction**
- 11.1. A measuring instrument other than a utility measuring instrument shall record by a durable means the measurement result accompanied by information to identify the particular transaction, when:
- (a) the measurement is non-repeatable; and
 - (b) the measuring instrument is normally intended for use in the absence of one of the trading parties.
- 11.2. Additionally, a durable proof of the measurement result and the information to identify the transaction shall be available on request at the time the measurement is concluded.

12. **Conformity evaluation**

A measuring instrument shall be designed so as to allow ready evaluation of its conformity with the appropriate requirements of this Directive.